Australian Gulf War Veterans' Follow Up Health Study

Technical Report 2015



Authors

Monash University

Professor Malcolm Sim Professor David Clarke Professor Andrew Forbes Associate Professor Deborah Glass Ms Stella Gwini Dr Jillian Ikin Dr Helen Kelsall Dr Dean McKenzie Ms Breanna Wright

The University of Adelaide

Professor Alexander McFarlane

The University of Melbourne

Professor Mark Creamer

Other

Dr Keith Horsley

Acknowledgements

We would like to gratefully acknowledge the contribution of several individuals and groups who have assisted us in undertaking the Australian Gulf War Veterans' Follow Up Health Study. A large multidisciplinary study such as this requires input from people of very diverse disciplines and backgrounds in both the research and veteran communities.

We are grateful to the staff at the Hunter Valley Research Foundation for their professional and caring approach when undertaking the telephone interviews, and to Datatime Services Pty Ltd for organising the mail-out and processing the returned consent forms and postal questionnaires. We would also like to thank Commander Geoffrey Fielder for assisting us in the interpretation of content in the Ships' Logs and Records of Proceedings. We are also grateful to the national and international researchers who assisted us with development of the instruments used in the baseline study and follow up study.

The authors acknowledge the help provided by several other members of the Monash University research team in setting up the study, ensuring its smooth running and preparation of the research report; Jane Miosge, Christina Dimitriadis, Anthony Del Monaco, Kristen Benke, Koraly Dimitriadis, Katherine Holdsworth, Alice Noone, Thomas Hall and Desmond Gul.

We are also very grateful for the input provided by the members of the study Advisory Committee during the meetings over the four years taken to complete this study.

Finally, and very importantly, we would like to acknowledge the time and effort made by Gulf War veterans and members of the comparison group to participate in this follow up study. They freely gave up their time to make a very important contribution to the health research of Australian veterans.

ii

Advisory Committee

The role of the Advisory Committee was to:

- Act as a mechanism for consultation and communication between the DVA, the researchers, and the veteran community about issues relating to the study;
- Represent veterans' interests and provide a veteran community perspective on issues relating to the study;
- Observe the progress of the study and report back to the wider veteran community;
- Provide a mechanism for knowledge dissemination of the study findings.

A number of organisations were represented on the Advisory Committee. The findings presented in this Report do not necessarily reflect the views and opinions of the Advisory Committee members nor the organisations which they represented. Those Advisory Committee members who agreed that their names, and the name of their organisation, be included in this Report are shown below along with their dates of service on the Committee:

Chair

Professor Malcolm Sim (October 2010 - end)

Monash University

Australian Peacekeeper & Peacemaker Veterans Association (APPVA)

Mr Michael Quinn (February 2012)

Mr Bruce Relph JP (March 2012 - end)

Department of Defence Representative

CAPT John Parkes CSC, RANR (October 2010 - end)

Department of Veterans' Affairs (DVA)

Ms Sandy Bell (May 2013 - end)

Ms Leonie Mack (July 2012)

Ms Elaine Waddell (July 2012)

Dr Eileen Wilson (October 2010 – April 2012)

DVA Secretariat:

Ms Julie Bicker (October 2010 – March 2011)

Ms Tracey Chant (November 2013 - end)

Mr Tim Cummins (May 2013)

Mr Jeff Fairweather (March 2011)

Ms Megan MacDonald (October 2011 – July 2012)

Ms Liz O'Neill (October 2010)

Naval Association of Australia

Mr Barry McDaniel (October 2010 – end)

Returned & Services League of Australia

CMDR John Hodges RAN (Rtd) (February 2012 – end)

Ethics Committees

The following ethics committees have approved all aspects of the Gulf War Veterans' Follow Up Health Study:

Monash University Human Research Ethics Committee Australian Defence Human Research Ethics Committee Department of Veterans' Affairs Human Research Ethics Committee

The following ethics committees have approved the linkage with the Australian Cancer Database and, in the case of AlHW, the linkage with the National Death Index: Australian Capital Territory Health Human Research Ethics Committee Australian Institute of Health and Welfare Cancer Council Victoria's Human Research Ethics Committee Department of Health Western Australia Human Research Ethics Committee New South Wales Population and Health Services Research Ethics Committee Queensland Health Human Research Ethics Committee South Australia Human Health Research Ethics Committee Tasmania Health Human Research Ethics Committee

The following ethics committees have approved the Medicare and PBS linkage:

Department of Human Services External Request Evaluation Committee

Table of Contents

Authors		i
Acknowledgementsii		
Advisory Committeeiii		
Ethics Co	mmittees	iv
Table of C	Contents	v
List of Tab	ples	ix
List of Fia	ures	xiv
1 Intro	duction	1
2 Mor	ality and Cancer Incidence Study	5
2.1	ntroduction	5
22 A	Nim	5
23 F	Research questions	5
2.0 F	Results	8
2.1 I	(av findings	0
3 Hoa	lth Study	13
31 9	Study design	13
32 6	Research questions	13
	Ith Study Mathada	1/
4 Nea	IIII Sluuy Meli jous	14
4.1 F	anticipations	14
4.2 0	Contact and recruitment methods	14
4.3 F	Participation options	10
4.4 L	Jata collection, instrumentation and measures	10
4.4.1	Postal questionnaire-derived data	16
4.4.2		31
4.4.3	Data linkage with Medicare Australia and DVA	34
4.5 E	Data management	35
4.5.1	Checking, keving and secure transfer of electronic data	36
4.5.2	Additional data checking, cleaning and coding	36
4.5.3	Methods to ensure privacy and security.	
4.5.4	Long term storage of data	37
4.6	statistical methods	37
4.7 (chemical, environmental and medical exposure assessment	40
4.7.1	Deployments	41
4.7.2	Pattern of self-reported exposures by Ship and other deployments	41
4.7.3	Documents from the Australian Department of Defence records	53
4.7.4	Methodology for information extraction from Ships Logs, Reports of	
	Proceedings and Ships' Medical Journals	56
4.7.5	Information extracted from Ships Logs, Reports of Proceedings and	
	Ships' Medical Journals	57
4.7.6	Other sources of information	69
4.7.7	Deployment-based metrics used for the analyses of associations	
	between exposures and health outcomes at follow up	71
5 Ros	ulte	7/
5 1 E	2 Acruitmont	74
J.I F 544	Kov findinge	14 75
5.1.1	เรียง แก่นแห้ง	73
5.2 0	Comparison of participants with non-participants	76
5.3 F	Participant characteristics	79
5.3.1	Demographic and socioeconomic factors	79
5.3.2	Recent ADF Service	79
5.3.3	Key findings	82
5 A C	Ceneral physical and mental health	22
J.4 (שלווביומו אוואסולמו מווע ווובווגמו וובמונוו	03

5.4.1 5.4.2	Self-perceived physical and mental health status at follow up Association between Gulf War-deployment characteristics and self- perceived physical and mental health in veterans at follow up	83 84
5.4.3	Change in self-perceived physical and mental health status since	04
5.4.4	Key findings	86
5.5 Svi	mptoms	87
5.5.1	Self-reported symptoms	87
5.5.2	Multisymptom illness	96
5.5.3	Patterns of symptom reporting	99
5.5.4 5.5.5	Symptom patterns at follow-up	100
5.5.5 5.5.6	Kev findings	105
56 Ne	uropathic Symptoms	107
5.6.1	Neuropathic symptoms at follow up.	107
5.6.2	Association between Gulf War deployment characteristics and	
	neuropathic symptoms in veterans at follow up	109
5.6.3	Key findings	109
5.7 Ch	ronic Fatigue	111
5.7.1 5.7.2	Fatigue at follow up Association between Gulf War deployment characteristics and chronic	111
573	fatigue in veterans at follow up	112
0.7.0	chronic fatigue since baseline	113
5.7.4	Key findings	114
5.8 Sle	ep	116
5.8.1	Sleeping pattern	116
5.8.2	Daytime sleepiness	116
5.8.3	Sleep apnoea	117
5.8.4	Key findings	118
5.9 Pa	in	119
5.9.1	Pain at follow up	119
5.9.Z	Key findings	121
5.10 Re	spiratory health	123
5.10.1	Respiratory symptoms and conditions at follow up	123
5.10.2	Key Initialitys	400
5.11 IIII 5.11.1	Invitable Bowel Syndrome and other gastro-intestinal disorders	120
0.11.1	up	126
5.11.2	Association between Gulf War-deployment characteristics and Irritable	407
5 11 3	Bowel Syndrome in veterans at follow up	127
5.11.5		127
5.12 Re	Productive health	129
5 12 2	Pregnancies fathered since 1992	129
5.12.3	Reproductive health at follow up	130
5.12.4	Key findings	131
5.13 Inii	Jries	132
5.13.1	Injury events in the 12 months prior to follow up	132
5.13.2	Injuries in the past three years which potentially involved concussion	135
5.13.3	Key findings	135
5.14 Mu	sculoskeletal disorders	137
5.14.1	Musculoskeletal disorders at follow up	137

	5.14.2	Key findings	138
Į	5.15 Dep	Dression Depression at follow up	139
	5.15.2	Association between Gulf War-deployment characteristics and	1.00
	5.15.3	Change in prevalence, also persistence, remittance and incidence of 12	141
	5.15.4	Key findings	142 143
Į	5.16 Pos	sttraumatic Stress Disorder	145
	5.16.1 5.16.2	Association between Gulf War-deployment characteristics and 12 month	145
	5.16.3	Change in prevalence, also persistence, remittance and incidence of 12	140
	5.16.4	Key findings	147
ţ	5.17 Alc	ohol and other substance use	149
	5.17.1	Alcohol disorders at follow up	149
	5.17.2	Association between Gulf War-deployment characteristics and alcohol	454
	5.17.3	Change in prevalence, also persistence, remittance and incidence of 12	151
	5 17 <i>1</i>	month alcohol disorder since baseline	151
,		er indiastere of neurobale rised basht	100
;	5.18 Utn 5.18.1	CIDI defined disorders at follow up other than major depression. PTSD	154
	0.10.1	and alcohol	154
	5.18.2	Screening instruments for psychosis, Intermittent Explosive Disorder and eating disorders	155
	5.18.3	12-item General Health Questionnaire	157
	5.18.4	Demoralisation	158
	5.18.5		159
	5.10.0 5.18.7	Dick taking proponsity	109
	5.18.8	Kev findings	161
,	5 10 Oth	er medical conditions	163
`	5.19 0.1	Kev findings	164
ı	5.20 Life	- Events	166
`	5.20 Elic	Events due to shortage of money	166
	5.20.2	Homelessness	166
	5.20.3	Convictions or incarcerations	166
	5.20.4	Potentially traumatic events	167
	5.20.5	Key findings	168
Į	5.21 Hea	alth risk factors	169
	5.21.1	Health risk factors at follow up	169
	5.21.2	Change in health risk factors since baseline	171
	5.21.3	Key findings	172
Ę	5.22 Soc	sial health	173
	5.22.1	Functional social support	173
	5.22.2	Structural social support	173
	5.22.3	involvement in ex-service organisations and commemoration of military	17/
	5.22.4	Kev findings	175
	5 23 Our	ality of life	176
;	5 23 1	Quality of life at follow up	176
	5.23.2	Key findings	180
		· •	

	5.24 He	ealth service utilisation and DVA healthcare support	181
	5.24.1	Description of linkage data obtained from Medicare and DVA healthcare	
		databases	181
	5.24.2	Consultations with health professionals	183
	5.24.3	Hospital services	187
	5.24.4	Pharmaceuticals dispensed since 2001	189
	5.24.5	Disability claims submitted to DVA	190
	5.24.6	DVA Treatment Card history	193
	5.24.7	Key findings	194
	5.25 He 5.25.1	ealth outcomes at follow up among participants with disorders at baseline Key findings	.196 .201
	5.26 G 5.26.1	ulf War deployment-related exposures and health outcomes at follow up Key findings	202 212
6	Discu	ission	.214
7	Refei	ences	.250
8	Appe	ndices	258
	8.1 Ap	opendix 1 Abbreviations	
	8.2 Ap	pendix 2 Study group definitions	
	8.3 Ap	opendix 3 Health measures and occupational exposures collected at baselin and follow up	e
	8.4 Ap	ppendix 4 Participant questionnaire	
	8.5 Ap	opendix 5 Mail out materials	

List of Tables

Table 1 Demographic characteristics for the male members of the cohort
Table 2 Mortality rates for the Gulf War veterans and comparison group relative to the
Australian male population10
Table 3 Mortality rates for the Gulf War veterans relative to the comparison group10
Table 4 Cancer incidence rates for the Gulf War veterans and comparison group relative to the
Australian male population11
Table 5 Cancer incidence rates for the Gulf War veterans relative to the comparison group12
Table 6 Distribution of Gulf War veteran participants at baseline and at follow up by deployment
41
Table 7 Number of times exposures of interest noted in Ships' Logs 63
Table 8 Number of times exposures of interest noted in Reports of Proceedings
Table 9 Summary of environmental exposures reported in the Ships' Medical Journals64
Table 10 Summary of health outcome and health service use reported in the Ships' Medical
Journals65
Table 11 Summary of reporting of vaccinations in the Ships' Medical Journals67
Table 12 Summary of reporting of preventive medication in the Ships' Medical Journals68
Table 13 Health outcomes and environmental, chemical and medical exposure metrics based
on Ship and other deployment groups72
Table 14 Recruitment outcomes for the Gulf War veterans and comparison group at follow up 74
Table 15 Comparison of participants with non-participants in the follow up study77
Table 16 Characteristics for male participants at follow up80
Table 17 ADF service characteristics for male participants at follow up 81
Table 18 ADF Operations participants have deployed on for at least one month since Jan 1991
81
Table 19 SF12 Physical and Mental Component Summary scores at follow up84
Table 20 Association between Gulf War-deployment characteristics and SF12 Physical
Component Summary sores at follow up in Gulf War veterans
Table 21 Association between Gulf War-deployment characteristics and SF12 Mental
Component Summary sores at follow up in Gulf War veterans
Table 22 SF12 Physical and Mental Component Summary mean scores at baseline and follow
up for participants who completed the SF12 at both time points
Table 23 Prevalence of past-month symptoms at follow up
Table 24 Mean number of past-month symptoms endorsed at baseline and follow up90
Table 25 Change in symptom prevalence between baseline and follow-up by study group92

Table 26 Percentage of participants who reported a symptom at baseline which was persistent
(repeated) at follow up, for the 20 most prevalent symptoms among Gulf War
veterans94
Table 27 Percentage of participants who did not report a symptom at baseline which was
incident at follow up, for the 20 most prevalent symptoms among Gulf War veterans
Table 28 Association between Gulf War-deployment characteristics and multisymptom illness at
follow up in male Gulf War veterans98
Table 29 Prevalence of multisymptom illness at baseline and follow up
Table 30 Persistent, remitted and incident cases of multisymptom illness among participants
assessed at baseline and follow up99
Table 31 Symptoms with low prevalence (<4%) in at least one dataset, excluded from
exploratory factor analysis100
Table 32 Factor loadings by study group based on follow-up symptom reporting102
Table 33 Comparisons of factors using Tucker's Congruence Coefficient 105
Table 34 Number and type of neuropathic symptoms at follow up
Table 35 Association between Gulf War deployment characteristics and average number of
neuropathic symptoms at follow up in Gulf War veterans
Table 36 Prevalence and Risk Ratios for fatigue, prolonged fatigue and chronic fatigue at follow
up112
Table 37 Chalder Fatigue Scale (CFQ) fatigue scores and caseness by study group112
Table 38 Association between Gulf War-deployment characteristics and chronic fatigue at follow
up in male Gulf War veterans113
Table 39 Prevalence of prolonged fatigue and chronic fatigue at baseline and follow up113
Table 40 Persistent, remitted and incident cases of chronic fatigue among participants at
baseline and follow up114
Table 41 Sleeping pattern in the two weeks prior to follow up 116
Table 42 Chronic Pain Grade at follow up 119
Table 43 Number of body areas of pain or tenderness in the seven days prior to follow up121
Table 44 Self-reported respiratory symptoms and medical conditions at follow up124
Table 45 Association between Gulf War-deployment characteristics and Rome III IBS at follow
up in male Gulf War veterans127
Table 46 Difficulty fathering a pregnancy and treatment for infertility since January 1992129
Table 47 Outcome of pregnancies fathered since 1992 130
Table 48 Live birth outcomes since 1992 130
Table 49 Activities and outcomes associated with participant's two most recent injuries134
Table 50 Association between Gulf War-deployment characteristics and 12 month major
depression at follow up in Gulf War veterans142

Table 51 Prevalence of 12 month major depression at baseline and follow up for participants
who completed the CIDI at both time points142
Table 52 Persistent, remitted and incident cases of 12 month major depression among
participants who completed the CIDI at baseline and follow up
Table 53 PCL total and subscale mean scores in male Gulf War veterans and comparison group
members at follow up146
Table 54 Association between Gulf War-deployment characteristics and 12 month PTSD at
follow up in male Gulf War veterans147
Table 55 Prevalence of 12 month PTSD at baseline and follow up for male participants who
completed the CIDI at both time points147
Table 56 Persistent and new incident cases of 12 month PTSD among male Gulf War veterans
and comparison group members who completed the CIDI at baseline and follow up
Table 57 Association between Gulf War-deployment characteristics and 12 month alcohol
disorders at follow up in Gulf War veterans151
Table 58 Prevalence of 12 month alcohol disorders at baseline and follow up for male
participants who completed the CIDI at both time points
Table 59 Persistent and incident cases of 12 month Alcohol disorders among Gulf War veterans
and comparison group members who completed the CIDI at baseline and follow up
Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol
 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans

 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
 153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans
153 Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up154 Table 61 Association between Gulf War-deployment characteristics and GHQ-12 caseness at follow up in Gulf War veterans

Table 74 Proportion of consenting participants with records in the linked Medicare datasets183
Table 75 Self-reported health professional consultations in the 12 months prior to follow up184
Table 76 General Practitioner consultations since 2001 as recorded on MBS
Table 77 DVA- and Medicare-MBS data on specialist consultations since 2001 186
Table 78 Self-reported hospital service utilisation in the 12 months prior to follow up
Table 79 DVA data on number of hospitalisations and length of stay since January 2007188
Table 80 Principal diagnosis in participants who were hospitalised as recorded by DVA189
Table 81 Pharmaceuticals dispensed based on PBS and RPBS
Table 82 Summary of disability claims from 1 January 2001 to 15 August 2012
Table 83 Number of accepted disability claims, and legislation type, for participants who
consented to DVA-data linkage191
Table 84 Proportion of participants who had at least one successful claim under each of the
broad SOP categories (VEA and MRCA claims only)192
Table 85 DVA Treatment Card history for participants for the period 1 Jan 2001 to 15 Aug 2012
Table 86 Description of participants with at least one of MSI, chronic fatigue, or CIDI-defined 12-
month major depression, PTSD or alcohol use disorder at baseline
Table 87 Health outcomes at follow up amongst participants with, and without, any of MSI,
chronic fatigue, 12-month major depression, PTSD or alcohol use disorder at baseline
Table 88 DVA Disability claims data for participants with, and without, any of MSI, chronic
fatigue, 12 month major depression, PTSD or alcohol disorder at baseline199
Table 89 Health service use amongst participants with, and without, any of MSI, chronic fatigue,
12 month major depression, PTSD or alcohol disorder at baseline
Table 90 Association between use of PB during the Gulf War and health outcomes at follow up
in Gulf War veterans205
Table 91 Association between vaccinations for the Gulf War deployment and health outcomes
at follow up in Gulf War veterans206
Table 92 Association between anti-malarial tablets taken during the Gulf War deployment and
health outcomes at follow up in Gulf War veterans
Table 93 Association between exposure to pesticides during the Gulf War and health outcomes
at follow up in Gulf War veterans207
Table 94 Association between intense smoke exposure during the Gulf War and health
outcomes at follow up in Gulf War veterans208
Table 95 Association between SMOIL exposure during the Gulf War and health outcomes at
follow up in Gulf War veterans208
Table 96 Association between exposure to oil in water during the Guif war and health outcomes

Table 97 Association between dust exposure during the Gulf War and health outcome	es at follow
up in Gulf War veterans	209
Table 98 Association between possible exposure to gastroenteritis outbreaks during t	he Gulf
War and health outcomes at follow up in Gulf War veterans	210
Table 99 Association between Gulf War deployment era and MSEQ score with health	outcomes
at follow up in Gulf War veterans	211

List of Figures

Figure 1 Dist	tribution of self-reported exposures by Ship for baseline participants44
Figure 2 Dist	tribution of self-reported exposures by all other small group deployments for
ba	seline participants45
Figure 3 Dist	tribution of self-reported SMOIL exposure by Ship and other deployments for
ba	seline participants46
Figure 4 Tota	al number of self-reported vaccinations by Ship and small group deployments48
Figure 5 Tota	al number of recorded vaccinations by Ship and small group deployments49
Figure 6 Dep	bloyment-based metric for vaccinations50
Figure 7 Dist	tribution of self-reported taking of pyridostigmine bromide tablets by Ship and other
de	ployments51
Figure 8 Dep	bloyment-based metric for PB tablets52
Figure 9 Dist	tribution of self-reported taking of anti-malarial tablets by Ship and small
de	ployments53
Figure 10 Sh	hip- and deployment- based summary of Ships' sick list data66
Figure 11 Sh	hip- and deployment- based summary of specialist attendances
Figure 12 Sh	hip- and deployment- based summary of specified medical tests67
Figure 13 Sh	nip- and deployment- based summary of vaccinations recorded in Ships' Medical
Jo	urnals69
Figure 14 SF	F12 Physical and Mental Component Summary scores at follow up83
Figure 15 Pa	ast month-symptom prevalence at follow up87
Figure 16 Co	omparison of baseline and follow-up symptom prevalence
Figure 17 Pro	oportion of participants by symptom attribution style96
Figure 18 Pe	ercentage of participants who met criteria for multisymptom illness or multisymptom
illn	ness-exclusionary at follow up97
Figure 19 Nu	umber of neuropathic symptoms reported at follow up107
Figure 20 Pe	ercentage of participants who reported extreme tiredness or fatigue, prolonged
fat	tigue (at least 1 month duration) or chronic fatigue (at least 6 months duration) in
the	e past 12 months111
Figure 21 Pa	attern of scores achieved on the Epworth Sleepiness Scale for daytime sleepiness
Figure 22 Th	ne severity of bodily pain in the four weeks prior to follow up
Figure 23 Th	ne extent to which pain interfered with normal work in the four weeks prior to follow
up	
Figure 24 Se	elf-reported doctor diagnosed or treated gastrointestinal disorders since 2001126

Figure 25 Number of injuries, in the 12 months prior to follow up, bad e	nough to interfere with
daily activities	132
Figure 26 Event reported for the two most recent injuries in the 12 mon	ths prior to follow up .133
Figure 27 Percentage of participants with any injuries in the last three y	ears which potentially
involved concussion	135
Figure 28 Musculoskeletal disorders which were reported to be doctor-	diagnosed or treated
since January 2001	137
Figure 29 Percentage of participants who possibly have depression ba	sed on the CIDI interview,
PBS and RPBS records of scripts being dispensed for anti-d	epressive medications,
and self-reported doctor diagnosed and treated depression in	n the past 12 months.140
Figure 30 Depressive symptom severity derived from the PHQ-9 for pa	rticipants at follow up 141
Figure 31 Percentage of participants who had PTSD based on the CID	I interview, the PCL and
self-reported doctor diagnosed and treated PTSD in the past	12 months145
Figure 32 Percentage of participants with possible alcohol disorder in the	he past 12 months based
on CIDI, AUDIT and self-report doctor-diagnosis data	149
Figure 33 Percentages of participants with any one, any two or any three	ee or more CIDI-defined
12-month disorders	155
Figure 34 Distribution of Demoralization Scale scores at follow up	158
Figure 35 Suicidality in the 12 months prior to follow up	160
Figure 36 Risk taking propensity of Gulf War veteran and comparison g	group participants at
follow up	160
Figure 37 Usual number of serves of fruit eaten per day	170
Figure 38 Usual number of serves of vegetables eaten per day	171
Figure 39 Involvement in ex-service organisations by study group	174
Figure 40 Commemoration of significant military occasions by study groups and the study groups and the study of the study	oup175
Figure 41 Distribution of Life Satisfaction responses for participants at f	follow up177
Figure 42 WHOQOL-Bref Overall Quality of Life ratings by participants	at follow up178
Figure 43 WHOQOL-Bref Health Satisfaction ratings by participants at	follow up178
Figure 44 Box plot of the WHOQOL-Bref domains showing the means	and interquartile range
	180
Figure 45 Flow of follow up study participants through DVA linkage	
Figure 46 Number of MBS recorded GP visits in the 12 months precedi	ing study participation 185
Figure 47 Cumulative disability claims during period 2001 to 2012	191
Figure 48 Proportion of participants with a DVA Treatment Card in each	h year from 2001 to 2012
	193

1 Introduction

The Iraqi invasion of Kuwait on the 2nd August 1990 was followed by international condemnation and a large multinational response in support of United Nations Security Resolutions. Ultimately a coalition of 41 countries mobilised a force of almost one million soldiers.¹ The first commitment of Australian Defence Force (ADF) personnel was announced as early as the 10th August 1990² with Royal Australian Navy (Navy) ships departing soon after to join a multinational naval force formed to enforce and support trade embargos. After many months of tension, intense air attacks against Iraqi forces began on the 16th January 1991. These were followed by the launch of a ground attack on the 24th February 1991 which ended in the defeat of the Iraqi forces as few as four days later. A formal ceasefire was declared by the United Nations on the 12th April 1991.

Australia's deployment eventually included 1,871 ADF personnel, according to the Nominal Roll for the Gulf War, involved in several different Operations between the 2nd August 1990 and 4th September 1991. The Australian contingent was predominantly (84%) Navy personnel, and these included personnel on Her Majesty's Australian Ship (HMAS) *Darwin*, HMAS *Adelaide* and HMAS *Success* deployed in Operation Damask I; HMAS *Brisbane*, HMAS *Sydney* and HMAS *Westralia* deployed in Operation Damask II; HMAS *Darwin* deployed in Operation Damask III; Clearance Diving Team 3; and Task Group Medical Support Element (TGMSE) deployed to USNS *Comfort*. The Royal Australian Air Force (Air Force) supplied transport and logistic support but did not fly combat missions. Other ADF personnel who were involved in Gulf operations included intelligence officers (mainly Air Force but some Navy and Australian Army) and Army linguists. Some individual officers (mainly Army) were on secondment to United Kingdom (UK) and United States of America (USA) forces and deployed to the region with those forces. Other ADF deployments in the region at this time included Operation Habitat and Operation Blazer.

The Gulf War was considered an extremely successful coalition military operation, with few coalition battle casualties and deaths. However, soon after repatriation Gulf War veterans began reporting a variety of symptoms and illnesses which they attributed to their Gulf War service but which could not be readily explained by medical science.³ The media coined the term "Gulf War Syndrome" shortly after.⁴ Most early health research was carried out on Gulf War veterans from the United States (US),⁵⁻⁷ however other coalition nations followed with studies of Gulf War veterans of the United Kingdom (UK),⁸ Canada,⁹ and Denmark¹⁰ among others.

During the decade following the Gulf War, Australian veterans became increasingly concerned about the effects of that war upon their own health. Based on submissions from its members, the Australian Gulf War Veterans' Association compiled a report outlining their health concerns, likely exposures and the supporting evidence linking veterans' chronic ill health with service in the Gulf.¹¹ Included amongst the Australian Gulf War veterans' numerous health concerns were reports of joint pain, headaches, stomach cramps, shortness of breath, skin problems, nightmares, fatigue, short term memory problems, irritability, mood swings, depression, suicidal thoughts, loss of sexual libido, increased startle response and clumsiness.¹¹

In 2000, the Australian Government Department of Veterans Affairs (DVA) commissioned, through competitive tender, a cohort study of the health of ADF personnel who were deployed to the Gulf region during that conflict (the Australian Gulf War veterans) and a comparison group of ADF personnel who had not deployed to that conflict. The resulting Australian Gulf War Veterans' Health Study was undertaken by a research team based primarily at the Monash University Centre for Occupational and Environmental Health (MonCOEH).

Data collection for, what is now termed, the *baseline* Australian Gulf War Veterans' Health Study commenced in mid-2000 and concluded in late 2002. The baseline health study included the entire cohort of ADF personnel included on the Nominal Roll for the Gulf War and a frequency matched comparison group of 2,796 ADF, or formerly ADF, personnel who had been in operational units at the time of the Gulf War but who had not deployed to that conflict. The baseline study included extensive self-reported health and exposure data, also health data collected via face to face medical and psychological examinations, all-cause mortality and cancer incidence data sourced from Australian national registries, and some ADF service-related data collated from records maintained by the DVA.

The results of the baseline study have been extensively reported in peer-reviewed scientific journals (e.g.¹²⁻²⁰) and cited in published reviews of the international Gulf War veteran health literature (e.g.²¹). To summarise some of the key findings, the baseline health study found that, 10 years after the Gulf War, veterans were at significantly greater risk of a number of adverse health outcomes relative to the comparison group. These included a doubling of the risk of several fatigue and chronic fatigue-related outcomes, a four-fold increase in 12 month PTSD, an 80% increase in multisymptom illness, a 70% increase in 12 month major depression and a 60% increase in 12 month alcohol disorder, increased rates of general health-symptom and neuropathic-symptom reporting, increased rates of reporting for numerous doctor-diagnosed medical conditions; particularly gastrointestinal disorders, skin

conditions and PTSD; and greater functional impairment in the previous two weeks and poorer self-perceived physical health status and mental health status. Objective measures of health, including blood pressure, physical fitness, body mass index, lung function, and the pattern of blood test abnormalities did not differ between the two study groups. Ten years after deployment, a number of Gulf War deployment-related characteristics and exposures were found to be associated with health outcomes in Gulf War veterans. Number of vaccinations, especially where ten or more were reported, number of pyridostigmine bromide tablets reportedly taken, being in a chemical weapons area and reported number of deployment-related stressors were all associated with higher symptom reporting, lower perceived physical health status and greater functional impairment in Gulf War veterans at baseline. Number of vaccinations reported was also associated with PTSD and psychological distress at baseline. Number of deployment-related stressors was also associated with affective, anxiety and substance use disorders, ten years after deployment.

The baseline Australian Gulf War Veterans' Health Study included an assessment of the mortality and cancer incidence experience of the cohort through linkage to the national death and cancer registries in 2002. At that time the numbers of deaths and cancers in the cohort were small and both were lower than those expected in the general Australian population. When Gulf War veterans and the comparison group were compared, there was a small excess of disease-related deaths in the veteran group, however the numbers were too small at that time to draw any meaningful conclusions from this.

Included among the recommendations arising from the results of the baseline Australian Gulf War Veterans' Health Study, was the recommendation that consideration be given to undertaking follow up studies, especially in relation to the cohort mortality and cancer incidence study, but also in relation to some of the health outcomes found in excess in Gulf War veterans, such that the longer term health sequelae of the Gulf War deployment could be monitored. In its most recent review of the vast health literature on Gulf War veterans internationally, the US Institute of Medicine (IOM) has recommended longitudinal monitoring of robust cohorts to carefully track the development of neurological and psychiatric conditions, also brain cancer and other long latency cancers, and additional health issues that occur at later age such as cardiovascular disease.²¹ The IOM specifically mentioned the usefulness of the Australian cohort for tracking frequently seen health outcomes such as 'Gulf War illness' (also termed Gulf War Syndrome or multisymptom illness), cardiovascular and respiratory diseases, other cancer types, and some psychiatric disorders.²¹

This report describes the first follow up of the health of the members of the Australian Gulf War Veterans' Health Study cohort. This follow up study comprises two primary components; a study of all-cause mortality and cancer-incidence in the entire cohort using up-to-date data sourced from Australian national mortality and cancer registries, and a study of the health of those members of the cohort who participated in the baseline health study, using data collected from a self-report postal questionnaire, an over-the-phone psychological health interview and linkage with Medicare Australia- and DVA-held health data. This follow up health study has been funded under a services agreement through the DVA competitive Applied Research Program. The research has been conducted by MonCOEH researchers and collaborators. Data collection for the follow up study has been undertaken in the period 2011-2013, approximately ten years after the baseline study.

2 Mortality and Cancer Incidence Study

2.1 Introduction

The baseline Australian Gulf War veterans Health Study included a Mortality and Cancer Incidence Cohort Study. In 2002, the cohort was linked to records held in the Australian National Death Index (NDI) to determine all-cause mortality in the cohort for the period 1 January 1991 to 31 December 2000, and to the Australian Cancer Database (ACD) to determine cancer-incidence rates in the cohort for the period 1 January 1991 to 31 December 1998. The matching revealed a total of 43 deaths and 19 cancers among male cohort members in the study period. Although the rate of death and the rate of cancer were both slightly higher in the Gulf War veteran group than in the comparison group, these differences did not reach statistical significance. However, the cohort was relatively small in size, the members were relatively young and the period of follow up was short, all limiting the power of the study to detect excess mortality and cancer at that time. Using the same cohort as that used in the 2002 linkage, the follow up Australian Gulf War veterans Health Study includes a repeat investigation of mortality and cancer incidence.

2.2 Aim

The aim of these analyses was to investigate whether Gulf War veterans have an excess risk of death or of developing cancer, than the comparison group or the Australian community.

2.3 Research questions

- Do Gulf War veterans have a greater rate of death than the comparison group?
- Do Gulf War veterans have a greater rate of death than same-aged Australians?
- Do Gulf War veterans have a greater risk of developing cancer than the comparison group?
- Do Gulf War veterans have a greater risk of developing cancer than same-aged Australians?

Cohort composition

At the commencement of the baseline Australian Gulf War veterans' Health Study, a cohort totalling 4,975 members was compiled which consisted of the entire deployed group of 1,871 Australian veterans of the Gulf War and 2,924 comparison group members. The Australian Gulf War veterans were defined as ADF members who deployed in support of the Gulf War at any time during the period 2 August 1990 to 4 September 1991 as part of ADF *Operation Ozone* or *Operation Damask*, or with overseas forces as part of Operations *Desert Shield* or

Desert Storm. They were primarily Naval personnel (84%) and men (98%). Comparison group members were randomly drawn from a population of 26,411 ADF personal who were in operational units at the time of the Gulf War but who were not deployed to that conflict. The comparison group was frequency matched to the Gulf War veteran group by sex, 3-year age band, service branch (Royal Australian Navy, Australian Army, Royal Australian Air Force), 2-rank categories (Officer versus other ranks) for Army personnel, and 2-task categories (aircrew versus non-aircrew) for the Air Force. There was some oversampling of eligible Army and Air Force comparison group members because the total numbers in these service branches were very low relative to the Navy, and a lower participation rate was anticipated in the comparison group relative to the Gulf War veterans' group. Further details regarding the eligibility criteria for each study group are shown in Appendix 2.

The cohort for the Mortality and Cancer Incidence Study, in 2002 and again at follow up, comprised 4,793 members. This was the entire original cohort minus two comparison group members who, during the baseline Health study, declined to participate in the Mortality and Cancer Incidence Study.

Registry linkage

Approval for both the NDI and ACD linkage was obtained from the Human Research Ethics Committees representing the AIHW, Monash University, the ADF and DVA. Additional approvals for the ACD linkage were obtained from the each of the Human Research Ethics Committees representing the Australian State and Territory cancer registries respectively.

In July 2011 a dataset, including the full name, date of birth, last known state and last contact date for the cohort members, was provided to the AIHW for linkage to the NDI and the ACD. At the time of the linkage, the NDI was complete up to 30 November 2010 and the ACD was complete up to 31 December 2008.

Data returned from the NDI included the identifying information (e.g. full name and date of birth) for the NDI record that appeared to match a cohort member, and also date of death and all causes of death coded in International Classification of Diseases (ICD) Version 10 and ICD Version 9 codes. Returned matches were independently reviewed by two members of the Monash research team to identify those to be accepted as likely true matches.

Data returned from the ACD included identifying information for the ACD record that appeared to match a cohort member in the case that the cohort member had participated in the cross-sectional component of the baseline Gulf War veterans Health Study. For cohort members who had not participated in the cross-sectional component of the baseline Gulf War veterans Health Study, data returned for matches to the ACD were deidentified. Other ACD data included for all matches included date of cancer diagnosis, site of body (topography), histology (affected tissue type), state in which the cancer was diagnosed, date of death (if applicable) and the ICD-10 codes for the type of cancer.

Statistical analysis

The cohort was followed-up from 1st January 1991 to 30th of November 2010 for mortality and 31st of December 2008 for cancer incidence. These periods were used to calculate total person-time.

Data were analysed using Stata Version 12 and a 5% level of significance was used in interpreting statistical significance. Box 1 describes the ICD 10 and ICD 9 codes used for each classification of cause of death and cancer type.

Causes of Death [ICD9; ICD10 codes]	Types of cancer [ICD9; ICD10 codes]
All-cause [001-999;A00-Y99]	All malignant neoplasms [C00-C97;D45-
Cancer [140-239; C00-D48]	D46; D47.1; D47.3]
Cardiovascular diseases [390-459; 100-199]	Lip cancer [C00]
All External causes [800-999; V01-Y98]	Colorectal [C18-C20]
Intentional self-harm [950-959; X60-X84]	Other digestive organs [C15 - C17; C21-
Transport accidents [800-848; V01-V99]	C26]
	Lung, trachea and bronchus [C33-C34]
	Melanoma [C43]
	Prostate [C61]
	Testis [C62]
	Kidney [C64]
	Brain and other CNS cancers [C70-C72]
	Thyroid [C73]
	All lymphomas [C81-C85; C88; C90-C91]
	Leukemia [C91-C95]

Box 1 Codes used to categorise causes of death and types of cancer.

For comparison with Australian population rates, cancer and death data for the general Australian population were obtained from AIHW. Using the population rates, expected number of deaths or cancer cases were calculated for each age group and calendar year of follow-up. The expected numbers of deaths or cancers were then compared with the cohort

observed numbers to calculate Standardised Mortality Ratios (SMRs) and Standardised Incidence Ratios (SIRs). In keeping with usual practice, and for ease of presentation, the SMRs and the SIRs and their 95% confidence intervals were multiplied by 100. Values over 100 represent increased risk of death or cancer and values below 100 represent decreased risk of death or cancer. A value of 100 is where the risk of death or cancer is the same as that in the Australian population.

The rate of death or cancer in the Gulf War veteran group was compared with the rate of death or cancer in the comparison group of the cohort using hazard ratios (HRs). Hazard ratios were calculated using the Cox regression model.²² The hazard ratios were adjusted (adj HR) for branch of service (Navy; Army; Air Force), rank (Commissioned Officer (CO); non-commissioned officer (NCO); other ranks) and age (<20; 20-24; 25-34; >=35 years), each estimated as at August 1990, the approximate commencement date of the Gulf War.

2.4 Results

Because of the very small proportion of women in the cohort (approximately 2%) results for the 4,680 men in the cohort (1,833 Gulf War veterans and 2,847 comparison group) are presented in the tables in this chapter. There were no female deaths in either group identified during the NDI linkage over the study period. A total of four cancers, all breast cancers, were identified for females from the ACD linkage during the study period. These four cancers were all among members of the comparison group.

Men in the cohort averaged 47.7 years of age (sd 6.38) at 30 November 2010 (the date to which mortality data was available). A breakdown of the cohort into age category at 30 November 2010, service branch at the time of the Gulf War and rank at the time of the Gulf War is shown in Table 1 for each study group. The Gulf War veteran group had a similar age and rank composition to the comparison group. There were proportionately fewer Army and Air Force members in the Gulf War veteran group, reflecting some over-sampling for these service branches in the comparison group.

Cohort characteristics

Characteristic	Gulf War veterans	Comparison group	Whole cohort			
	N=1,833	N=2,847	N=4,680			
Expected age in years at	n (%)	n (%)	n (%)			
30 November 2010	11 (70)	11 (70)	11 (70)			
35 – 44	742 (40.5)	1,083 (38.0)	1,825 (39.0)			
45 – 54	863 (47.1)	1,368 (48.1)	2,231 (47.7)			
55+	228 (12.4)	396 (13.9)	624 (13.3)			
	between group	os p-value = 0.16				
Service branch at August 199	0					
Navy	1,558 (85.0)	2,088 (73.3)	3,646 (77.9)			
Army	115 (6.3)	319 (11.2)	434 (9.3)			
Air Force	160 (8.7)	441 (15.5)	600 (12.8)			
	between group	s p-value <0.001				
Rank at August 1990						
Officer	405 (22.1)	720 (25.3)	1,125 (24.0)			
Non-commissioned Officer	1,168 (63.7)	1,676 (58.9)	2,844 (60.8)			
Enlisted rank	260 (14.2)	451 (15.8)	711 (15.2)			
between groups p-value = 0.004						

Mortality

The number of deaths observed in each study group, and the number expected in the Australian population of same-aged men, are shown in Table 2 for the period 1 January 1991 to 30 November 2010. In total 108 deaths were observed, comprising 2.3% of the cohort. There were 49 deaths in the Gulf War veteran group and 59 deaths in the comparison group. In both study groups the all-cause mortality was lower than that in the Australian male population however this difference was statistically significant only for the comparison group (all cause SMR=59, 95% CI 45-76), while it did not quite reach statistical significance for the Gulf War veterans (all cause SMR=77, 95% CI 58-102). Mortality from all-external causes was also statistically significantly lower in the comparison group than in the same-aged Australian male population. There were no significant differences between the Gulf War veterans and the Australian male population, and between the comparison group and the Australian male population, for all other causes of death.

Cause of death	Gulf War veterans person years = 36,065.1 N = 1,833		Comparison group person years = 56,139.1 N = 2,847			
	Observed	Expected	SMR (95% CI)	Observed	Expected	SMR (95% CI)
All-cause	49	63.7	77 (58–102)	59	100.8	59 (45–76)
Cancer	16	14.0	115 (70–187)	14	22.6	62 (37–104)
Cardiovascular diseases	5	10.8	46 (19–111)	11	17.5	63 (35–114)
All External causes	17	24.3	70 (43–113)	23	37.5	61 (41–92)
Intentional self- harm	6	9.9	60 (27–134)	9	15.4	59 (30–113)
Transport accidents	7	6.4	110 (52–231)	10	9.8	103 (55–191)

Table 2 Mortality rates for the Gulf War veterans and comparison group relative to the Australian male population

Table 3 shows the number of deaths in each study group, as a proportion of group size, and the ratio of deaths in the Gulf War veteran group relative to those in the comparison group. There were no statistically significant differences in mortality rates between the Gulf War veterans and the comparison group. It is worth noting that deaths from intentional self-harm were very similar in the two groups. However, there was an overall pattern of the adjusted HRs for all deaths and all causes of death (except for deaths from cardiovascular disease) being slightly greater in the Gulf War veteran group.

	Gulf War veterans N = 1,833		Compar	ison group		
Cause of death			N=2,847			
	n	(%)	n	(%)	Adj HR (95% CI)	
All causes of death	49	(2.7)	59	(2.1)	137 (94 – 202)	
Cancer	16	(0.9)	14	(0.5)	182 (88 – 374)	
Cardiovascular diseases	5	(0.3)	11	(0.4)	79 (27 – 229)	
All External causes	17	(0.9)	23	(0.8)	119 (63 – 225)	
Intentional self-harm	6	(0.3)	9	(0.3)	112 (39 – 317)	
Transport accidents	7	(0.4)	10	(0.4)	119 (45 – 316)	

Table 3 Mortality rates for the Gulf War veterans relative to the comparison group

Cancer incidence

The number of cancers observed in each study group, and the number expected in the Australian population of same-age men, are shown in Table 4 for the period 1 January 1991 to 30 December 2008. In total 115 cancers were observed, affecting about 2.5% of the total male cohort; 49 (2.6%) in the Gulf War veteran group and 66 (2.3%) in the comparison

group. In both study groups cancer incidence from all-causes, and from the specific causes tabulated, were not statistically significantly different from those in the same aged Australian male population, apart from a significant excess of thyroid cancer in the comparison group. The other finding of note is the higher than expected number for brain cancers in the Gulf War veterans, although this did not reach statistical significance and was based on very small numbers.

Cancer type	Gulf War veterans person years = 32,664.7 N = 1,833		Comparison group person years = 50,797.7 N = 2,847			
	Observed	Expected	SIR (95% CI)	Observed	Expected	SIR (95% CI)
All malignant neoplasms	49	49.4	99 (76-133)	66	79.4	83 (65-107)
Colorectal	**	4.5	89 (33-237)	7	7.3	95 (45-200)
Other digestive organs	6	3.3	184 (83-410)	5	5.3	94 (39-226)
Brain and other CNS cancers	**	1.7	238 (89-635)	**	2.7	38 (53-267)
Melanoma	11	10.8	102 (56-184)	14	17.2	81 (48-137)
Prostate	8	5.0	161 (81-323)	6	8.3	73 (33-161)
Testis	**	3.9	52 (13-207)	**	5.9	34 (8-135)
Kidney	**	1.7	58 (8-414)	5	2.8	179 (75-431)
Thyroid	**	1.1	91 (13-647)	5	1.7	289 (120-693)
Lung, trachea and bronchus	**	2.4	42 (6-300)	**	3.9	52 (13-207)
All lymphomas	**	5.1	39 (10-156)	8	8.2	98 (49-196)
Leukaemia	**	1.7	59 (8-420)	**	2.7	149 (56-397)
Lip cancer	**	1.7	173 (56-537)	**	2.8	109 (35-338)
Other cancer types	6	8.2	73 (33-163)	8	13.2	61 (30-122)

Table 4 Cancer incidence rates for the Gulf Wa	ar veterans a	Ind comparison	group relative to	the
Australian male population		-		

** Observed number of cancer not displayed because of small numbers (<5 cases).

Table 5 shows the ratio of incident cancers in the Gulf War veteran group relative to those in the comparison group. There were no statistically significant difference in the overall cancer incidence rates between the Gulf War veterans and the comparison group. While none of the specific cancer types were found to be statistically significantly higher in the Gulf War veterans, there were some types of cancer (e.g. brain and prostate) where the Adj HR was greatly in excess of one, but the confidence intervals were very wide because of small numbers.

Fable 5 Cancer incidence rat	es for the Gulf War vetera	ns relative to the comparison gro	oup
------------------------------	----------------------------	-----------------------------------	-----

Cancer type	Gulf Wa N =	r veterans 1,833	Comparison group N=2,847		
	n	(%)	n	(%)	Adj HR (95% CI)
All malignant neoplasms	49	(2.7)	66	(2.3)	120 (83–173)
Colorectal cancer	**		7	(0.2)	92 (28–308)
Other digestive organs	6	(0.3)	5	(0.2)	169 (50–571)
Brain	**		**		513 (67–3924)
Melanoma	11	(0.6)	14	(0.5)	119 (54–262)
Prostate	8	(0.4)	6	(0.2)	209 (72–603)
Testis	**		**		170 (27–1078)

** Observed and expected values not displayed because of small numbers (<5 cases).

2.5 Key findings

In the 20 year period since the Gulf War, there have been proportionately fewer deaths in the male Gulf War veteran group compared to the same aged Australian male population, and, while not quite reaching statistical significance, slightly more overall deaths and deaths from cancer occurred in the male Gulf War veteran group relative to the comparison group. In the same time period, mortality from all-external causes, has been statistically significantly lower in the male comparison group than in the same aged Australian male population.

In the 18 year period since the Gulf War, there have been no statistically significant differences in cancer incidence of any type between the male Gulf War veterans, the male comparison group members and the same-aged Australian male population.

While the results were suggestive of some types of cancer (eg brain and prostate) being higher than expected among the Gulf War veterans when compared with the comparison group, these were based on very small numbers and therefore the possibility of these findings being observed by chance could not be excluded in the current analysis.

There were too few deaths or cancers among females in the study group to make any meaningful interpretation.

The power of the study to detect excess mortality and cancer continues to be limited by the fact that the cohort was still quite young at 30 November 2010, with approximately 40% aged between 35-44 years, and the period of follow up is still relatively short for the purpose of detecting disease-related deaths or cancers of long-latency.

3 Health Study

3.1 Study design

The Australian Gulf War Veterans' Health Study is a longitudinal cohort study of the militaryrelated exposures and the physical, psychological and social health of ADF veterans of the 1991 Gulf War and a comparison group also drawn from the ADF. The cohort was first assessed in the period 2000-2002 in, what is referred to in this report as, the baseline study. The research questions, methods and results that are presented from here onward in this report are those relating to the first follow up of the participants from the baseline study. The collection of data for the follow up health study occurred in the period 2011-2012, approximately 10 years after the baseline

3.2 Research questions

This 10 year follow up to the baseline Australian Gulf War Veterans' Health Study cohort sought to address the following research questions:

- Do Gulf War veterans currently have a higher prevalence of multisymptom disorder, psychological disorder including depression, PTSD and alcohol use disorders, chronic fatigue, and other adverse physical health outcomes, and poorer social health and wellbeing than the comparison group?
- 2. Does the persistence of, or recovery from, multisymptom disorder, psychological disorder including depression, PTSD and alcohol use disorders, and chronic fatigue at ten years after the baseline study differ between the Gulf War veteran and comparison group?
- 3. What factors predict either persistence or recovery from the disorders described above, including personal, social, demographic, socioeconomic, deployment related and other characteristics, and do these factors differ between the Gulf War veteran and comparison group?
- 4. Has the pattern of health services utilisation since the baseline study differed between the Gulf War veteran and comparison groups, and between participants with and without the disorders described above?
- 5. Has the presence, at baseline, of one or more of the disorders described above, led to poorer physical and psychological functioning, greater demoralisation, greater disability, greater somatisation, poorer quality of life and poorer social functioning at ten year follow up?

4 Health Study Methods

4.1 Participants

A detailed description of the inclusion and exclusion criteria for the Gulf War veteran group and the comparison group is shown in Appendix 2. The cohort eligible for inclusion in the follow up health study comprised the 1,456 Gulf War veterans and 1,588 comparison group members (N=3,044) who participated in the baseline health study.¹⁶ They represented 80.5% and 56.8% of all eligible Gulf War veterans and comparison group members respectively who had been invited to take part at baseline.

Removal of deceased participants from the recruitable sample

In August 2011 the 3,044 members of the study population were matched against the National Death Index to identify those who had deceased since the baseline study. This linkage identified 40 deaths and those participants were removed from the cohort eligible for inclusion in the follow up health study.

Removal of participants from the recruitable sample for other reasons

In the period since the baseline study, four participants had contacted the research team to indicate that they wished to decline participation in any further health research. Those four participants were removed from the cohort eligible for inclusion in the follow up study. Despite numerous search strategies, valid contact details could not be located for a further 221 baseline study participants, and they were removed from the cohort eligible for inclusion in the follow up study because no invitation to participate could be issued to them.

Final sample size

In total 265 cohort members were removed from the initial recruitment denominator of 3,044. The final eligible cohort for participation totalled **2,779** which comprised **1,330 Gulf War veterans** and **1,449 comparison group** members.

4.2 Contact and recruitment methods

The study cohort was invited to participate by mailed invitation. The invitation package is shown in Appendix 5; it contained:

- A personally addressed letter of invitation to participate in the study from the Chief Investigator of the Monash University-based research team, Professor Malcolm Sim
- A letter of endorsement from the Repatriation Commissioner, Major General Mark Kelly AO
- A letter of endorsement from representatives on the Advisory Committee; specifically the National President of the Naval Association of Australia (Mr Les Dwyer) and Acting head of Navy People and Reputation (Commodore Vicki McConachie)
- The Study Explanatory Statement
- The participant consent form
- The participant questionnaire
- The Australian Defence Human Research Ethics Committee Guidelines for Volunteers
- A Reply-paid envelope

If no response was received within three weeks of the mailed invitation package, a reminder postcard was mailed.

If no response was received within three weeks of the mailed reminder postcard, a reminder package was mailed. The reminder package included a cover letter from the Chief Investigator and new copies of the study Explanatory Statement, Consent Form, postal questionnaire and Reply Paid envelope.

If no response was received within three weeks of the mailed reminder package, the study team attempted to contact cohort members by phone or email.

Source of contact details

At the time of the baseline study, participants provided up-to-date contact details including a postal address and, in some cases, email addresses and phone numbers. Many participants also provided a name, address and phone number for up to two alternative contact persons; those being people who might be able to provide the study team with current contact details in the event that the participant was lost-to-follow-up. In 2007/2008 the research team attempted to contact 2,691 members of the study population who had blood serum samples stored as part of their baseline study participation and who were thought to still be alive. Responses were received from 75% of that group and they provided up-to-date addresses, phone numbers and email addresses as well as details for up to two alternative contact persons.

The follow up study mail out was based on the most up-to-date address information held from either the baseline study or the 2007/2008 serum study. In the cases where it was

already known that an address was invalid, or where mailed invitations were returned-tosender from an incorrect address, or where no response was received after reminders had been sent, a number of strategies were used to make contact with the cohort member. These included:

- attempts to contact the cohort member using any telephone numbers or email addresses that they had previously provided,
- attempted phone contact with the 'alternate contact persons' previously nominated by the cohort member,
- a check against the DVA client database for a current address,
- a check against the Australian Electoral Roll for a current address,
- a check against the Electronic white pages for a current address or phone number.

4.3 Participation options

Participants were offered the option of participating in any, or all, of four study components which included:

- i. a postal questionnaire including questions about demographics, military service, numerous health outcomes, health-behaviours, life events and social functioning.
- ii. a psychological health interview conducted over-the-phone
- iii. consent for the researchers to access their DVA-held health data
- iv. consent for the researchers to access their Medicare, PBS and RPBS claims history

4.4 Data collection, instrumentation and measures

4.4.1 Postal questionnaire-derived data

The postal questionnaire was used to measure a number of self-reported health outcomes, health-behaviours, participants' background characteristics in terms of socio-demographic and economic indices, and also military service and civilian employment information. The follow up study questionnaire included several instruments which were also included in the baseline study questionnaire or medical examination, plus some additional measures which were not included at baseline. Appendix 3 provides a detailed outline of which health measures and occupational exposures were included in the baseline study, in the follow up

study, or in both studies. The follow up study questionnaire was mailed to cohort members and they were invited to complete it in their own time and return it to the study team in a Reply Paid envelope.

The complete questionnaire can be found at Appendix 4. The sections of the questionnaire, and associated question numbers, are described here:

Section A: Background information (A1-A7)

This section included questions about date of birth, current marital status, change in marital status since January 2001, highest educational qualification attained, any period of unemployment since January 2001, main source of income, and total household income.

Section B: Recent Australian Defence Force service including operational deployments (B1-B6)

This section included questions about whether participants were still serving members of the ADF and, if not, year of discharge; length of service in years; and current rank or rank upon discharge.

Participants were also asked to identify, from a list provided, any ADF operational deployments on which they had served in the period since January 2001. These were defined as war-like, peace operations, peace-keeping, peace-monitoring or humanitarian support deployments, and not training exercises or good will visits. Participants had the option to add additional deployments that were not on the list provided.

Section C: Civilian employment and voluntary work (C1-C2)

For each civilian job held for at least three months since January 2001, participants were invited to complete a job history including the year each job started, duration held, job title, main duties, employer, industry, number of hours per week and number of weeks per year. Participants were also asked to indicate whether they had done any voluntary work for emergency service, community welfare, health or humanitarian aid organisations.

Section D: Health and well being

Short Form-12 Health Survey, version 1 (D1-D7)

The 12-item Short Form Health Survey (SF-12) is a self-administered generic measure of health status.²³ It was developed to be a brief, yet valid, alternative to the longer SF-36²⁴ for

use in large surveys of general and specific populations as well as large longitudinal studies of health outcomes. The SF-12 was also included in the baseline study questionnaire and therefore it can be used for longitudinal comparisons of participants' health status.

The principal scores from the SF-12 are a Physical Component Summary (PCS) representing self-perceived physical health and a Mental Component Summary (MCS) representing self-perceived mental health. Both the PCS and the MCS use the same 12 items but these are differentially weighted. Scores range from 0-100 with higher scores representing better physical or mental health status. Full instructions, including treatment of out-of-range values, incomplete data and scoring have been published elsewhere.²³

The 12-item General Health Questionnaire (D9)

The 12-item general Health Questionnaire (GHQ-12) is a self-administered screening instrument designed to detect potential cases of current diagnosable psychiatric disorders in surveys or clinical settings.^{25,26} The instrument covers four identifiable elements of psychological distress; those being depression, anxiety, social impairment and hypochondriasis. The instrument is not intended to distinguish among psychiatric disorders or to be used in making a diagnosis of an actual disorder. Emphasis is on changes in condition, not on absolute level of a problem, so items compare the present state to the person's normal situation.

Studies have found that the scale achieves consistently high reliability and validity measures.^{25,27} Split half reliability on the 12-item version has been reported at 0.83²⁵ with Cronbach's coefficient alphas^{28,29} ranging from 0.82 to 0.90.³⁰ Sensitivity and specificity ranges of between 74.2% and 95.0% have been reported.²⁵

The GHQ-12 was included in the baseline study questionnaire and therefore it can be used for longitudinal comparisons of participants' levels of psychological distress.

Symptom questionnaire (D10)

This 63-item symptom questionnaire was included in the baseline study questionnaire and it comprises respiratory, cardiovascular, musculoskeletal, dermatological, gastrointestinal, genitourinary, neurological, neuropsychological or cognitive, and psychological symptoms. Participants are asked about the occurrence of symptoms in the past month and, if symptoms were experienced, to indicate whether the symptom was mild, moderate or severe in nature.

This 63-item symptom questionnaire was based on the symptom questionnaire developed and used by the King's College Gulf War Illness Research Unit,⁸ which was based on the Hopkins Symptom Checklist,³¹ and employed the same severity scale for symptoms reported to have occurred in the last month. It also included some symptoms used in other overseas symptom prevalence surveys. Similar symptom questionnaires and symptoms have been used in a number of overseas postal surveys investigating the health of their country's Gulf War veterans.^{7-10,32-35}

Multisymptom illness

We used the same definition of multisymptom illness as that used in the baseline study,²⁰ to assess whether or not a participant was likely to have multisymptom illness at follow up based on reporting of symptoms in the past month in the 63 item symptom questionnaire. Our study definition of multisymptom illness²⁰ was based on the Centers for Disease Control (CDC) operational definition³⁴ established in the US and adopted for studies of UK⁸ and US Gulf War veterans.³⁶

The CDC definition required one or more chronic symptoms from at least two of three categories (fatigue, mood-cognition, and musculoskeletal), where the latter two categories comprised the two factors identified in the factor analysis of symptoms in US veterans. Our definition required one or more symptoms in the past month rated as at least moderate severity from at least three of four categories (fatigue, psycho-physiological, cognitive, and arthro-neuromuscular), where the latter three categories comprised the three factors identified in the exploratory factor analysis of symptoms in the baseline Australian Gulf War veterans and comparison group population.¹⁹

Our main definition of multisymptom illness also formed the basis for an alternative definition in which people with medical or psychological conditions that may have explained their multiple symptom reporting or interfered with the person's ability to interpret or report symptoms³⁷ were excluded (multisymptom illness-exclusionary). This alternative definition was used in the follow up study, but not at baseline.

Other research groups have used this alternative approach to defining multisymptom illness in Gulf War veterans, whereby participants with serious medical and psychiatric conditions that might produce similar symptoms or might interfere with respondent's perception or reports of their symptoms are excluded e.g. serious psychiatric conditions.³⁷ The exclusionary conditions included cancer, diabetes, heart disease other than hypertension (e.g. heart attack, heart failure, angina), infectious disease e.g. pneumonia or hepatitis, cirrhosis of the liver, multiple sclerosis, neurological disorders e.g. motor neurone disease

and stroke, systemic disorders such as lupus or systemic lupus erythematous, CIDI defined bipolar disorder in the past 12 months, hospitalisation for CIDI defined alcohol use disorder or substance use disorder, major depression or PTSD in the past 12 months, or injuries requiring hospitalisation in the past 12 months. The past 12 months was included as part of the criteria for concurrency with multisymptom illness which is based primarily on past-month symptoms.

Neuropathic symptom questionnaire (D11)

This 17-item neuropathic symptom questionnaire was included in the baseline study questionnaire. It asks about neuropathic symptoms indicative of peripheral neuropathy experienced in the past month. The instrument was developed in consultation with a neurologist specifically for the baseline study, as a suitable pre-existing instrument could not be identified. The questions were based on those included in other studies of neurological function^{38,39} and related to four parameters of peripheral neurological dysfunction; those being muscle weakness; sensory disturbance; autonomic function; and severity of neurological dysfunction. The instrument produced a total score, being the total number of endorsed symptoms, plus a score for each of the four parameters representing the number of symptoms endorsed therein.

Pain occurrence and intensity (D8, D12-D13)

Chronic pain status was assessed using seven questions (D12. a-g) described by Von Korff et al (1992).⁴⁰ Three items measure pain intensity *right now* and in the past six months and the remaining four items measure disability associated with the pain in the past six months. The items were modified slightly in that, where items 1, 4, 5, 6 and 7 refer to "… back/ headache/facial pain…", this text was replaced with "pain". The instrument is scored to produce five Chronic Pain Grades; Grade 0 "pain free"; Grade I "low disability-low intensity"; Grade II "low disability-high intensity"; Grade III "high disability-moderately limiting"; Grade IV "high disability-severely limiting". The complete algorithm for scoring can be found in Von Korff et al (1992).⁴⁰

The Widespread Pain Index⁴¹(D13) was used to identify which areas of the body participants had experienced pain or tenderness in the past seven days. The Index was scored by summing the number of body areas endorsed from a list provided of 19 areas.

By supplementing the SF12²³ with one additional item from the SF- 36^{24} we were able to construct the Bodily Pain subscale from the SF36. This two item subscale is comprised of items 7 and 8 in the original SF36, which are items D5 and D8 in our questionnaire.
Respiratory health (D14)

In the baseline study a respiratory health questionnaire, based on the European Community Respiratory Health Survey⁴² and the American Thoracic Society questionnaire⁴³ was administered to participants by a nurse. In this follow up study a pared down set of respiratory health questions were included in the postal questionnaire. The purpose of the questions was to identify respiratory symptoms such as wheeze, cough and sputum and respiratory medical conditions such as asthma, chronic bronchitis and emphysema or Chronic Obstructive Pulmonary Disease (COPD).

In the baseline study, a working definition of chronic bronchitis was derived using both symptom data and spirometry results. In this follow up study, however, spirometry was not conducted. Therefore a symptom-based definition of chronic bronchitis was derived for the follow up study; defined as morning, day or night time cough for as much as three months in each of the previous two years.

Sleeping pattern (D15-16)

Participants were asked to indicate how satisfied or dissatisfied they were with their current sleeping pattern, and to rate their sleeping pattern in regard to their difficulty falling asleep, staying asleep or waking up early, in the past two weeks. These questions were used in the ADF Health & Wellbeing questionnaire⁴⁵ and the US Millennium Cohort Study.⁴⁶

Chalder Fatigue Scale (D17)

The 11 item Chalder Fatigue Scale⁴⁷ (CFQ) is a brief self-rating fatigue scale which was developed for the assessment of symptom severity and the detection of fatigue cases in epidemiological studies. In clinical practice, however, it is not recommended that the scale is used alone to detect fatigue cases, but used as an adjunct to further clinical assessment.

The 11 items are scored on a 4-point scale; 0 'less than usual', 1 'no more than usual', 2 'more than usual' and 3 'much more than usual'. The scale has been shown to be reliable and valid.⁴⁷ There are two subscales; the Physical fatigue component score is obtained from items a-g of the CFQ and the Mental fatigue component score is obtained from items h-k.^{47,48} Total scores range from 0-33, with higher scores representing greater fatigue symptom severity. Fatigue cases were defined as those participants with a score \geq 4.^{48,49}

Epworth Sleepiness Scale (D18)

The Epworth Sleepiness Scale is a self-administered eight-item questionnaire designed to measure the general level of daytime sleepiness or sleep propensity in adults.⁵⁰ The instrument has been shown to be reliable and have high internal consistency.⁵¹ Subjects are

asked to rate on a scale of 0-3 the chances that they would have dozed off, or fallen asleep, in eight specific situations that are commonly encountered in daily life. The scores from each of the eight items are summed to give a total which ranges from 0 to 24.

Chronic fatigue (D19)

An 11-item questionnaire, based on the criteria for the epidemiological investigation of chronic fatigue syndrome⁵² was used to assess fatigue related outcomes in participants. This was a pared down version of a 20-item questionnaire which was administered by a doctor in the medical examination component of the baseline study. The 11 items chosen at follow up enabled consistency with the baseline study reporting of three fatigue related outcomes; those being whether participants had experienced extreme tiredness or fatigue following their normal activities in the past 12 months; prolonged fatigue (\geq 6 months).⁵³

9-item Patient Health Questionnaire (D20)

The 9-item Patient Health Questionnaire (PHQ-9)⁵⁴ is a brief depression severity measure which includes the nine criteria upon which DSM IV (4th edition of the Diagnostic and Statistical Manual of Mental Disorders)⁵⁵ depressive disorders are based. As a severity measure, responses to each of the nine questions can be scored from 0 'not at all' to 3 'nearly every day'. Individual item scores are summed to produce a total score ranging from 0-27, with higher scores representing greater depressive symptom severity. The severity scores can be further categorised as representing *minimal* (0-4), *mild* (5-9), *moderate* (10-14), *moderately severe* (15-19) and *severe* (20-27) symptoms. Scoring has been described by Kroenke *et al* 2001⁵⁴ who reported the instrument to be a reliable and valid measure of depression severity, and to have excellent internal reliability, criterion validity and external validity for making criteria-based diagnoses of depressive disorders.

Symptom Interpretation Questionnaire (D21)

The Symptom Interpretation Questionnaire (SIQ)⁵⁶ assesses whether respondents typically attribute their health symptoms to physical/somatic, psychological, or environmental/normalising explanations; otherwise termed *causal attribution*. Developed by Robbins and Kimayer (1991)⁵⁶ the brief *forced choice format* of the SIQ, was used in the follow up study postal questionnaire. The *forced choice format* of the SIQ presents the respondent with 13 health symptoms and asks them to choose from three explanations provided, which correspond with how they might explain the symptom if it was present. When all 13 symptoms are completed, the numbers of somatic, psychological and normalizing explanations are summed. According to Kessler et al (1999),⁵⁷ the respondents

can then be classified as predominantly normalisers, psychologisers or somatisers if they scored \geq 7 on this scale.

Irritable Bowel Syndrome (D22)

The Irritable Bowel Syndrome (IBS) module of the Rome III diagnostic questionnaire⁵⁸ was included to identify possible cases of IBS in the cohort. The diagnostic criteria require abdominal pain or discomfort in at least three of the previous six months, with two or more of: pain or discomfort improved after defecation; pain or discomfort associated with a change in frequency of stool; pain or discomfort associated with change in the form of stool. This instrument is well validated and has been found to have good reliability in different populations.^{59,60} In clinical practice the presence of structural inflammatory bowel conditions such as Crohn's disease or Ulcerative colitis would exclude a diagnosis of IBS.

Demoralization Scale (D23)

The developers of the Demoralization Scale describe demoralisation as an expression of existential distress which can range from disheartenment at one end through despondency to profound despair.⁶¹ The instrument's 24 items cover five dimensions of demoralisation which the authors labelled as loss of meaning, dysphoria, disenheartenment, helplessness and sense of failure.⁶¹ The items are scored from 0 'never' to 4 'all the time' except items 1, 6, 12, 17 and 19 which are reverse scored.

Resilience (D24)

The 10-item version of the Connor Davidson-Resilience Scale (CD-RISC 10)⁶² was used to measure resilience, described as an individual's ability to thrive despite adversity.⁶² Respondents were presented with ten examples of how they might respond to challenging situations such as change, illness, pressure and failure, and responses are rated on a scale from 0 '*not true at all*' to 4 '*true nearly all the time*'. Individual item scores were summed to produce a total score ranging from 0-40 with higher scores indicating greater resilience.

Suicidal thoughts (D25-28)

Four questions asked about whether the respondent has felt that life was not worth living, and whether they had thought about suicide, made a suicide plan or attempted suicide. These questions were included in the ADF Middle East Area Operations (MEAO) Health Study questionnaire⁶³ and the ADF Health and Wellbeing Survey.⁴⁵

Medical conditions (D29)

This 49-item questionnaire was modified from a similar instrument included in the baseline study questionnaire. Respondents indicated whether or not a medical doctor had diagnosed

them with, or treated them for, any of the 49 listed medical conditions since January 2001. This time period was intended to equate approximately to the time since the respondent participated in the baseline study. Additional information was requested in relation to the year any endorsed medical condition was diagnosed, whether the respondent had been treated by a doctor for that condition in the last year, whether any medication had been taken for that condition in the last month and the names of those medications. In addition to the 49 medical conditions listed, respondents were offered the opportunity to list any further medical conditions that they had been diagnosed with or treated for by a doctor since January 2001.

Hospitalisations and other health service utilisation (D30-32)

One question, seeking the cause and duration of up to four hospitalisations in the past 12 months, was included in the baseline study questionnaire and was based upon a questionnaire previously administered to US Gulf War veterans.³³

Additional questions, not included at baseline, which were based on the Australian 2001 and 2007/08 National Health Study questionnaires,^{64,65} were included to capture use of health services in the last 12 months (such as hospital outpatient or emergency wards, or day clinic procedures or tests) or consultations with health- and allied-health professionals (such as specialist doctors, dentists, psychologists, social workers or naturopaths). Questions about frequency of consultations with general practitioners or specialist doctors in the last two weeks were also included.

Days out of role in the previous 2 weeks (D33)

Respondents indicated whether they had stayed in bed or at home for all, or part, of any day due to illness or injury in the previous two weeks. This question was included in the baseline study questionnaire and was based upon a questionnaire previously administered to US Gulf War Veterans.³³

Reproductive Health (D34)

These questions about fertility difficulties, pregnancy history (for female respondents, or in relation to the partners of male respondents) and pregnancy outcomes since January 2000 including miscarriages, still births and live births, were modified from similar questions that were included in the baseline study questionnaire. The information provided by respondents at follow up was merged with that provided at the time of the baseline study, so that a complete history of reproductive health since the time of the Gulf War could be collated.

Section E. Injury (E1-3)

This section assessed the frequency of injuries in the past 12 months that were severe enough to interfere with daily activities, the main cause of the two most recent injuries, the type of activity being undertaken, the type of health service used, any time off work or study, other functional limitations and whether alcohol was involved. Injuries in the previous three years which involved being dazed, loss of memory or loss of consciousness were also assessed for the purpose of identifying events that might have involved concussion. Questions were based on the 2004/05 National Health Survey Injury module⁶⁶ and the AIHW National Injury Survey Unit National Data Standards⁶⁷

Section F. Risk taking (F1)

The Evaluation of Risks Scale - Bubble Sheet Version (EVAR-B)⁶⁸ was used to assess risktaking propensity. Respondents were presented with 24 statements such as '*I am driving and the lights turn yellow, I feel like...*' or '*faced with a potentially dangerous event...*' and they indicated how they were likely to feel along a visual analogue scale featuring 25 *bubbles* (these were shown as boxes in the follow up study questionnaire) where the opposing ends of the scale represent high risk or low risk responses.

Each of the scale items were initially scored from 1 to 25 from left to right. Ten items were then reverse scored by subtracting the score for each item from 26; they were items 5, 7, 8, 10, 12, 14, 16, 18, 20 and 22. A total score was obtained as the average of the 24 individual items; i.e. sum of the scores for the 24 items divided by 24. Standardized z-scores 0.5 and 1.5 can be used to classify the respondents as average risk-takers, moderate risk-takers and severe risk-takers.

French authors Sicard et al 1999⁶⁹ reported five factors based on this scale; self-control, danger seeking, energy, impulsiveness and invincibility whilst American authors Killgore et al 2006⁷⁰ reported three factors; risk/thrill seeking, self-confidence and need for control.

Section G. Life Events

Financial strain (G1)

This question, about things which might have happened due to a shortage of money, was drawn from the 2007 NSMHW questionnaire.⁷¹

Homelessness (G2)

This question about any duration of homelessness since January 2001 was modified from the questionnaire used in the Continuous Improvements for Veterans in Care-Mood Disorders (CIVIC-MD) study.^{72,73}

Convictions and incarcerations (G3-4)

Two questions were included about any criminal convictions and any periods of time in jail or on remand for the time period prior to August 1990 (commencement of the Gulf War), between August 1990 and December 2000 (commencement of the baseline study) and since January 2001.

The questions, described above, about financial strain, homelessness and convictions or incarcerations, were included because these outcomes could be associated with chronic health problems, social dysfunction or maladaptive behaviours related to war deployment.

Stressful life events (G5)

These items comprise 26 of the 28 items included in the life events module of the Composite International Diagnostic Interview version 3.0 (CIDI v.3.0).⁷⁴ The original 28 items were also included in the 2007 Australian National Survey of Mental Health and Wellbeing (2007 NSMHW).⁷¹ Respondents were invited to indicate which of the 26 items had happened to them since January 2001. Two of the original 28 items (numbers 13 and 22) were not included because they specifically referred to childhood experiences which would have been previous to the period of enquiry. One of the original 28 items, in relation to rape, was modified for our study because it included events that occurred when the respondent was *"so young that they did not know what was happening"* and this was deemed to be previous to the period of enquiry.

Posttraumatic Stress Disorder Checklist - Civilian Version (G6)

The Posttraumatic Stress Disorder Checklist (PCL)⁷⁵ is a self-report rating scale based on the 17 symptoms associated with DSM IV PTSD. First developed in the early 1990s, the PCL was normed in part on a US Gulf War veteran sample.⁷⁵ The baseline study questionnaire included the PCL-S, which is a version requiring respondents to nominate a specific criterion event and to report symptoms in relation to that event. That version proved to be problematic in the baseline study, with the lead question poorly answered or not answered even after the researchers made modifications subsequent to a pilot study. Therefore, in the follow up study questionnaire the PCL-C was used; a version where respondents were asked to endorse symptoms related to *a stressful experience from the past*, and not to nominate a specific event. The original 17-item PCL-C was supplemented with four additional items (numbered G6. 18-21 in the questionnaire) which were based on revised PTSD criteria in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM V).⁷⁶

Section H: Lifestyle

Cigarette smoking (H1)

Cigarette smoking has been associated with numerous diseases including cardiovascular diseases, cancers, emphysema, stroke and thrombosis.⁷⁷ In this questionnaire, respondents indicated whether they were current-, former- or never-smokers and, if applicable, age of smoking commencement, age of cessation, total years of being a smoker, and average number of cigarettes smoked per day. Similar questions were included in the baseline study questionnaire.

Alcohol Use Disorders Identification Test

The self-report Alcohol Use Disorders Identification Test (AUDIT) was included as a screening instrument for current hazardous and harmful alcohol consumption.⁷⁸ The instrument's 10-items assess alcohol consumption, dependence symptoms and personal and social harm related to drinking alcohol. Items refer to the previous year and are scored according to their frequency of occurrence rather than their presence or absence. The psychometric properties of the scale are quite favourable.⁷⁹⁻⁸⁰

The AUDIT was scored by coding the five possible responses to questions 1-8, as 0 - 1 - 2 - 3 - 4, and coding the three possible responses to questions 9-10 as 0 - 2 - 4. The ten items were then summed to result in a total score ranging from 0 to 40.⁸¹

Caseness for the AUDIT, representing risk of hazardous or harmful drinking, is generally regarded as a total score equalling or exceeding a threshold or cut-off value of eight.⁸² Our previous research established a caseness threshold for male Australian Gulf War veterans and comparison group members of ten and so this threshold was employed.⁸³ This threshold still lies within the range of scores of eight to 15, defined as alcohol problems that may require brief advice on safe drinking of alcohol from a clinician or other health practitioner.⁸²

When used in the baseline study, AUDIT caseness criteria for possible harmful or hazardous drinking referred to the past three months, however in the follow up study it referred to the past year. The two measures were therefore not directly comparable, as any changes in prevalence might be due to changes in case definition, in that a broader time interval and hence broader definition was employed at follow up.

Vegetable and fruit consumption (H3-H4)

These questions on the usual number of daily serves of vegetables and fruits were drawn from the 2007/08 National Health Survey module L.⁶⁵ Responses can be compared to the Australian Dietary Guidelines⁸⁴ which recommend five or more serves of vegetables, and two or more serves of fruit, per day for both men and women.

Exercise (H5-6)

These questions measuring frequency and duration of walking for fitness, recreation and sport, and moderate and vigorous exercise in the previous two weeks, comprise nine of 28 questions from the 2007/08 National Health Survey module J.⁶⁵ Respondents were categorised into one of four exercise levels based on their responses to the nine items, according to the formula set out below:⁶⁵

An "intensity" value was estimated for each of the three categories of exercise; they were: 3.5 for walking; 5.0 for moderate exercise; and 7.5 for vigorous exercise. A score was derived for each of the three categories of exercise using the following algorithm:

Number of times activity taken (in last 2 weeks) X average time per session in minutes X "intensity".

The three scores achieved; for walking, moderate exercise and vigorous exercise respectively, were then summed to provide a total for each respondent for the two week period. Total score ranges were then grouped and labelled as follows:

Exercise level	Criteria
Sedentary	Scores less than 100 (includes no exercise)
Low	Scores of 100 to less than 1600
Moderate	Scores of 1600 to 3200, or more than 3200 but less than 2 hours
	vigorous exercise
High	Scores greater than 3200 and 2 hours or more of vigorous exercise

Section I: Social networks and support

The Medical Outcomes Study Social Support Survey (I1-2)

The Medical Outcomes Study (MOS) Social Support Survey⁸⁵ is a brief, self-administered measure of the availability of four dimensions of support; emotional/ informational, tangible, affectionate, and positive social interaction. An Overall Support Index is also calculated. The instrument is intended for use in survey research with people with chronic illness. However it can be used with general population samples.

Group participation (I3-4)

Questions I3 and I4 in the questionnaire, are questions 10 and 11 from the RAND Social Health Battery.⁸⁶ They comprise a two-item sub-scale which assesses voluntary group participation.

Military-related networks and occasions (I5-I6)

These two questions, modified from the ADF MEAO survey ⁶³ were included to assess the extent to which respondents were involved with ex-service organisations and commemorated significant military-related occasions.

Section J: Quality of Life

World Health Organization brief Quality of Life questionnaire (J1-26)

The World Health Organization brief Quality of Life questionnaire (WHOQOL-Bref) is a selfadministered, 26-item, abbreviated version of the 100-item World Health Organization Quality of Life questionnaire (WHOQOL-100).⁸⁷ The questionnaire was developed to measure participants' "perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns".⁸⁷ The WHOQOL-Bref contains two individual questions exploring overall selfrated quality of life and satisfaction with health, and 24 questions that explore the four Domains of Physical Health (e.g. ability to perform activities of daily living and mobility), Psychological health (e.g. self-esteem, concentration, negative mood, and body image), Social Relationships (e.g. personal relationships and social support) and the Environment (e.g. financial resources, transport, safety, and access to information). All questions are asked in relation to the "last two weeks".

The Domain scores have been shown to demonstrate good discriminant validity (P values <= 0.001 for "ill" versus "well" subjects in each Domain), internal consistency (Cronbach's alpha values ranging from 0.66 for Social Relationships to 0.84 for Physical Health) and test-retest reliability (Pearson's r correlation coefficients ranging from 0.66 to 0.87 for the four Domains).⁸⁸

The instrument's 26 questions are answered on a five-point scale from 1-5.⁸⁷ Questions 3, 4 and 26 in the instrument are reverse scored before summation. Final scores are scaled in a positive direction such that higher scores denote higher quality of life. WHOQOL-Bref question 1, representing overall quality of life, and question 2, representing health satisfaction, are examined separately and have total scores ranging from 1-5.

The four Domains are comprised of the following sets of questions:

- Domain 1 Physical Health: questions 3, 4, 10, 15, 16, 17 and 18.
- Domain 2 Psychological; questions 5, 6, 7, 11, 19 and 26.
- Domain 3 Social Relationships: questions 20, 21 and 22.
- Domain 4 Environment: questions 8, 9, 12, 13, 14, 23, 24 and 25.

The mean score of items within each Domain is used to calculate each Domain score. Mean scores are then multiplied by four, giving a total Domain score range of 4-20, in order to make Domain scores comparable with the scores used in the WHOQOL-100. Where participants fail to provide a response to at least 21 (80%) of the WHOQOL-Bref's 26 questions, they are excluded from scoring. Further, if participants have two or more items missing from Domains 1, 2 or 4, or one or more items missing from Domain 3, the associated Domain scores are not able to be calculated for those individuals.

Life Satisfaction Scale (J27)

The Life Satisfaction Scale assesses satisfaction with life in general⁸⁹ and has been reported to perform well in large population-based studies.⁹⁰ Some Australian normative data is available as this instrument has been included in the ABS 1997 National Survey of Mental Health and Wellbeing (1997 NSMHW)⁹¹ and the AIHW 2001 National Health Study.⁹² The instrument's single question has seven possible responses. The raw scores (S), ranging from 1-7, are converted by applying a linear transformation 100(7-S)/6 and are presented as 'percent life satisfaction' (PLS).^{90,93} These transformed scores range from 0-100, with higher scores representing higher life satisfaction.

Section K. Weight, waist and hip circumference

Excess body fat is associated with numerous health problems including Type 2 diabetes, coronary heart disease, respiratory disease, gall bladder disease, ischaemic stroke and some cancers.⁷⁷ At Section K of the questionnaire, participants' were asked to measure their weight in kilograms (kg), and their waist and hip circumference in centimetres using a tape-measure provided by the research team, to facilitate estimation of a number of measures of body fat (or adiposity).

Body Mass Index (BMI) is the most common method used to estimate the prevalence of underweight, normal weight, overweight and obesity in a population. A person's BMI is calculated by dividing their weight (in kg) by their height (in metres) squared; i.e. kg/m². Participants' height was assumed to be relatively unchanged from that measured in a

standard way by a nurse in the baseline study and, therefore, height at baseline was used in the follow up study for the calculation of BMI. In accordance with the standards recommended by the World Health Organization for adults aged 18 years and over,⁹⁴ follow up study participants were allocated to one of the following BMI categories:

- Underweight (<18.5)
- Normal (18.5 <25)
- **Overweight** (>=25 <30)
- **Obese** (>=30)

Waist circumference is a measure of abdominal or central adiposity, which is considered a better predictor of obesity related disorders than general adiposity. In accordance with the waist circumference cut-offs described by the Australian Institute of Health and Welfare⁷⁷ participants were allocated to one of the following categories indicating risk of obesity-related health complications:

- not at risk: less than 94cm
- Increased risk: 94cm to less than 102cm
- Substantially increased risk: 102 cm or more

4.4.2 Psychological health interview

The psychological health assessment was designed to detect the probable presence or absence of a variety of psychological disorders, but not to deliver a comprehensive clinical diagnosis for any one condition. Psychological health interviews were conducted over the phone by trained interviewers based at the Hunter Valley Research Foundation. Interviewers were initially blinded to each participant's study group, although this may have been surmised on the basis of responses during the interview. The primary instrument of use was the computer-assisted Composite International Diagnostic Interview (CIDI) Core version 2.1.⁹⁵ The CIDI is a structured interview of demonstrated reliability and validity for research purposes.^{96,97} The complete CIDI comprises 11 structured questionnaire modules which, when scored, indicate whether diagnostic criteria have been satisfied according to the definitions and criteria of the 10th revision of the International Classification of Diseases (ICD 10)⁹⁸ and the DSM IV.⁵⁵

The CIDI v 2.1 was also administered in the baseline study, however for that study it was administered face-to-face and by trained psychologists at Health Services Australia Pty Ltd. For both the baseline study and this follow up study, only six of the CIDI questionnaire

modules were administered to generate a DSM IV based categorical result, with onset and recency codes, for the following psychological disorders:

Somatoform and Dissociative Disorders including:

- Somatoform pain disorder,
- Somatisation disorder,
- Conversion disorder, and
- Hypochondriasis

Anxiety disorders including:

- Obsessive-compulsive disorder
- Generalised anxiety disorder
- Posttraumatic stress disorder
- Specific phobia,
- Social phobia, and
- Agora phobia and Panic disorder

Depressive disorders and dysthymic disorders Manic and Bipolar Affective disorders Alcohol use disorders Psychoactive substance use disorders.

Some additional questions, drawn from the CIDI v.2.1, CIDI v.3.0 and from the 1997 NSMHW,⁹¹ were also administered by the interviewers to screen for the possibility of the following three additional psychiatric conditions:

Eating Disorders (CIDI 2.1)

The complete CIDI questionnaire Eating Disorders module was not administered in the interview as this disorder was considered likely to be very rare in Gulf War veterans and that the focus of the psychological interview should be on aspects of psychological health most relevant to Gulf War veterans. However, some assessment of eating disorders was considered important as the presence of this disorder can be an explanation for chronic fatigue in some individuals. Therefore, to facilitate the full assessment of chronic fatigue in the study population, five stem questions from the CIDI module were used as screening questions for this disorder. These included those opening questions for which a set of Yes (positive) responses typically leads to the administration of the remaining 12 module questions.

Schizophrenia and Psychoses (1997 NSMHW)

The complete CIDI questionnaire module for schizophrenia and psychoses was excluded from the psychological interview on the basis that it was reported to produce excessive false positive diagnoses in an Australian community sample.⁹⁹ However, three screening questions for psychoses and one for schizophrenia, were used in preference to the full CIDI module. These questions were drawn from the 1997 NSMHW.⁹¹

Intermittent Explosive Anger Disorder (CIDI 3.0)

The complete CIDI v3.0 questionnaire module for Intermittent Explosive Anger Disorder (IED) was not administered, as it was not included at the time of the baseline study and therefore longitudinal comparisons would be not be possible. However, it was deemed a potentially important outcome for this population, as exposure to trauma has been linked with explosive anger¹⁰⁰ and has been strongly associate with combat-related PTSD.^{101,102} Thus, three screening questions were included from the CIDI v3.0 to assess whether discrete episodes of failure to resist aggressive impulses, resulting in serious assaultive acts or destruction of property, have occurred.

Two remaining CIDI modules were not administered:

- Dementia, amnestic and other cognitive disorders. This module was considered of least relevance to the study population.
- Nicotine Use Disorder. Questions pertaining to quantitative use of nicotine, in cigarettes, cigars and pipes, were instead included in the postal questionnaire.

Modifications to the posttraumatic stress disorder module

The introduction to the PTSD module in the CIDI was slightly modified for the purpose of this study. Typically respondents to the CIDI interview are invited to view a standard list of eleven broad experiences. A participant must have encountered one or more of those experiences to be eligible for a PTSD diagnoses and to continue with the PTSD questions within the module. Item 1 on the list originally read "Have you ever had *direct combat experience in a war?*" It was felt that many ADF personnel, who had served on active, operational deployments such as the Gulf War deployment, would not consider that their service included 'direct combat experience' as there were few on this deployment who came under direct military attack. Thus a broader question was devised to ensure inclusion, in this module, of all ADF personnel who served on war-like or peacekeeping operations. Item 1 on the list was therefore altered to read "Have you ever been *deployed to a war zone or peace keeping operation?*"

4.4.3 Data linkage with Medicare Australia and DVA

The aim of linking each consenting participant's details with Medicare Australia was to obtain Medicare Benefit Scheme data (MBS) and Pharmaceutical Benefits Scheme (PBS) data to assess participant's health services utilisation and pharmaceutical use. In addition, the linkage data also provides objective measures of health status. These data, when combined with further information derived from DVA-held MBS and Repatriation Pharmaceutical Benefits Scheme (RPBS) data, and the data provided by participants at follow up via the self-report questionnaire, served to provide as complete a dataset as possible about health services utilisation and pharmaceutical use in the ten year period since the time of the baseline study.

Consent for linkage with Medicare Australia and with DVA held data was requested into the future so that these linkages could be repeated.

Overview of data linkage and periods of linkage

Each consenting participant's identifying information (including full name, previous name (if any), title, gender, date of birth, address, post code, previous address (if any), Medicare or DVA number and prefix if available, linkage start and end date) was transferred to, and returned from, Medicare Australia and DVA in password protected files. Medicare Australia and DVA health data were obtained for the period 01/01/2001 to 15/08/2012.

Data linkage with Medicare Australia

Medicare Australia is an Australian government funded program that covers a wide range of health care services. The Medicare Benefits Schedule (MBS) is a health publication listing of services that are subsidised by the Australian government under Medicare.¹⁰³ It covers some services that are usually privately provided. Providers are paid by patients on a feefor-service basis and patients are reimbursed in-part or in-full by the government. Medicare covers services that are provided out-of-hospital, e.g. in doctor's consulting rooms, as well as in-hospital services provided to private patients treated in a private or public hospital. Medicare excludes services provided to public inpatients, and thus does not hold information on these services.

The PBS database lists all medicines dispensed in Australia at a Government-subsidised price, other than those dispensed under the RPBS (described below). PBS data are based on payments to pharmacies after a PBS medicine has been dispensed to a patient. The RPBS lists all medicines dispensed in Australia to eligible veterans at a DVA-subsidised price. Data from both PBS and the RPBS were accessed to identify participants who had

received at least one prescription under these schemes for any medication classified according to the Anatomical Therapeutic Chemical (ATC) coding system.¹⁰⁴

Medicare Australia specified the information required for the linkage and the linkage was undertaken at least three months after the study end date of 15/08/2012 to allow for delays in processing of claims. The specific data extracted from MBS and PBS is listed below.

Variables extracted from MBS

- Participant ID
- Claim details (Date of service, Medicare item number and description)
- Service provider & referrer (Scrambled ordering and rendering provider numbers, Date of referral, hospital indicator)
- Costs (Provider charge, Schedule fee, Benefit paid, Patient out of pocket)
- Provider derived major speciality
- Item Category grouping similar professional services together.

Variable extracted from PBS

- Participant ID
- Item Description (Date of prescribing, Date of supply, Item description and code)
- Costs (Patient category, Patient contribution, Net benefit)
- Prescribing details (Scrambled prescriber number, Form category)
- Anatomical Therapeutic Chemical (ATC)
 Code and name, Prescriber derived major speciality.

Data linkage with DVA

DVA-held health and compensation data were accessed to complement Medicare data and obtain other data that would not be obtained solely through linkage with Medicare Australia. Six separate sets of data were obtained from DVA and these included DVA Treatment Card history, disability claims data, DVA-held MBS data, RPBS, DVA-funded hospitalisation data and non-card medical treatment. A detailed description of the data is provided in the results chapter, in the Health Services Utilisation section. Hospitalisation data was only available from January 2007 to August 2012.

4.5 Data management

Several methods were employed to ensure the quality, completeness, integrity, privacy and security of all identifying, health and exposure data collected for the follow up study.

4.5.1 Checking, keying and secure transfer of electronic data

The study consent form and postal questionnaire were designed such that all responses to items with tick-boxes could be directly scanned and captured into a dedicated database. Any discrepancies in the tick-box responses detected by the data capture software; e.g. where a participant appeared to have marked more than one tick-box when only one response was requested; were then reviewed by two data entry personnel separately. All text data, including written numbers and words, were also keyed by two data entry personnel separately. Where the data entered by the two data entry personnel did not match exactly, a supervising staff member reviewed the discrepancy and decided upon the correct entry. The data capture software included programmed rules that corrected seemingly indecisive or incomplete data. For example, the program corrected a year written as "95" to "1995", or selected the higher of two ticked educational qualifications when the highest education level was requested in the questionnaire. The captured data was then password protected and uploaded to a secure File Transfer Protocol (FTP) server from where it was downloaded by designated Monash research team personnel.

The data collected from the over-the-phone psychological health interview were keyed directly into the computer-assisted version of the CIDI v.2.1.⁹⁵ This program has numerous built in checks to prevent the collection of invalid, out of range or incomplete data. The completed interview data was password protected and uploaded to AAARNet's Cloudstor Service, which is the Monash University's approved file transfer service, from where it was downloaded by designated Monash research team personnel.

4.5.2 Additional data checking, cleaning and coding

The scanned and keyed data from the consent forms and postal questionnaire were then further checked by the Monash researchers for invalid, out of range, or incomplete responses. For example, an invalid response might be where a respondent reported an age at which they first had asthma, having previously responded "No" to a question about whether they had ever had asthma; an out-of-range response could be a number larger than 12 when the question has asked which month of the year an event occurred; an incomplete response could be where a respondent has reported that they deployed to a particular Operation, however failed to indicate the year in which they deployed or the total duration of that deployment. In these instances a PDF of the respondent's completed questionnaire was viewed by a Monash researcher to see if any additional information was available from which to complete or correct the captured data.

Data coding primarily involved the coding of text responses into categories. An example from the Medical Conditions section of the questionnaire would be the coding of separate written responses which read "gall bladder infection", "gall bladder removal" or "gall stones" into one category called "gall bladder disease".

4.5.3 Methods to ensure privacy and security

All electronic and hard copies of the participant consent forms, which contain identifiers such as name and date of birth, are stored separately from the electronic and hard copies of the postal questionnaires which contain personal health information.

4.5.4 Long term storage of data

In accordance with the 2007 Australian Code for the Responsible Conduct of Research,¹⁰⁵ the researchers will retain all original and derived data for a period of at least seven years from completion of the study.

4.6 Statistical methods

General statistical analyses were performed using Stata 12¹⁰⁶ and Stata 13¹⁰⁷ software and factor analysis (defined below) was performed using Mplus 7.¹⁰⁸

Participant characteristics, symptoms and other adverse health outcomes were most typically measured on dichotomous (e.g. 'never', 'yes'), categorical (e.g. married; divorced; single, never married), Likert-type²⁸ (e.g. 'better than usual', 'same as usual', 'less than usual'), ordinal (e.g. mild; moderate; severe) or continuous (e.g. score ranging from 1-100) scales, although counts (e.g. number of symptoms) were also measured.

The first stage of statistical analyses involved a cross-sectional comparison of the demographics and health of participants at follow up. Differences on participant characteristics between the Gulf War and comparison groups at follow up are presented using Pearson chi-squared tests for categorical measures and t-tests for continuous measures. Differences in the prevalence of health outcomes in Gulf War veterans relative to the comparison group at follow up are primarily presented as risk ratios (RR) and accompanying 95% confidence intervals (CI), calculated using Poisson regression.¹⁰⁹ The RR is a measure of the risk of the health outcome happening in one group compared to the risk of the health outcome happening in one group compared to the value one would mean there is a 95% chance that no difference exists between the two

groups in terms of their risk of the measured health outcome. A RR with a CI lower limit that was greater than one (e.g. a CI of 1.2 to 3.0) would mean there is a 95% chance that Gulf War veterans are at greater risk of the health outcome than the comparison group. In contrast, a RR with a CI upper limit that was lower than one (e.g. a CI of 0.25 to 0.90) would mean there is a 95% chance that Gulf War veterans are at lower risk of the health outcome than the comparison group.

Differences between the Gulf War veterans and comparison group on categorical outcomes with more than two responses (e.g. difficult falling asleep with responses none, mild, moderate or severe to very severe) were usually estimated using multinomial logistic regression.¹¹⁰ If the frequencies of a health outcome in the Gulf War veteran or comparison groups were small (arbitrarily but conventionally defined as being five or less), exact Poisson regression was performed within Stata.¹¹¹ Differences between the Gulf War veterans and comparison group on health outcomes which were measured on a continuous scale, e.g. SF12 score, were presented as mean differences (mean diff) using linear regression when the data were normally distributed, or median difference (median diff) using quantile or median regression¹¹² when the data were skewed (i.e. a preponderance of very low or very high values).

For data involving counts (e.g. number of health symptoms reported), either Poisson regression or negative binomial regression were employed. The latter technique was used if the data showed more variation than would be expected under a model following a simple Poisson distribution.¹¹⁰ If a particular condition was rarely reported and so the number of "zeroes" (e.g. scoring "none" on a count variable, indicating not having any symptoms) was higher than would be expected, zero-inflated negative binomial regression was employed, to take this into account.¹¹⁰

Where individual health outcomes were sufficiently prevalent in Gulf War veterans at follow up, the second stage of analysis involved detailed comparisons of subgroups of Gulf War veterans, utilising measures such as rank and service branch, and medical, environmental or chemical exposures. These included assessment of the existence and magnitude of an exposure-response trend in symptom/outcome prevalence at follow up, across exposure categories. Where a more exact measure of exposure was available, dose-response trends were computed using the exposure as a linear variable in the regressions. The exposureresponse comparisons being made within the Gulf War group were thought to be free of any "healthy soldier" effect, which may otherwise exist in comparisons with non-deployed personnel. Where a health outcome was measured at both baseline and follow up and where prevalence at each time point was sufficient, the third stage of analysis involved measuring change over time in both study groups. Participants who met criteria for a health outcome at baseline and again at follow up were defined as "*persistent*" or repeated cases. *Persistence*, in this instance, only indicates that the health outcome was present at baseline and at follow up; it does not indicate whether the condition persisted continuously for the decade since baseline, or whether it had remitted and recurred. Participants who met criteria for a health outcome at baseline, but not at follow up, were defined as "*remitted*" cases. Participants who did not meet criteria for a health outcome at baseline, but then met these criteria at follow up, were defined as "*incident*" cases. Poisson regression was used to compare the proportion of persistent, remitted and incident cases between the veterans and comparison group, using relative risks, as defined above.

Throughout the results, and unless otherwise specified, statistical adjustment was made for age (<20; 20-24; 25-34; >=35), rank category (Commissioned Officer; non-commissioned officer; other rank) and service branch (Navy; Army; Air Force) each estimated at August 1990, which was the approximate commencement of the Gulf War.

In order to compare the co-occurrence of self-reported symptoms between the Gulf War veterans and the comparison group, a technique known as factor analysis was employed. Factor analysis attempts to identify a set of underlying and not directly observable dimensions, known as factors, which represent the underlying correlations between a larger group of variables.¹¹³ In the context of our study, factor analysis attempts to determine whether the co-occurrence of self-reported symptoms can be represented by a number of underlying factors, and whether these factors differ between the Gulf War veterans and the comparison group. The number of dimensions or factors needed to represent the underlying correlations between variables was determined by various methods, including the scree plot, ^{113,114} a commonly used visual technique. Factor analytic methods appropriate for symptom data were employed.^{19,115}

4.7 Chemical, environmental and medical exposure assessment

In the baseline Australian Gulf War Veterans' Health Study exposure assessment was primarily, but not exclusively, based on participant's self-reported exposure to a number of chemical, environmental and medical substances and stressors. Participants were asked to report on a large number of possible Gulf War-related exposures, including dust storms, smoke from oil well fires (SMOIL), pesticides and insecticides, biological or chemical weapons, and vaccinations and prophylactic medications such as pyridostigmine bromide (PB). Where available, some additional sources of information were used to supplement the self-reported exposure data, such as vaccination data recorded in participant's International Certificates of Vaccination (ICVs), ADF-held information about locations and dates of deployment and other information known about significant events during the Gulf War.

For the purpose of this follow up study, a number of further sources of information pertaining to exposures relevant to the Gulf War have been reviewed. These include the Reports of Proceedings, Ships Logs and Ships Medical Journals for the Ships which were deployed as part of the Gulf War, and other reports. The purpose of reviewing these documents is to both support and augment the exposure data which has already been collected by self-report methods. These data sources and the methods employed to extract data therein are described in more detail in this chapter.

In a further attempt to supplement the self-reported exposure information collected at baseline, this chapter also describes the pattern of exposures reported across different Ships' complements and other groups deployed to the Gulf War. The purpose of this is to determine whether the personnel on any Ships or other deployed groups could be collectively categorised as belonging to a particular stratum of exposure. For example, exposure "x" could be self-reported by 80% of a Ship's complement, whereas 5% from that Ship might report that they were not exposed to "x" and 15% might report that they did not know if they were exposed. If "x" was something that the Ship's complement were likely to be equally exposed to (e.g. oil in drinking water), then it is likely that some of those who reported "no" and most of those who reported "don't know" were misclassified, and their correct classification should be "yes". Based on the pattern of self-reported exposure to "x", this Ship's personnel could be collectively categorised as having "high" likelihood of exposure, with the assumption that this may reduce the proportion of misclassified participants.

4.7.1 Deployments

The Australian Gulf War veterans were deployed in several Ships and other groups as shown in Table 6. The numbers of baseline and follow up study participants who were in each of these Ships or deployments are also shown in Table 6. The distribution of participants across Ships and other deployments is similar for the baseline and follow up studies.

Deployment	Participants at baseline* N=1,456	Participants at follow up [†] N=697
Damask I		
HMAS Adelaide	155 (11%)	79 (11%)
HMAS Darwin (Darwin 1)	189 (13%)	90 (13%)
HMAS Success	171 (12%)	82 (12%)
Damask II		
HMAS Brisbane	303 (21%)	140 (20%)
HMAS Sydney	189 (13%)	93 (13%)
HMAS Westralia	71 (5%)	29 (4%)
Damask III		
HMAS Darwin (Darwin 2)	156 (11%)	77 (11%)
USNS Comfort 1	14 (1%)	8 (1%)
USNS Comfort 2	30 (2%)	12 (2%)
USNS Comfort 3	9 (1%)	3 (0.4%)
Clearance Divers	47 (3%)	12 (2%)
Operation Habitat	55 (4%)	30 (4%)
All other deployments	218 (15%)	105 (15%)

Table 6 Distribution of Gulf War veterar	n participants at baseline and at follow up b	y
deployment		

* 59 Gulf War veterans were deployed on both HMAS *Darwin 1* and 2; and all veterans deployed on USNS *Comfort* 3 had been deployed on USNS *Comfort* 2

† 31 Gulf War veterans were deployed on both HMAS Darwin 1 and 2 of follow up participants

4.7.2 Pattern of self-reported exposures by Ship and other deployments

4.7.2.1 Self-reported chemical and environmental exposures

In the baseline study, participants were asked to self-report exposure to a number of chemical or environmental hazards. They were asked 28 questions; for example:

- Were you exposed to dust storms?
- Were you exposed to intense smoke? e.g. from forest fires or burning oil
- Have you been exposed to engine exhaust so that it irritated your eyes?

- Did you use a respirator?
- Did you use a chemical protective suit (NBC suit)?
- Have you drunk water that looked or tasted like it had oil in it?
- Have you showered in water with fuel in it (evident by visible oil film, smell or smarting eyes)?

The findings were reported on pages 193-199 of Volume 1 of the Gulf War Veterans' Health Study report (2003).¹¹⁶ For some exposures, e.g. sunscreen, over 80% of all participants reported exposure during the Gulf War and on other deployments. In subsequent analysis of these reported chemical and environmental exposures, we found that some exposures were strongly associated with the Gulf War deployment and not with other deployments e.g. use of a respirator.¹¹⁷ We analysed the association between Gulf War-related chemical and environmental exposures at baseline by using exposure metrics based primarily on individual self-reported data.

The pattern of self-reported exposure to a number of chemical and environmental exposures is shown in Figure 1 for Ships' companies and in Figure 2 for other deployed groups. Some exposures such as sunscreen were reported at the same rate by personnel in Ship and in shore- or ground- based deployments such as Clearance Divers and Operation Habitat personnel. Respirators and chemical protective suits were least likely to be reported by those on Darwin 2 compared to other Ships and groups. *Darwin 2* personnel and Clearance Divers were much more likely than other Ships or groups to report exposure to intense smoke and to report inspecting enemy equipment. Exposure to dust storms was less likely to be reported by HMA Ships *Adelaide* and *Success* and *Comfort* 1, 2 and 3 than those on other deployments. Exposure to oil- or fuel-contaminated drinking or showering water was most frequently reported by the Clearance Divers, followed by HMAS Brisbane and Other deployments, compared to other groups.

The Clearance Divers and Operation Habitat personnel reported a number of exposures at a much higher rate than other deployments. Clearance Divers reported environmental exposures such as solvents, dust storms and insect repellent exposure. Operation Habitat personnel reported exposure to pesticides including insect repellent. Pesticide application is a very specialised task, so it is not surprising that most Ships' participants did not report this exposure.

In respect to eating locally sourced non-military food, eating locally sourced military food or drinking locally sourced water, the participants on different Ships report exposure at similar rates, about 80%, 60% and 40% respectively. There is more spread among the smaller deployments, 65-80% of Clearance Divers, Operation Habitat, *Comfort 1* and those on other unspecified deployments reported eating local non-military food but only 40% of those on *Comfort 1* and *2* reported this. About 60% or fewer of those on the smaller deployments reported eating local military food. In respect to drinking local water, about 50% of Clearance Divers and Operation Habitat personnel reported this exposure and 20% of those on other small deployments.

Based on the differences across Ships and other deployed groups in the pattern of selfreported exposures, new deployment-based exposure metrics for use in the statistical analysis were proposed for the following exposures:

Intense smoke:

"*High*" categorisation for *Darwin* 2 and Clearance Divers where > 90% reported exposure to intense smoke;

"Low" categorisation for HMA Ships *Westralia*, *Sydney*, *Darwin* 1, *Brisbane*, *Success*, Adelaide, USNS Success, Operation Habitat, and all other groups (Not otherwise specified; NOS) where < 90% reported exposure to intense smoke.

Dust:

"Higher" categorisation for HMA Ships *Darwin* 1 and 2, *Westralia*, *Sydney* and *Brisbane*, Operation Habitat, and all other groups (NOS) where >40% report exposure to dust storms; *"Lower*" categorisation for USNS Comfort 1, 2 and 3, and HMA Ships *Success* and *Adelaide* where <40% report exposure to dust storms.

Oil in drinking or showering water:

"Possible" categorisation for Clearance Divers and HMAS *Brisbane* where >= 20% report exposure to oil in drinking water or oil in showering water *"Unlikely*" categorisation for all other groups.

Pesticides:

"Higher" categorisation for Operation Habitat where >30% answered affirmatively to any of four pesticide use questions; 'applied pesticides', 'clothing treated with pesticides', 'tent treated with pesticides' and 'worked in pesticide sprayed area'; *"Lower*" categorisation for all other groups



Figure 1 Distribution of self-reported exposures by Ship for baseline participants



Exposure

Figure 2 Distribution of self-reported exposures by all other small group deployments for baseline participants

4.7.2.2 Self-reported exposure to SMOIL

Commencing 6 January 1991, the Iraqis set fire to 788 of 943 Kuwaiti oil wells and damaged a further 175. Efforts to cap the wells were prolonged, with the last well capped on 6 November 1991. To measure the Gulf War veterans' exposure to the resulting SMOIL, the veterans were asked to estimate the number of days during which they had direct contact with, or were exposed to, intense smoke from burning oil wells. Also, during the smoke and oil cloud, they were asked how many hours on each of those days, on average, were they outside/on the upper decks. Respondents were classified as having *none, low* or *high* SMOIL exposure. The pattern of SMOIL exposure classification across Ships and other deployments, based upon these self-reported data, is shown in Figure 3.



Figure 3 Distribution of self-reported SMOIL exposure by Ship and other deployments for baseline participants

HMAS *Adelaide* departed the Gulf region on 3 December 1990 which was before the torching of the oil wells. Consistent with this, the HMAS *Adelaide* participants at baseline were most likely, compared to other Ships and deployment groups, to report that they had no SMOIL exposure. It is possible that a proportion of the 18% of HMAS *Adelaide* participants, who reported low SMOIL exposure, should be reclassified to no exposure as it is unlikely

that many HMAS *Adelaide* participants redeployed to the Gulf during the period of the SMOIL cloud. It is difficult to assess whether a similar level of misclassification occurs in the other Ship and deployment groups for SMOIL exposure. The first deployment of HMAS *Darwin* (Darwin 1) also departed the Gulf region on 3 December 1990, however personnel on that deployment may have been exposed to SMOIL if they returned when HMAS *Darwin* was redeployed to the Gulf region in June 1991 (Darwin 2). For other Ships and deployment groups, variability across personnel in exposure level, as shown in Figure 3, is reasonable to expect. On a Ship, for example, personnel conducting tasks on the upper decks are likely to have been more exposed than personnel whose tasks restricted them to lower decks. The torching of the oil wells during the Gulf War was an extremely high profile event, and we believe that most study participants would have accurately reported their presence, or not, in the region during these fires. For these reasons we do not think it is justified to create a new, deployment-based SMOIL metric, in which all members of a Ship or deployment group would be classified as having equal exposure.

4.7.2.3 Self-reported medical exposures

Gulf War veterans were asked to report the number of vaccinations they received, or whether they received none or did not know how many they received, as part of their deployment to the Gulf War, in the baseline study postal questionnaire. They were also asked to provide their WHO vaccination books (International Certificate of Vaccination, ICV) and these were photocopied and the data recorded subsequent to the baseline report.¹¹⁸

Figure 4 shows that similar proportions of Gulf War veterans across Ship and other deployed groups reported that they received any vaccinations; i.e. at least 1-4 vaccinations, and a combination of 1-4 and 5-9 vaccination categories. There was not a particular Ship or group of Ships that differed markedly in relation to the self-reporting of number of vaccinations received. The proportion of personnel on Ships reporting that they received ≥ 10 vaccinations was low (range 0 - 7%).





Approximately one half of the baseline study Gulf War veteran participants (51%) who completed the postal questionnaire indicated that they had their ICV to refer to when reporting their vaccinations, and 48% of male Gulf War veterans provided their ICV for photocopying.¹¹⁸

Figure 5 shows the total number of recorded vaccinations (in those who provided their vaccination record) compared by Ship or deployment group. Five or more vaccinations were recorded for a high percentage (at least 83%) of personnel in Darwin 1 and 2, HMAS *Brisbane* and *Sydney*, Operation Habitat and Clearance Divers, and for a slightly lesser proportion of those on USNS *Comfort*, HMAS *Westralia* and Other deployments (68% to 78%). One to four recorded vaccinations was predominant in HMA Ships *Adelaide* and *Success*. The greatest proportion of personnel with \geq 10 recorded vaccinations were on HMAS *Darwin* (34%) and Operation Habitat (21%).



Figure 5 Total number of recorded vaccinations by Ship and small group deployments

The distribution of self-reported vaccinations shown in Figure 4 did not support the collective grouping of Ships or other deployments into particular stratum of vaccination exposure level in order to reduce misclassification that might have occurred in the self-reported data. However, the distribution of recorded vaccinations in Figure 5 suggests HMAS *Darwin* 1 and 2, HMA Ships *Brisbane* and *Sydney*, Clearance Divers and Operation Habitat could be collectively grouped as having "high" vaccination exposure, HMAS *Westralia* and USNS Comfort and Other deployments could be collectively grouped as having "moderate" vaccination exposure and HMA Ships *Adelaide and Success* could be collectively grouped as having "low" vaccination exposure during the Gulf War. Figure 6 shows this deployment based metric for vaccination exposure derived from the <u>recorded</u> vaccinations. This new vaccinations and health outcomes at follow up, along with the metric based on individual <u>self-reported</u> vaccinations which was also used in the baseline study.



Figure 6 Deployment-based metric for vaccinations

In the baseline study questionnaire, Gulf War veterans were also asked to report whether they took pyridostigmine bromide (PB; also termed anti-nerve agent pills or NAPS) during the Gulf War deployment. Figure 7 shows that the highest proportions of personnel who reported taking PB were Clearance Divers or those on HMAS *Brisbane*. A high but slightly lesser proportion, varying from 67% to 84%, of personnel on HMA Ships *Success, Westralia* and *Sydney*, also reported taking PB. For other groups, proportions of personnel taking PB were around 20% or less. Groups with the highest levels of personnel reporting that they did not know whether they took PB or not; suggesting that those who did not know whether they took PB may be most likely not to have taken it.





The distribution depicted in Figure 7 supported two deployment-based groupings based on self-reported likelihood of PB exposure, termed (i) "low uptake" consisting of HMA Ships *Adelaide*, *Darwin 1* and *2*, USNS *Comfort* and Operation Habitat; and (ii) "high uptake" consisting of HMA Ships *Success*, *Brisbane*, *Sydney*, and *Westralia* and Clearance Divers, as shown in Figure 8. This new deployment-based PB metric will be used to assess the association between Gulf War-related PB and health outcomes at follow up, along with the metric based on individual self-reported uptake of PB which was also used in the baseline study.



Figure 8 Deployment-based metric for PB tablets

Figure 9 shows the distribution of self-reported taking of anti-malarial tablets during the Gulf War across deployment groups. The greatest proportions of personnel who reported taking anti-malarial tablets were in Operation Habitat, HMAS *Darwin 1* and 2, and HMAS *Adelaide*. However, the distribution in Figure 9 does not support a clear division of deployment groups in to different levels of anti-malarial exposure. For the investigation of the association between Gulf War anti-malarial use and health outcomes at follow up, exposure based on individual self-reported data will be used, as per the baseline study.



Figure 9 Distribution of self-reported taking of anti-malarial tablets by Ship and small deployments

4.7.3 Documents from the Australian Department of Defence records

We obtained and examined the following documents from the Department of Defence, which were prepared at the time of the conflict and were thought to contain information about exposures which could be used to augment the information derived from the self-reported data.

The Reports of Proceedings (RoPs) and Ships' Logs (SLs) were obtained from Department of Defence or National Archives for the following Ships and periods: HMAS *Darwin* August to December 1990 (Darwin 1) April to Sept. 1991 (Darwin 2) HMAS *Adelaide* August to December 1990 HMAS *Success* August 1990 to February 1991 HMAS *Brisbane* November 1990 to April 1991 HMAS *Sydney* November 1990 to April 1991 HMAS *Westralia* January to June 1991 The Ships' Medical Journal/s (SMJs) were requested for the above periods and were provided for HMA Ships Darwin, Adelaide, Success and Brisbane.

Extensive searches, both electronic and physical, were conducted by the Director, Navy Ministerials and Coordination for the Ships' Medical Journals for HMA Ships *Sydney* and *Westralia,* but they could not be located. The following summary was provided of the searches that were conducted:

The agencies/branches that were engaged included:

- Fleet Health Support Unit (FSHU)
- Directorate of Navy Health (DNH)
- Joint Health Command (JHC)
- Queanbeyan archives
- Lidcombe archives (this is the repository for the journals we have recovered)
- Dandenong archives
- Sea Power Centre Australia (SPC-A)
- Navy Heritage Collection (NHC)

An extensive range of searches was also conducted through Defence's electronic records system - Defence Records Management System (DRMS). While DRMS has only been rolled out across Defence in about the last 10 years, a lot of older data, particularly file numbers, has been loaded onto the system. Broadly, DRMS uses a hierarchy of Work Groups/Files/Folders/Documents to save and search data. However, DRMS does have a number of constraints such as, if one searches for a 'file' the system will not identify 'folders', 'documents', etc., so one has to run searches at various levels within the hierarchy. It the search parameters are too large, the system 'times out' without results and the search needs to be started again. Following is a précis of some of these searches:

- Corporate Files beginning with 'WES' (*Westralia* Ship files) = 540 files. Relevant files recalled from archives and physically searched all these including; OP DAMASK, Gulf deployment, Operations Deployments.
- Corporate Files beginning with 'SYD' (*Sydney* Ship files) = 851 files. Relevant files recalled from archives and physically searched all these including; Medical Journal, Medical General, OP DAMASK, Training NBCD.
- Corporate Files beginning with 'AF86/7' (AF=FHQ files, 86=Medical) = 295 files. Relevant files recalled from archives and physically searched.
- Other Corporate File searches including inter alia for 'Sydney', 'Westralia, 'DAMASK', 'AF+Medical', 'Journal'.
- Corporate Files beginning with 'SUC' (*Success* Ship files) = 1340 files.
- At document level searches included inter alia FSHU, DNH, FHQ, NHC for key words such as 'Journal', 'Sydney', 'Westralia', 'NAPS'.

Finally, a number of searches were conducted of the National Archives of Australia (NAA) through their online search function, again without success.

Reports of Proceedings (RoPs) are monthly summaries of the major activities on board the relevant Ship. They are approved by the Commanding Officer and sent to the, then, Maritime Commander Australia (now Fleet Commander). They consist of a summary of significant events including where the Ship went, training drills and exercises undertaken, guests onboard and interactions with other vessels. Many of the specific activities and exercises are also summarised in annexes (e.g. distances travelled and days deployed) and in some reports photographs are included.

The Ships' Logs (SLs) are hand written by the officer who has control of the Ship at the time. The officer has control of the Ship for approximately four hours at a time and signs the log before handing over to the next officer, thereby validating the entries made. There can be over 100 entries on any one day made by a number of officers. Each entry has a time attached. The information recorded includes the position of the Ship, navigational fixes, activities carried out (e.g. refuelling), interactions with other vessels, weather observations and records of drills and exercises. Both simulated training and real events (e.g. fire alarms) are recorded. It is not always clear from the entry whether the activity was a drill/exercise or a genuine alarm and call to action stations. The SLs do not report medical matters unless it is related to an accident and/or the person needed to be transferred to another Ship or ashore.

The Ships' Medical Journals (also referred to as Medical Officer Journals) covered 6-monthly periods from 1 January to 30 June or 1 July to 31 December of the year, and listed the Medical Officers that were posted to the Ship during that period and were signed by the Commanding Officer.

The Ships' Medical Journals all had a similar format:

- A narrative by Ships' medical officer/s
- Medical aspects of an Operation the Ship was deployed on
- Special health precautions and investigations
 - Water supply and sanitation- fresh water taken on, testing, treatment if required
 - Food and water borne diseases, source
 - Prophylactic measures
 - Vaccinations
 - Malaria prophylaxis
- Matters of occupational health
 - e.g. noise, ventilation, climate
- Preventive medicine aspects

- e.g. eyesight protection, respiratory protection, protective clothing, Sexually transmissible diseases (STDs), weight management, exercise, safety
- Food handling , cooking, quality of food
- Other sections ACC Refresher training, Medical equipment, Medical training
- Sickbay management
- Annex A 6-mothly statistics (compiled from monthly conspectus', not shown in journal) included average Ship's complement, numbers of sick list, medicals, specialist consultations, STDs, medical tests; inspections/tests of medical equipment, number and type of vaccination given or a summary total of the number of vaccinations given, PM 54 rendered, accounting for drugs of addiction.
- Annex B Ships Movements
- Annex C Cases of Clinical Interest

4.7.4 Methodology for information extraction from Ships Logs, Reports of Proceedings and Ships' Medical Journals

All the RoPs and the Ships Logs for HMA *Westralia* and *Brisbane* were read and a summary of possible items of interest was presented to the Gulf War Study Advisory Committee meeting on 22 May 2013. At the meeting, it was agreed that entries relating to the following exposures of interest should be identified by systematically reading all the RoPs, SLs and Ships Medical Journals (SMJs):

- Chemical alarms sounded but not identified as an exercise in the document,
- Dust storm,
- SMOIL/smog/SMOID,
- Oil slick and smell,
- Gastroenteritis,
- PB/NAPS, and
- Vaccinations.

The RoPs, SLs and SMJs were then systematically read and all items of interest were noted in a spreadsheet and these are summarised below in Table 7 through to Table 12, and in Figure 10, Figure 11 and Figure 12. Items which were not understood, or where there was uncertainty about whether it was related, were identified, listed and sent to a contact in the Department of Defence who clarified the entry. Based on the information provided, Monash researchers decided whether the entry was related to one of the exposures of interest.
4.7.5 Information extracted from Ships Logs, Reports of Proceedings and Ships' Medical Journals

Chemical alarms

The number of times chemical alarms sounded on the Ships was noted from the SLs (see Table 7). All entries not identified as an exercise in the SLs that mentioned chemical alarms, NBCD (Nuclear, Biological, Chemical Defence) or NBC (Nuclear, Biological, Chemical) were recorded; NBCDX, NBCDEX or entries including the words "exercise" or "drill" were excluded (as they were identified as exercises). NBCD exercises were also reported in the Ships' Medical Journals for HMA Ships *Adelaide, Success* and *Brisbane* in the second sixmonth period of 1990 and *Darwin (2nd* deployment) in 1991 (Table 9).

The dates and number of NBCD exercises held on each Ship were recorded from the RoPs (see Table 8). There were many NBC exercises recorded in the RoPs, for example over 500 for HMAS *Adelaide*. Whether an alarm was activated for each exercise is unknown. Some entries were not specifically identified as exercises in the logs, so these entries were checked against the RoPs to confirm whether an exercise was held on the corresponding day. Two separate sub-categories were created for chemical alarms in Table 7:

- chemical alarms from the SLs which were not identified as exercises in the logs
- chemical alarms which were not identified as exercises in the logs and did not have a corresponding NBCD exercise noted in the RoPs for that day.

Chemical alarms not identified as exercises in the SLs were most frequent for HMAS *Sydney* (5), then *Darwin 2* (4), *Brisbane* (1) and *Success* (1). It was agreed at the Advisory Committee meeting in May 2013 that we would compare the number of unexplained chemical alarms during the first 2 weeks of March 1991 when Khamisiyah was destroyed with the number which occurred during the rest of the period of deployment, to identify whether the alarms went off more frequently during this period. There were no unexplained chemical alarms during this period.

Toxic gas alarms (not recorded as an exercise) were included as chemical alarms where the location was not specified, e.g. "below toxic gas detected in CHT (Collection, Holding and Transfer) CMPT (tank compartment)" was not included (HMAS *Darwin 2* Log, May 1991). Non-chemical alarms for example "high temperature alarms' and "gyro alarms" were also excluded.

Mentions of chemical alarms being cancelled were counted as a separate entry as it was unknown whether the entry was related to a previous item (e.g. "chemical safety rule in force", HMAS *Sydney* Log, November 1990).

Table 9 shows that undertaking of NBCD exercises were reported in Ships' Medical Journals of HMA Ships *Adelaide, Success* and *Brisbane* in the second six-month period of 1990 and during the *Darwin 2* deployment in 1991

From the above, it is not possible to identify alarms which accurately identified probable nuclear, chemical, biological warfare exposure and therefore the presence of chemical alarms is not considered an appropriate proxy for probable nuclear, chemical, biological warfare exposure for the purposes of this follow up study. Therefore a metric for chemical alarm exposure has not been further developed for use in the follow up study investigation of the association between health outcomes and Gulf War exposures.

Dust storms

Entries that mentioned dust, sand, "shamal" winds and red dust in the atmosphere were included in the dust storm category. Weather codes denoting a sand storm or dust storm (coded as "kz") were also counted. General mentions of dust on the Ship's equipment were not included in the final counts however such entries are indicative of the high levels of dust on the Ship. Examples of such references are "grit and dust remained to be cleaned from the Ship's winches" (HMAS *Success* RoP, February 1991) and "the amount of dust and grit associated with blasting meant that much of the Ship's equipment had to be masked" (HMAS *Success* RoP, February 1991).

Restricted visibility entries were only recorded if the incident was specifically attributed to one of the items of interest for example "visibility due to dust haze is poor" (HMAS *Darwin 2* RoP, June 1991). Any entries where the reason for restricted visibility was not recorded were not counted, for example "entered restricted visibility" (HMAS *Darwin 2* Log, April 1991) and "sunset obscured by haze" (HMAS *Darwin 2* Log, June 1991). Incidents related to weather ("Tropical Cyclones/ monsoons") were not recorded unless a dust storm (or similar event) was noted. For example "poor weather conditions comprising low visibility, high winds, driving rain and hail", (HMAS *Sydney* RoP, March 1991) was excluded.

Table 7 and Table 8 show that the Ships which were deployed after November 1990, particularly *Brisbane*, *Sydney* and *Westralia*, were more likely to report dust or sand storms in Logs and/or RoPs. HMA Ships *Adelaide* and *Success* did not report such events in either their Logs or their RoPs. These records of dust exposure are generally consistent with the

self-reported data shown in Figure 1 and Figure 2, and with the deployment-based metrics based thereon.

SMOIL/smog/SMOID

The oil fire pollution following the deliberate burning of oil wells was referred to as SMOID (smoke, oil, dust) or SMOIL (smoke and oil cloud)/smog category. All entries mentioning SMOID or SMOIL were recorded. Mentions of smoke and fog not relating to oil well fires were excluded e.g. "white smoke visual" (HMAS *Darwin 2* Log, May 1991).

The Ships Log for HMAS *Darwin* (2nd deployment) included eight references to SMOIL/SMOID (Table 7) although the RoP makes only one reference (Table 8). The RoPs for HMA Ships *Sydney* and *Westralia* each included two reports in the SMOIL/smog/SMOID category (Table 8).

Table 9 shows that SMOID and oil in water was recorded by the Medical officer of HMAS *Brisbane* during a visit to Kuwait, who noted the health concerns for the Clearance Diving Team (CDT). SMOID was also noted in 1991 Ships' Medical Journals during HMAS *Darwin*'s second deployment.

Oil Spills

Mentions of oil spills were included in the oil slick/smell exposures. Entries such as "small patches of globular oil appeared in the central gulf" (HMAS *Brisbane* RoP, January 1991) and "large oil slicks pervaded the area", (HMAS *Sydney* RoP, February 1991) were also included in this category.

The RoPs for HMAS Brisbane and the Ship's logs for HMA Ships *Darwin 1* and *Success* each had a single report of an oil slick/smell. HMAS *Sydney* had two mentions of oil slick/smell in the RoPs.

For HMAS *Brisbane*, events relating to water purification incidences were of particular interest. However, neither the SL nor the RoPs mentioned any events relating to water purification. The engineering section of the RoPs also did not mention anything relating to this.

The presence of oil spills or smell do not necessarily equate with Gulf War veterans being exposed to oil in their drinking or showering water. Conversely, the absence of water purification reports does not equate to the absence of oil in the water being drunk or used for showering. It was decided, therefore, that these sources of recorded oil exposure did not

provide useful information additional to the self-reported data. Therefore, the follow up study investigation of the association between health outcomes and oil in water have utilised exposure metrics that are based on self-reported data.

Medical Items

In relation to medical categories (gastroenteritis, PB/NAPS, and vaccinations), all preventive measures and medical episodes were recorded. Medical entries that were non-specific, for example "sailors were landed for medical reasons" (HMAS *Adelaide* RoP, September 1990) were excluded.

Gastroenteritis

Table 8 shows that the HMAS *Sydney* RoPs mentioned food poisoning; "During early stage of the passage a bout of staphylococcal viral food poisoning affected 37 members of the Ships company. The source was never isolated however HMAS *Brisbane* experienced similar problems" (HMAS *Sydney* RoP, April 1991). HMAS Brisbane RoPs also noted a "viral stomach ailment" (HMAS *Brisbane* RoP, April 1991). During April 1991 HMAS *Westralia* RoP also reported "a 24 hour viral gastroenteritis" (HMAS *Westralia* RoPs, April 1991). Table 10 indicates that mild outbreaks of gastroenteritis occurred on both deployments of HMAS *Darwin*. The SLs did not include any records of food poisoning or gastroenteritis.

Based on the above data, a new deployment-based metric for possible gastroenteritis exposure was created (see Table 13) which included HMA Ships *Darwin* (1st and 2nd deployments), *Brisbane, Sydney* and *Westralia*. Clearance Divers were added to this metric because of their increased risk of exposure to polluted water, as referred to in Table 9.

Pyridostigmine bromide

The RoPs recorded use of PB on board HMA Ships *Brisbane* and *Sydney* (Table 8). Reference was made to the use of anti-chemical warfare agents and chemical autojects in the Ships' Medical Journals for HMA Ships *Success* and *Darwin* 2nd deployment as summarised in Table 12, but the distribution and taking of PB tablets was not specifically recorded in any of the Ships' Medical Journals. These data sources provide limited support to the self-reported data for PB use shown in Figure 7, where personnel on HMA Ships *Brisbane* and Sydney were more likely than personnel on other Ships to report taking PB.

Vaccinations

Table 11 shows the vaccinations recorded in the Ships' Medical Journals and the average Ships complement. The only report of administration of plague vaccine was recorded during the second deployment of HMAS *Darwin*. Vaccination against anthrax was not recorded in any Ships' Medical Journals. Data on the total number and type of vaccinations from Table 11 is represented in Figure 13. Figure 13 shows that the highest total number of vaccinations was administered during the deployment of HMAS *Brisbane*, although this Ship also had the largest Ships complement.

As an indicator of the number of vaccinations given per person in the Ships complement, the following was calculated: HMAS *Darwin* 1st deployment = 5.4 vaccinations per person, HMAS *Success* = 7.1 during the period 1/7-31/12/90 and 1.1 during the period 1/1-30/6/91, HMAS *Brisbane* = 9.6, HMAS *Darwin* = 4.5 in the period 1/1/91-31/12/91. The total number of vaccinations was not recorded for HMAS *Adelaide* and therefore the estimated number given per person could not be calculated or estimated in this way. From the information recorded in HMAS *Adelaide* Ships' Medical Journal it might be interpreted that up to or around 5 vaccinations per person may have been administered. This approach has limitations, as it was not possible to identify from the Ships' Medical Journals which individuals or groups of individuals received which vaccinations or how many they received. Some individuals may have received more than others depending on their pre-existing vaccination status and immunisation requirements.

The RoP for HMAS *Westralia* was the only RoP to mention vaccinations with this entry; "their health is very good and a seemingly endless vaccination and inoculation schedule will hopefully protect them from most conceivable maladies" (HMAS *Westralia* RoP, February 1991).

The numbers of vaccinations per person per Ship, calculated above, show a somewhet different pattern to the numbers of vaccinations self-reported or recorded for study participants (as shown in Figure 4 and Figure 5). The limitations described above, in regard to the estimation of numbers of vaccines per person, and the absence of SMJs for HMA Ships *Sydney* and *Westralia*, further limits the usefulness of the SMJs to supplement the self-reported and recorded vaccination data which were collected at the time of the baseline study. For these reasons, it is not proposed that the researchers apply an additional new vaccination metric other than that shown in Figure 6.

Other medical or exposure information

Malaria prophylaxis was recorded in the Ships Logs for *Darwin* (1st and 2nd deployment), *Adelaide* and *Success*, but not for *Brisbane*. This is consistent to some extent with the selfreported use of anti-malarials being higher for *Darwin* I and II, *Adelaide* and *Success* than for *Brisbane* (as shown in Figure 9). This recorded information, however, is insufficient to justify any alternative stratification of anti-malarial exposure in participants other than that provided by the self-reported data.

Figure 11 shows that HMAS *Darwin* first deployment had a relatively larger proportion of dental assessments and HMAS *Brisbane* had a relatively large proportion of ophthalmological specialist attendances. This could have reflected, particularly in the case of dental attendances, the availability of these specialists. Otherwise, the distribution of specialist attendances was of a similar pattern across the Ships. Of particular relevance is that there was no recording of greatly increased neurological, respiratory or dermatological specialist attendances, that may reflect increased adverse health effects in these body systems requiring specialist medical attention during deployment, and which could relate to chemical, environmental or medical exposures such as PB, SMOIL, dust or oil in water.

	HMAS Darwin Aug - Dec 1990	HMAS Adelaide Aug - Dec 1990	HMAS Success Aug 1990 - Feb 1991	HMAS Brisbane Nov 1990 - Apr 1991	HMAS Sydney Nov 1990 - Apr 1991	HMAS Westralia Jan - June 1991	HMAS Darwin Apr - Sept 1991
Chemical alarms (not noted in logs as exercise)	4	22	6	11	13	2	7
Chemical alarms (not noted exercise in logs or RoP information)	0	0	1	1	5	0	4
Dust storm	0	0	0	3	4	2	0
SMOIL/SMOID	0	0	0	0	0	0	8
Oil slick and smell	1	0	1	0	0	0	0
Food Poisoning	0	0	0	0	0	0	0
Pyridostigmine bromide	0	0	0	0	0	0	0
Vaccinations	0	0	0	0	0	0	0

Table 7 Number of times exposures of interest noted in Ships' Logs

Table 8 Number of times exposures of interest noted in Reports of Proceedings

	HMAS Darwin Aug - Dec 1990	HMAS Adelaide Aug - Dec 1990	HMAS Success Aug 1990 - Feb 1991	HMAS Brisbane Nov 1990 - Apr 1991	HMAS Sydney Nov 1990 - Apr 1991	HMAS Westralia Jan - June 1991	HMAS Darwin Apr - Sept 1991
NBCD Exercises*	192	533	281	238	62	158	134
Dust storm	1	0	0	1	2	2	1
SMOIL/SMOID	0	0	0	0	2	2	1
Oil slick and smell	0	0	0	1	2	0	0
Pyridostigmine bromide	0	0	0	1	1	0	0
Vaccinations	0	0	0	0	0	1	0
Other	0	0	0	1 (viral stomach ailment)	1 (influenza) 1 (viral food poisoning)	1 (viral gastroenteri tis)	0

* One exercise was often held over multiple days and more than one exercise was often completed per day.

Ship and	HMAS Darwin	HMAS Adelaide	HMAS	Success	HMAS Brisbane		HMAS Darw	/in
deployment dates	Aug-Dec 1990	Aug-Dec 1990	Aug 199	90-Feb 1991	No	v 1990-Apr 1991	Apr-Sept 1991	
Six-month journal period	1/7-31/12/90	1/7-31/12/90	1/7- 31/12/90	1/1-30/6/91	1/7– 31/12/90	1/1-30/6/91	1/1/-30/6/91	1/7-31/12/91
NBCD exercises	-	Yes	Yes*	-	Yes	-	51 major, ~ 100 minor	2 major
Dust storm	-	-	-	-	-	-	-	-
SMOID (smoke, oil,	-	-	-	-	-	Medical officer (MO)	Yes. Variable day to day.	Yes. 30/7–
dust)						visited Kuwait 21-	Activity restricted. PM	4/9/91 light in
						23/3/91. Air thick with	170 completed for	density
						smoke, oil drops, ash -	member medical docs -	
						health concerns for CDT,	nature of cloud, no. days	
						particularly long term	exposed	
						respiratory health.		
Water pollution	-	-	-	-	-	Kuwait harbour, where	-	-
						CDT diving, had thick oil		
						slicks observed by MO –		
						CDT rashes and		
						dermatitis, improved with		
						better washing facilities		
Pest control routine								
Full contract spray	-	-	-	-	-	Yes	-	-
Routine/monthly	-	Yes	Yes	-	-	Yes	Yes	Yes
spray								
Specified control spray or baits	Cockroach baits	-	Traps, baits	-	Cockroach control	-	-	-

Table 9 Summary of environmental exposures reported in the Ships' Medical Journals

Defence

	HMAS Darwin	HMAS Adelaide	HMAS Success		HMAS Brisbane		HMAS Darwin	
Deployment dates	Aug - Dec 1990	Aug - Dec 1990	Aug 1990 ·	- Feb 1991	Nov 1990 -	Apr 1991	Apr -	· Sept 1991
Six-month journal period	1/7-31/12/90	1/7-31/12/90	1/7-31/12/90	1/1-30/6/91	1/7-31/12/90	1/1-30/6/91	1/1-30/6/91	1/7-31/12/91
Evidence of gastroenteritis	Minor	0	0	0	0	1	Minor	Frequent minor
Respiratory outbreaks	-	-	-	-	-	-	-	Freq mild URTIs
Average complement*	225	220	230	230	350	350	227	230
Sick list								
Outpatient attendances	763	647	870	415	814	838	549	576
Total sick list / hospital	15	21	14	24	3	9	16	13
Work related injuries	84	49	46	13	48	85	-	N/A
Specialist attendances								
Total specialists	69	42	61	43	60	28	62	35
Surgical	1	-	10	4	0	8	10	0
Medical	0	-	4	5	0	-	8	-
Orthopaedic	1	5	6	13	-	5	13	3
Ophthalmic	18	26	20	6	53	10	21	20
ENT	1	6	2	3	-	1	4	1
Neurologist	0	-	6	3	1	0	3	0
Genito Urinary	1	-	6	4	2	0	1	1
Dermatologist	1	1	4	5	2	2	2	3
Dental	43	-	0	0	0	2	0	2
Psychiatric	3	-	1	0	1	0	0	0
Other	-	4	2	0	1	-	0	5
Tests								
CXR	19	13	32	11	-	0	8	3
Vitalograph	-	-	-	-	32	-	-	-
Lab tests: hep B / HIV	230	202	-	-	All crew	-	-	-

Table 10 Summary of health outcome and health service use reported in the Ships' Medical Journals

*Average complement=average no. personnel on board. URTI=Upper respiratory tract illness. N/A (as stated, not defined in journal) "-" signifies no mention [‡]Total sick list/hospital includes Admissions to sick list onboard, hospital, Sick on Shore, Non Naval Hospital



Figure 10 Ship- and deployment- based summary of Ships' sick list data

* Average Ship's complement (number personnel on board) for reporting period. [†] Ship had two medical journals. HMA Ships Success and Brisbane for the periods 1/7-31/12/90 and 1/1-30/6/91; HMAS Darwin for the periods 1/1/91-30/6/91 and 1/7-31/12/91. Note: Work related injuries were based on recorded number of PM 278 (completed on first presentation of any injury or occupational illness, or when a member is injured, while not on duty, where this results in a loss of duty man-hours). Darwin 2 Medical Journals did not report actual numbers of work related injuries.
[‡] Total sick list/hospital includes admissions to sick list on board, hospital, Sick on Shore, Non Naval Hospital



Figure 11 Ship- and deployment- based summary of specialist attendances

* Average Ships' complement (number personnel on board) for the reporting period. † Ship has two medical journals. Ship has two medical journals. HMA Ships Sydney and Brisbane for the period 1/07-31/12/1990 and 1/01-30/06/1991; HMAS Darwin for period 1/01/1991-30/06/1991 and 1/7-31/12/91.



Figure 12 Ship- and deployment- based summary of specified medical tests

* Average Ships' complement (number personnel on board) for the reporting period. [†] Ship has two medical journals. HMA Ships *Sydney* and *Brisbane* for the period 1/07-31/12/1990 and 1/01-30/06/1991; HMAS *Darwin* for period 1/01/1991-30/06/1991 and 1/7-31/12/91. [‡] These tests were recorded in HMAS *Brisbane* Medical Journal for period 1/07-31/12/1990. [‡] Defence Question Time Brief. Sent to DVA by Department of Defence in 2008.

Deployment dates	HMAS <i>Darwin</i> Aug - Dec 1990	HMAS <i>Adelaide</i> Aug - Dec 1990	HMAS Su Aug 1990 199	uccess) - Feb 1	HMAS <i>Brisbane</i> Nov 1990 - Apr 1991		HMAS <i>Brisbane</i> Nov 1990 - Apr 1991		e HMAS <i>Darwin</i> 991 Apr - Sept 1991	
Six-month journal period	1/7- 31/12/90	1/7- 31/12/90	1/7- 31/12/90	1/1- 30/6/91	1/7– 31/12/90	1/1- 30/6/91	1/1- 30/6/91	1/7- 31/12/91		
Average complement [¶]	225	220	230	230	350	350	227	230		
Total vaccinations	1210	-	1630	-	-	3350	803	240		
Yellow fever	-	-	*	-	-	0	-	-		
Typhoid	230 (o) [‡]	Yes (o) [‡]	690	4	Yes	350	31	2		
Tetanus	31	-	-	-	-	-	15	-		
Cholera	274	Yes, 1 st and boosters	-	20		-	247	Yes, booster		
Hepatitis B	448	Yes, 1 st and 2 nd	-	-	Yes	-	283	-		
Sabin	227	Yes, oral boosters	-	-	-	-	-	-		
Plague	-	-	-	-	-	-	227	Yes, 2 nd dose [†]		
Other	-	-	940	240	-	3000	-	238		
Smallpox	-	-	-	0	-	-	-	-		

Table 11 Summary of reporting of vaccinations in the Ships' Medical Journals

- signifies no mention

* recorded as administered, no figure given

[†]IAW ABR1991

[‡](o) signifies typhoid vaccine was given in its oral form

[¶]Average complement = average number of personnel on board

	HMAS Darwin	HMAS Adelaide	HMAS Success		HMAS Brisbane		HMAS Dan	win
Deployment dates	Aug - Dec 1990	Aug - Dec 1990	Aug 1990 - Feb 1991		Nov 1990 - Apr 1991		Apr - Sept 1991	
Six-month journal period	1/7-31/12/90	1/7-31/12/90	1/7-31/12/90	1/1-	1/7—	1/1-30/6/91	1/1/91-30/6/91	1/7-31/12/91
				30/6/91	31/12/90			
Anti-chemical warfare	-	-	During period 14/8-				Reference to	-
agents			26/10/90 lectures re use				chemical autojects,	
			of anti-chemical warfare	of anti-chemical warfare			and removal of war	
			agents, medications	agents, medications			load supplement with	
			distributed				reduced biological	
							threat since cessation	
							of open hostilities	
Malaria prophylaxis								
Chloroquine	Yes	Yes	-	-	-	-	Yes	Yes
Doxycycline	Yes (in port)	Yes (in port)	-	-	-	-	-	-
Maloprim	-	-	-	-	-	-	Yes	Yes*
Not specified which	-	-	Yes	-	-	-	-	-

Table 12 Summary of reporting of preventive medication in the Ships' Medical Journals

* (IAW ABR1991)



Figure 13 Ship- and deployment- based summary of vaccinations recorded in Ships' Medical Journals

* Average Ships' complement (number personnel on board) for reporting period. [†] Ship has two Medical Journals. HMA Ships *Success* and *Brisbane* for the periods 1/7-31/12/90 and 1/1-30/6/91; HMAS *Darwin* for the periods 1/1/91-30/6/91 and 1/7-31/12/91. [‡] These vaccinations were recorded in HMAS *Brisbane* Medical Journal for period 1/07-31/12/1990.

4.7.6 Other sources of information

Defence Parliamentary Question Time brief on pyridostigmine bromide use

A Defence Parliamentary Question Time brief that was made available to the Study team stated that, based on assessed threat, PB was issued as prophylaxis against nerve gas poisoning. PB was approved by the Therapeutic Goods Administration to treat certain neurological disorders in the 10mg and 60 mg tablet formulations, but not in the 30mg tablet used by the ADF as a prophylactic measure against nerve gas.¹¹⁹ According to the report, personnel in HMAS *Brisbane* and *Sydney* commenced taking PB on or about 14 January 1991, and in HMAS *Westralia* on 5 February 1991. On 8-9 February 1991, further taking of PB was a matter of individual choice. According to the briefing, there was no evidence in the Ship's Medical Journal that PB was used on HMAS *Success*, but the crew reportedly received verbal directions, via the Ship's public address system, to commence PB. According to the briefing, PB was taken for a few days only.

This information brief broadly correlates with higher levels of PB use reported by participants on *Sydney*, *Brisbane*, *Westralia* and *Success*, relative to other Ships, as shown in Figure 7 and the deployment based stratification of PB exposure shown in Figure 8.

Post-Operation Report for Operation Habitat

The Post-Operation Report for Operation Habitat, a report to Land Commander Australia discussing the operation and the lessons learned, was read by members of the Study team with a particular emphasis on sourcing relevant exposure and health information. The Report did not contain significant information about the chemical or environmental exposures of SMOIL, dust storms, or chemical weapons use. The Report referred to a daily vector control program within the base camp and area of operations, waste disposal activities, provision of sanitised drinking water facilities to displaced persons in the area of operations including locating sites, field testing of samples and entomological identification. The Report also provided some information about the health of the contingent including use of antibiotics, vaccinations, and anti-malarial medication, i.e. daily doxycycline. Details of the aid provided by the personnel were recorded, including the medical complaints encountered and treated. Among displaced persons, the report noted that infectious diseases of typhoid, diarrhoeal diseases and respiratory tract infections were encountered at a higher rate than anticipated.

The reported use of anti-malarials is consistent with Operation Habitat personnel being highly likely to self-report taking anti-malarials, as shown in Figure 9. The reference to the Operation Habitat personnel providing medical aid to persons with diarrhoeal diseases supports this group's inclusion in the new metric for possible exposure to gastroenteritis, as shown in Table 13.

Oil spill and water contamination

Oil in water is an exposure that had received less attention in the health literature post-Gulf War than has the possible health effects from other exposures such as SMOIL. To source information on contamination of water that related to possible health effects in Gulf War veterans, particularly in naval personnel, a search of the Medline database was conducted and contact was made with US agencies. An occupational health physician at the Occupational & Environmental Medicine, Australian Department of Defence facilitated access to relevant document sources and contacts with US agencies including:

 Deputy Director for the US Defense Medical Research and Development Program, Office of the Assistant Secretary of Defense for Health Affairs, Force Health Protection and Readiness, Defense Health Headquarters Falls Church, VA

- AIPH, Health Risk Management, Portfolio Director COMM
- Medical Follow-up Agency, National Academy of Sciences, Institute of Medicine
- Defense Technical Information Center website [http://www.dtic.mil/dtic/] a repository of reports written for or by the US military
 - Methods of monitoring the Persian Gulf Oil Spill¹²⁰
- GulfLINK [http://www.gulflink.osd.mil/library/library_home.jsp] a publicly accessible library on the 1990-1991 Gulf War conflict
- National Oceanic and Atmospheric Administration (NOAA) Federal

The US Department of Defense investigated the possibility of contaminated drinking water during the 1990-91 Gulf War, and published a report on this issue.¹²¹ This report was circulated to the Advisory Committee. The US Close Out report¹²¹ investigated water policy, supply, storage, treatment, distribution, and use in the Kuwait theatre of operations. Its focus was around land-based sources and personnel. It concluded that there was an absence of water sampling and monitoring data available "to make responsible health-related conclusions about possible contaminants." The report also noted other factors that indicated it would not be possible to quantify any relationship with health effects; that it would be almost impossible to obtain this physical evidence given the passage of time (the report was submitted in 1992), in some cases physical evidence was never collected, and individual's contact with water varied considerably. The report also concluded that because the weight of evidence collected and evaluated to-date did not link water use in the Gulf to the unexplained symptoms reported by Gulf War veterans, the Presidential Special Oversight Board decided to conclude the investigation with this close-out report.¹²¹

These sources and reports provided useful information that reinforced the reported oil in water pollution that may have been experienced by personnel at different locations in the Gulf, but exposure was not quantified and could not be used to develop quantitative exposure metrics. We could not locate any specific epidemiological studies, and our contacts did not know of such studies, that addressed oil in water contamination as an exposure route for in-theatre military personnel and health effects.

4.7.7 Deployment-based metrics used for the analyses of associations between exposures and health outcomes at follow up

Throughout the chapter above, some new metrics for Gulf War exposures have been presented which are based on the patterns of Ship- and deployment-based differences in

self-reported exposure and, for some exposures, supporting documentation. These new exposure metrics, and the health outcomes to be investigated in relation to these, are shown below in Table 13. The analyses of associations between Gulf War-related exposures and health outcomes at follow up are reported in the relevant health section of this report.

Exposure Metric	Ship and deployment groups	Health Outcomes	
Intense smoke			
High (>90% reported exposure)	Darwin 2, Clearance Divers	General physical wellbeing (SF-12 PCS score), symptom count,	
Low (<90% report exposure)	Westralia, Sydney, Darwin 1, Brisbane, Comfort 1, 2,3 Success, Adelaide, Operation Habitat, Other deployments (NOS)	chronic bronchitis, asthma, Irritable Bowel Syndrome	
Dust			
High (>40% report exposure)	<i>Darwin 1</i> and 2, <i>Westralia</i> , <i>Sydney, Brisbane</i> , Clearance Divers, Operation Habitat, Other deployments (NOS)	General physical wellbeing (SF-12 PCS score), symptom count, chronic bronchitis, asthma	
Low (<40% report exposure)	Comfort 1, 2 and 3, Success, Adelaide.		
Oil in drinking or showering water			
Possible (>20% report exposure in either category)	Clearance Divers, Brisbane	General physical wellbeing (SF-12 PCS score), symptom count,	
Unlikely oil in drinking or showering water	All other groups	Irritable Bowel Syndrome	
Pesticide exposure reporting			
Higher (>30% in any of 4 exposure categories; treated clothing & tent, worked in sprayed area and pesticide application)	Operation Habitat	General physical wellbeing (SF-12 PCS score), symptom count, neuropathic symptom count, multisymptom illness, chronic	
Lower (<30% in all 4 exposure categories)	All other groups	fatigue	
Outbreaks of, or increased possibility of gastroenteritis during deployment			
Yes	<i>Darwin 1</i> and 2, <i>Brisbane,</i> <i>Sydney, Westralia</i> , Operation Habitat and Clearance Divers	Irritable Bowel Syndrome	
No	All other groups		
Likelihood of taking PB based on self-report			
High uptake	<i>Success, Brisbane, Sydney, Westralia</i> , Clearance Divers	General physical wellbeing (SF-12 PCS score), symptom count,	
Low uptake	<i>Adelaide, Darwin 1</i> and 2, <i>Comfort</i> , Operation Habitat	multisymptom illness, chronic fatigue, Chalder Fatigue Scale caseness, Irritable Bowel Syndrome	

Table 13 Health outcomes and environmental, chemical and medical exposure metrics base	d
on Ship and other deployment groups	

Recorded vaccinations

Exposure Metric	Ship and deployment groups	Health Outcomes
High vaccination	<i>Darwin 1</i> and 2, <i>Brisbane</i> and <i>Sydney,</i> Operation Habitat and	General physical wellbeing (SF-12 PCS score), symptom count,
Moderate vaccination	Clearance Divers Westralia, Comfort and Other deployments	neuropathic symptom count, multisymptom illness, chronic fatigue
Low vaccination	Adelaide and Success	langue

5 Results

5.1 Recruitment

Recruitment for the follow up study commenced in October 2011 and closed in August 2012. As described in Appendix 2, the cohort eligible for inclusion in the follow up study comprised the 1,456 Gulf War veterans and 1,588 comparison group members (N=3,044) who participated in the baseline health study.¹⁶

Of the 1,456 Gulf War veterans eligible for inclusion, 126 were removed from the recruitment denominator because they were identified as having deceased (n=25), to have previously refused further research (n=3) or because no valid mailing address could be found (n=98). Similarly, from the 1,588 comparison group members eligible for inclusion, 139 were removed from the recruitment denominator because they were identified as having deceased (n=15), to have previously refused further research (n=1) or because no valid mailing address could be found (n=123). Consequently, the recruitment denominators were 1,330 for the Gulf War veterans and 1,449 for the comparison group.

	Gulf War veterans	Comparison group	Study total
Recruitment outcome	(N=1,330)	(N=1,449)	(N=2,779)
	n (%)	n (%)	n (%)
Participant	715 (53.8)	675 (46.6)	1,390 (50.0)
Completed health questionnaire	712 (99.6)	674 (99.9)	1,386 (99.8)
Completed phone interview			1,282 (92.2)
Consented to Medicare/PBS and RPBS linkage			1,152 (82.9)
Consented to DVA health data linkage			1,075 (77.3)
Refuser	100 (7.5)	156 (10.8)	256 (9.2)
Non-responder	515 (38.7)	618 (42.6)	1,133 (40.8)

Table 14 Recruitment outcomes for the Gulf War veterans and comparison group at follow up

Table shows that 54% of the recruitable Gulf War veterans and 47% of the recruitable comparison group members participated in the study. Participation in the four study components was very complete, in that all but four participants (who consented to linkage only) completed the health questionnaire, 92% of all participants completed the over-the-phone psychological health interview, 83% consented to Medicare, PBS and RPBS linkage and 77% consented to DVA health data linkage.

Only 9% of the recruitable population advised the research team that they wished to decline participation (tabulated as "refusers") while a further 41% did not respond with a decision about participation during the study recruitment period.

5.1.1 Key findings

The recruitment rates achieved in the study were 54% for the Gulf War veterans and 47% for the comparison group. In total there were 1,390 participants at follow up, comprising 715 Gulf War veterans and 675 comparison group members. The health questionnaire was completed by 99% of all participants and the over-the-phone psychological health interview was completed by 92%. Eighty three percent and 77% of participants, respectively, consented to Medicare, PBS and RPBS linkage, and DVA health data linkage.

5.2 Comparison of participants with nonparticipants

Participation bias can occur if participants differ from non-participants on characteristics which are associated with the study dependent measures, such as health status. A complete examination of participation bias would require the collection of comprehensive and current health, demographics and deployment information for all non-participating Gulf War veterans and comparison group subjects. Whilst such data are not available for non-participants, we are able to conduct a number of comparisons of participants and non-participants using data which were collected at the time of the baseline study, to assess the extent to which participants are representative of the study groups from which they were drawn.

Table 15 shows the comparison of participants with non-participants in each study group, across a number of demographic, service and health-related variables using data from the baseline study. Participating Gulf War veterans were older and more likely to have been Officers in 1991 compared to veterans who did not participate. Participating Gulf War veterans had very slightly lower median SF-12 mental health scores (representing poorer mental health) than non-participating veterans, with this difference only just achieving statistical significance. There were no statistically significant differences observed between participating, and non-participating, Gulf War veterans in regard to their gender, service branch, whether or not they were still serving in the ADF at baseline, their SF-12 physical health score at the time of the baseline study, and whether or not they met CIDI criteria or not for PTSD, major depression or alcohol dependence in the 12 months prior to the baseline study. Participating comparison group members were older, more likely to have been in the Air Force and more likely to have been Officers in 1991, relative to comparison group members who did not participate. There were no statistically significant differences observed between participating, and non-participating, comparison group members across the remaining demographic and health variables included in the table.

The differences observed between participants and non-participants in the two groups may mean that the study slightly over-estimates or underestimates the true health of each group; i.e. the observed health results for each group may vary slightly from that which would have been observed if full participation has occurred. However, because a similar pattern of non-participation amongst the younger and lower ranked group members occurred in both study groups, it is unlikely that those two factors will notably affect the magnitude or direction of any differences in health observed between the Gulf War veteran and the comparison group.

The observed difference between participating and non-participating Gulf War veterans in median SF-12 mental health is so small that it is also unlikely to have an impact on the magnitude of differences in health observed between the participating groups. The increased participation rate by Air Force members in the comparison group may contribute to the study slightly overestimating the true health of the comparison group; and this highlights the need to statistically adjust for service type when comparing the health outcomes across the two groups.

	G	ulf War veteran	IS	Comparison group			
Measure	Participants (N=712)*	Non- participants (N=719) [†]		Participants (N=674)*	Non- participants (N=899) [†]		
	n (%)	n (%)	χ ² p-value	n (%)	n (%)	χ ² p-value	
Gender							
male	697 (50.0)	702 (50.2)	0 742	659 (43.0)	874 (57.0)	0.480	
female	15 (46.9)	17 (53.1)	0.742	15 (37.5)	25 (62.5)	0.409	
Age at follow up [‡]							
< 40	34 (37.0)	58 (63.0)		19 (32.8)	39 (67.2)		
40 - 44	171 (39.8)	259 (60.2)		118 (28.9)	290 (71.1)		
45 - 49	208 (53.6)	180 (46.4)	<0.001	185 (41.9)	257 (58.1)	<0.001	
50 - 54	172 (55.3)	139 (44.7)		189 (51.5)	178 (48.5)		
>= 55	127 (60.5)	83 (39.5)		163 (54.7)	135 (45.3)		
Service branch in 1	991						
Navy	606 (49.3)	624 (50.7)		457 (40.5)	671 (59.5)		
Army	51 (55.4)	41 (44.6)	0.515	75 (42.4)	102 (57.6)	0.001	
Air Force	55 (50.5)	54 (49.5)		142 (53.0)	126 (47.0)		
Rank in 1991							
Officer	157 (57.7)	115 (42.3)		205 (51.1)	196 (48.9)		
Other-ranks supervisory Other ranks-	358 (52.3)	327 (47.7)	<0.001	339 (45.8)	401 (54.2)	<0.001	
non supervisory	196 (41.5)	276 (58.5)		130 (30.1)	302 (69.9)		
Still serving in the A	ADF at baseline	9					
Yes	291 (48.0)	315 (52.0)	0.260	277 (44.0)	352 (56.0)	0 426	
No	421 (51.0)	404 (49.0)	0.200	397 (42.1)	547 (57.9)	0.430	
CIDI diagnosis in 12	2 months prece	eding baseline [§]					
PTSD							
absent	667 (50.7)	650 (49.4)	0 300	606 (44.1)	768 (55.9)	0 800	
present	31 (44.3)	39 (55.7)	0.300	10 (45.5)	12 (54.6)	0.033	
Major depression							
absent	644 (50.9)	621 (49.1)	0 161	585 (44.3)	735 (55.7)	0 6 4 7	
present	54 (44.3)	68 (55.7)	0.101	31 (40.8)	45 (59.2)	0.047	

Table 15 Comparison of participants with non-participants in the follow up study

	Gulf War veterans			Comparison group			
Measure	Participants (N=712)*	Non- participants (N=719) [†]		Participants (N=674)*	Non- participants (N=899) [†]		
	n (%)	n (%)	χ ² p-value	n (%)	n (%)	χ^2 p-value	
Alcohol dependend	e/abuse						
absent	674 (50.8)	653 (49.2)	0.400	605 (44.4)	758 (55.6)	0.000	
present	24 (40.0)	36 (60.0)	0.102	11 (33.3)	22 (66.7)	0.206	
SF-12 at baseline	Median (IQR)	Median (IQR)	Wilcoxon test p-value	Median (IQR)	Median (IQR)	Wilcoxon test p-value	
Physical Health Component	52.4 (45.3-55.9)	52.2 (44.4 - 55.6)	0.611	53.4 (46.9-55.9)	53.1 (46.0-55.9)	0.345	
Mental Health Component	51.4 (41.1 – 56.5)	50.6 (38.5 - 55.9)	0.059	55.0 (47.6-57.8)	53.7 (45.8-57.4)	0.012	

* Includes all those who completed the health questionnaire at follow up
† Excludes those who are known to be deceased
‡ Age was calculated as of 01 June 2011
§ Only calculated for those with baseline CIDI results

5.3 Participant characteristics

Men represented 98% of all participants in both study groups whereas women represented only 2%. Because of the small numbers of participating women and the fact that health patterns in men and women can be quite different, the results presented from here on in this, and subsequent, chapter/s are limited to the male participants.

5.3.1 Demographic and socioeconomic factors

Male participants ranged from 38 to 72 years of age. Gulf War veterans were slightly younger, with a mean age of 49.4 years (sd 6.6) whilst in the comparison group the mean age was 50.9 years (sd 6.2; p<0.001). Age category and other participant characteristics at follow up are shown in Table 16. Consistent with the mean age difference described above, there were proportionately more Gulf War veterans than comparison group members aged less than 45 years, and proportionately fewer Gulf War veterans than comparison group members aged 55 years or older. The two groups were similar in regard to marital status, education level, main source of income and total household income. More than 80% of all participants were married or in a defacto relationship, approximately 50% had a trade certificate or diploma as their highest level of education, and about 75% earned a wage or salary as their main source of income. More than 6% of Gulf War veterans and less than 3% of the comparison group reported that their main source of income was a pension or other type of income-support from the DVA.

5.3.2 Recent ADF Service

Gulf War veterans averaged 20 years of regular ADF service at the time of the follow up study, whilst the comparison group averaged 21.2 years (p<0.013). As shown in Table 17, Gulf War veteran participants were more likely than comparison group participants to have served with the Navy, and less likely to have served with the Army or Airforce. Gulf War veterans and comparison group participants were equally likely to have separated from the ADF with only 17% and 18% respectively still serving. Gulf War veterans and comparison group participants were deployed for at least one month on a major ADF Operation since the baseline study, and to have served in a combat role. Gulf War veteran participants were slightly less likely to have achieved a Junior Non Commissioned Officer (NCO) or lower rank, than comparison group participants.

	Gulf War veterans	Comparison group	
Participant characteristics	(N=697)	(N=659)	
Age at participation [†]	n (%)	n (%)	P value*
<45	176 (25.25)	112 (17.00)]
45-54	381 (54.66)	364 (55.24)	<0.001
>=55	140 (20.09)	183 (27.77)	J
Marital status at follow up			
Married/de facto	559 (80.32)	556 (85.02)	1
Divorced/separated	83 (11.93)	67 (10.24)	0.007
Widowed	6 (0.86)	7 (1.07)	- 0.037
Single/never married	48 (6.90)	24 (3.67)]
Highest educational			
qualification at follow up			
Secondary up to year 10	79 (11.38)	72 (10.96)]
Secondary year 11-12	67 (9.65)	60 (9.13)	
Certificate (trade/	110 (15 95)	97 (12 24)	
apprenticeship/technicians)	110 (15.65)	87 (13.24)	0.000
Diploma	259 (37.32)	237 (36.07)	0.306
Undergraduate degree	58 (8.36)	72 (10.96)	
Post-graduate degree	118 (16.86)	128 (19.48)	J
Main source of income			
Wage or salary	520 (74.93)	498 (76.57)	1
Income from investments	2 (0.29)	3 (0.46)	
Superannuation/annuity	32 (4.61)	44 (6.76)	
Own business/partnership	49 (7.06)	46 (7.07)	0.000
DVA pension/income	45 (0.40)	47 (0.04)	0.029
support	45 (6.46)	17 (2.01)	
Other gov't pension/	42 (6 20	40 (6 14)	
allowance/benefit	43 (0.20	40 (0.14)	
Other	3 (0.43)	3 (0.46)	J
Total household income			
<\$30,000	26 (3.82)	29 (4.47)]
\$30,000-\$49,000	47 (6.91)	39 (6.01)	
\$50,000-\$79,999	102 (15.00)	97 (14.95)	0.966
\$80,000-\$99,000	94 (13.82)	86 (13.25)	0.000
\$100,000-199,999	321 (47.21)	299 (46.07)	
>\$200,000	90 (13.24)	99 (15.25)	J

Table 16 Characteristics for male participants at follow up

* P values for chi² test of association between study group and participant characteristic
 † Age for each participant was calculated as of the date that the postal questionnaire was received by the researchers

ADF service	Gulf War	Comparison	<u> </u>
characteristics	veterans (N=697)	group (N=659)	
	n (%)	n (%)	P value [†]
Still serving member of			
regular ADF at follow up			
Yes	116 (16.7)	121 (18.4)	J
No	579 (83.3)	536 (81.6)	0.404
If No, discharged to reserves	256 (44.2)	225 (42.0)	
If No, discharged out of ADF	290 (50.1)	283 (53.8)	
Highest rank [*] (at follow up o	r upon separation)		
Senior CO	93 (13.3)	105 (16.0)]
СО	101 (14.5)	126 (19.2)	
Senior NCO	320 (45.9)	303 (46.0)	0.006
Junior NCO	119 (17.1)	85 (12.9)	
Other ranks	64 (9.2)	39 (5.9)	J
Service branch			
Navy	599 (85.9)	449 (68.1)]
Army	46 (6.6)	72 (10.9)	-<0.001
Air Force	52 (7.5)	138 (21.0)	
Actively deployed [‡]			
No	429 (61.6)	437 (66.3)	
Yes, ever	268 (38.5)	222 (33.7)	0.068
Yes, since baseline	139 (19.9)	129 (19.6)	0.865
Combat role since baseline	60 (8.6)	45 (6.8)	0.220

Table 17 ADF service characteristics for male participants at follow up

* CO; Commissioned officer. NCO; Non-commissioned officer. † P values for chi² test of association between study group and participant characteristic

[±] Other than the Gulf War deployment

Table 18 shows that Gulf War veteran and comparison group members were equally likely to have deployed for at least one month to a number of major ADF Operations since January 1991. Approximately 10% of all participants had deployed as part of Operation Slipper in Afghanistan, and to Operations in Iraq.

ADF Operations	Gulf War veterans (N=697)	Comparison group (N=659)
	n (%)	n (%)
OP Slipper (Afghanistan)	69 (9.90)	74 (11.23)
Iraq	75 (10.76)	60 (9.10)
OP Anode (Solomon Islands)	17 (2.44)	18 (2.73)
OP Bel Isi II (Bouganville)	11 (1.65)	8 (1.21)
East Timor [†]	34 (4.88)	27 (4.10)
OP Resolute (Border protection)	22 (3.16)	35 (5.31)
OP Sumatra Assist	11 (1.58)	5 (0.76)
Other	29 (4.16)	30 (4.55)

Table 18 ADF Operations participants have deployed on for at least one month since Jan 1991

* Includes any of Operations Bastille, Falconer, Catalyst or Kruger

† Includes any of Operations Tanager, Citadel, Spire, Astute, Chiron or Tower

5.3.3 Key findings

At the time of the follow up study, male participants ranged in age from 38 to 72 years of age, and averaged approximately 50 years. Gulf War veteran participants were proportionately younger than the comparison group, more likely to have served in the Navy and less likely to have served in the Army or Air Force. Gulf War veteran and comparison group participants were similar in regard to their marital status, education level, and their main source and level of income. Since the time of the Gulf War, the two groups have deployed in similar proportions to a number of ADF Operations including Operation Slipper in Afghanistan, and Operations in Iraq, the Solomon Islands, East Timor, Bouganville and Sumatra. However, at the time of follow up, only one in six participants were still serving in the ADF. There was no statistically significant difference between the two groups in relation to the pattern of highest achieved rank (at follow up or separation) however participating male Gulf War veterans were slightly less likely than the comparison group to have achieved senior CO or CO ranks.

5.4 General physical and mental health

The Short Form-12 Health Survey (SF12) was administered at both baseline and follow up to facilitate longitudinal comparisons of participants' self-perceived physical and mental health status.

5.4.1 Self-perceived physical and mental health status at follow up





The charts in Figure 14 show the distribution of the SF12 Physical Component Summary (PCS) and Mental Component Summary (MCS) scores at follow up for both the Gulf War veterans and the comparison group. Higher scores represent higher perceived health status. The distributions for both the PCS and MCS in both groups were left skewed, with larger numbers of participants reporting high scores than low scores. The distributions were less skewed in the Gulf War veteran group, with these participants more likely than the comparison group participants to report mid-range PCS and MCS scores.

SF12 subscale score	Gulf War veterans (N=670)	Comparison group (N=642)		
	mean (sd)	mean (sd)	mean diff	Adj mean diff (95% Cl)
Physical Component Summary	46.68 (10.30)	48.18 (9.76)	-1.50	-1.34 (-2.42, -0.26)
Mental Component Summary	46.12 (11.85)	49.92 (10.67)	-3.80	-3.32 (-4.57, -2.06)

Table 19 SF12 Physical and Mental Component Summary scores at follow up

Comparing the two groups on mean PCS and MCS scores at follow up, Table 19 shows that the Gulf War veterans reported significantly poorer physical health status and mental health status than the comparison group, with a greater difference found for the mental component score.

5.4.2 Association between Gulf War-deployment characteristics and self-perceived physical and mental health in veterans at follow up

The associations between Gulf War deployment characteristics and self-perceived physical health at follow up, as measured by the SF12 PCS, are shown in Table 20 for male Gulf War veterans. Significantly poorer self-perceived physical health status at follow up was associated with older age at deployment and with ranks lower than Officer. There were no significant differences in self-perceived physical health across Gulf War veterans from different service branches.

The associations between Gulf War deployment characteristics and self-perceived mental health at follow up, as measured by the SF12 MCS, are shown in Table 21 for male Gulf War veterans. None of the differences were statistically significant, however lower self-

perceived mental health status in 'other ranks, non-supervisory' and younger age at deployment approached statistical significance; p = 0.10 and p = 0.08 respectively.

Gulf War deployment characteristic	Mean SF12 PCS score for Gulf War veterans at follow up				
	Ν	mean (sd)	diff	Adj diff (95% CI)	
Age at deployment					
< 20	58	47.28 (9.80)	0.00	0.00	
20-24	165	48.13 (10.49)	0.85	-0.47 (-3.65, 2.71)	
25-34	351	46.54 (10.11)	-0.74	-3.70 (-7.19, -0.21)	
>=35	96	44.34 (10.66)	-2.94	-7.11 (-11.10, -3.12)	
Service branch					
Navy	577	46.73 (10.33)	0.00	0.00	
Army	44	44.85 (10.20)	-1.87	-2.01 (-5.20, 1.18)	
Air Force	49	47.75 (9.97)	1.02	0.43 (-2.34, 3.21)	
Rank category					
Officer	142	49.36 (9.53)	0.00	0.00	
Other rank-supervisory	341	45.83 (10.24)	-3.53	-4.55 (-6.46, -2.65)	
Other rank - non supervisory	186	46.20 (10.69)	-3.16	-6.78 (-9.47, -4.08)	

 Table 20 Association between Gulf War-deployment characteristics and SF12 Physical

 Component Summary sores at follow up in Gulf War veterans

Table 21 Association between Gulf War-deployment characteristics and SF12 Mental
Component Summary sores at follow up in Gulf War veterans

Gulf War deployment characteristic	Mean SF12 MCS score for Gulf War veterans at follow up				
	Ν	mean (sd)	diff	Adj diff (95% CI)	
Age at deployment					
< 20	58	41.23 (11.85)	0.00	0.00	
20-24	165	45.71 (12.67)	4.48	3.32 (-0.46, 7.10)	
25-34	351	46.63 (11.40)	5.40	3.05 (-1.05, 7.16)	
>=35	96	47.93 (11.41)	6.70	3.93 (-0.84, 8.69)	
Service branch					
Navy	577	45.97 (11.85)	0.00	0.00	
Army	44	48.46 (11.90)	2.49	1.78 (-1.98, 5.55)	
Air Force	49	45.84 (11.84)	0.14	-1.15 (-4.69, 2.38)	
Rank category					
Officer	142	47.49 (11.77)	0.00	0.00	
Other rank-supervisory	341	47.03 (11.38)	-0.45	-0.27 (-2.66, 2.12)	
Other rank - non supervisory	186	43.45 (12.42)	-4.04	-2.91 (-6.34, 0.51)	

5.4.3 Change in self-perceived physical and mental health status since baseline

In both study groups, participants' self-perception of their physical health, as represented by their PCS scores, and mental health, as represented by their MCS scores, decreased in the period from baseline to follow up. These differences within groups across time were statistically significant. Additional analysis showed that there was no difference between the two groups in regard to change over time on either subscale (PCS: diff -0.67, adj diff -0.67, 95% CI -1.69, 0.35; MCS: diff -0.36; adj diff -0.16, 95% CI (-1.45, 1.13).

Table 22 SF12 Physical and Mental Component Summary mean scores at baseline and follow up for participants who completed the SF12 at both time points

	Gulf War veterans (N=652				Comparison gr	oup (N=624)
	Baseline mean (sd)*	Follow up mean (sd)*	mean diff (95% CI)	Baseline mean (sd)*	Follow up mean (sd)*	mean diff (95% CI)
PCS	49.41 (9.07)	46.72 (10.29)	-2.68 (-3.38, -1.97)	50.34 (8.71)	48.32 (9.70)	-2.01 (-2.72, -1.29)
MCS	48.07 (10.86)	46.18 (11.85)	-1.80 (-2.69, -0.91)	51.56 (9.12)	50.03 (10.61)	-1.64 (-2.55, -0.73)

* Includes only those participants who also completed the SF12 at follow up

5.4.4 Key findings

In both study groups, participants completing the SF12 were more likely to report high selfperceived physical and mental health scores than low scores. However, Gulf War veteran participants were more likely than the comparison group participants to report mid-range physical health and mental health scores. Comparing the two groups on SF12 mean PCS and MCS scores, Gulf War veterans reported significantly poorer physical health status and significantly poorer mental health status than the comparison group, with the greater difference being for the mental component scale.

Amongst Gulf War veterans, poorer self-perceived physical health status at follow up, but not mental health status, was associated with older age at deployment and with ranks lower than Officer. There were no significant differences in self-perceived physical or mental health at follow up across Gulf War veterans from different service branches.

In both study groups, participants' self-perception of their physical health and mental health declined in the time period from baseline to follow up to a similar degree.

5.5 Symptoms

5.5.1 Self-reported symptoms

At both baseline and follow up, participants completed a 63-item past-month symptom checklist.

Symptom reporting at follow-up

The crosses (+) in Figure 15 represents the Gulf War veteran and comparison group prevalence for each of the 63 symptoms endorsed as being present in the month prior to follow up, in order of least prevalent to most prevalent for Gulf War veterans. For example the + at the lower left represents a symptom which was endorsed by 0.9% of the Gulf War veterans and 0.5% of the comparison group, whilst the + at the top right represents a symptom which was endorsed by 68.2% of the Gulf War veterans and 59.8% of the comparison group at follow up. The dashed diagonal line represents equal symptom prevalence for the Gulf War veteran and comparison group at follow up. Figure 15 clearly shows a pattern of greater symptom prevalence in the Gulf War veterans relative to the comparison group at follow up, with all but one of the crosses visibly above the dashed line.



Figure 15 Past month-symptom prevalence at follow up

Table 23 Prevalence of past-month symptoms at follow up

Symptom	Gulf War veterans N=698	Comparison group N=659	
	n (%)	n (%)	adj RR (95% CI)
Unrefreshed after sleep	493 (70.8)	377 (57.7)	1.20 (1.10 - 1.30)
Fatigue	473 (68.2)	392 (59.8)	1.12 (1.04 - 1.22)
Sleeping difficulties	457 (66.0)	377 (57.8)	1.13 (1.03 - 1.23)
Muscle aches or pains	440 (63.3)	375 (57.4)	1.07 (0.98 - 1.17)
Headaches	418 (60.2)	322 (49.2)	1.19 (1.08 - 1.31)
Low back pain	412 (59.4)	371 (56.7)	1.05 (0.96 - 1.15)
Irritability/outbursts of anger	393 (56.5)	271 (41.6)	1.31 (1.17 - 1.47)
Stiffness in several joints	381 (54.9)	315 (48.2)	1.12 (1.01 - 1.24)
Ringing ears	356 (51.1)	295 (45.0)	1.14 (1.02 - 1.27)
Flatulence or burping	354 (50.9)	252 (38.5)	1.28 (1.13 - 1.44)
Difficulty finding the right word	345 (49.6)	232 (35.5)	1.40 (1.23 - 1.59)
Forgetfulness	334 (48.3)	214 (32.8)	1.44 (1.26 - 1.65)
Pain in several joints without swelling or redness	321 (46.2)	236 (36.1)	1.27 (1.11 - 1.44)
Avoiding doing things or situations	312 (44.9)	194 (29.8)	1.48 (1.28 - 1.71)
Loss of concentration	307 (44.1)	195 (29.8)	1.44 (1.24 - 1.67)
Loss of interest in sex	298 (42.8)	211 (32.2)	1.34 (1.16 - 1.54)
Itchy or painful eyes	266 (38.2)	193 (29.5)	1.27 (1.09 - 1.48)
Feeling distant or cut-off from others	247 (35.5)	148 (22.7)	1.51 (1.27 - 1.80)
Rash or skin irritation	245 (35.3)	146 (22.3)	1.53 (1.28 - 1.83)
Shortness of breath	233 (33.5)	144 (22.0)	1.46 (1.22 - 1.75)
Problems with sexual functioning	226 (32.5)	157 (24.0)	1.39 (1.17 - 1.65)
Distressing dreams	208 (30.1)	117 (17.8)	1.63 (1.34 – 2.00)
Indigestion	206 (29.6)	136 (20.8)	1.38 (1.14 - 1.67)
Increased sensitivity to noise	194 (27.9)	126 (19.3)	1.41 (1.16 - 1.72)
Feeling jumpy/easily startled	191 (27.5)	122 (18.7)	1.44 (1.18 - 1.76)
Tingling or burning sensation in hands/feet	188 (27.1)	130 (19.8)	1.33 (1.10 - 1.62)
Rapid or pounding heart beat	186 (26.9)	114 (17.4)	1.47 (1.19 - 1.82)
Diarrhoea	183 (26.3)	106 (16.2)	1.54 (1.24 - 1.91)
Dry mouth	174 (25.1)	115 (17.6)	1.38 (1.11 - 1.70)
Night sweats	166 (23.9)	96 (14.7)	1.57 (1.25 - 1.96)
Chest pain	143 (20.6)	100 (15.3)	1.25 (0.99 - 1.58)
Persistent cough	142 (20.4)	112 (17.1)	1.19 (0.95 - 1.50)
Loss of sensation in hands/feet	133 (19.2)	94 (14.4)	1.29 (1.01 - 1.64)
Stomach cramps	133 (19.1)	71 (10.8)	1.67 (1.27 - 2.19)
Passing urine more often	131 (18.9)	107 (16.4)	1.16 (0.92 - 1.47)
Increased sensitivity to light	123 (17.7)	64 (9.8)	1.69 (1.28 - 2.23)

Symptom	Gulf War veterans N=698	Comparison group N=659	
	n (%)	n (%)	adj RR (95% CI)
Wheezing	121 (17.5)	71 (10.9)	1.47 (1.12 - 1.94)
Sore throat	120 (17.2)	87 (13.3)	1.25 (0.97 - 1.62)
Unintended weight gain > 4kg	119 (17.1)	72 (11.0)	1.46 (1.11 - 1.93)
Loss of balance or coordination	117 (16.8)	72 (11.0)	1.46 (1.11 - 1.92)
Toothache	109 (15.7)	83 (12.7)	1.20 (0.92 - 1.57)
Alcohol intolerance	107 (15.5)	59 (9.0)	1.58 (1.17 - 2.15)
Loss of or decrease in appetite	106 (15.3)	65 (9.9)	1.50 (1.12 –2.00)
Constipation	100 (14.4)	78 (11.9)	1.21 (0.91 - 1.59)
Dizziness or blackouts	97 (13.9)	59 (9.0)	1.46 (1.08 - 1.97)
Shaking	96 (13.9)	52 (7.9)	1.65 (1.20 - 2.26)
Skin infections	94 (13.5)	38 (5.8)	2.29 (1.57 - 3.32)
Mouth ulcers	82 (11.8)	54 (8.2)	1.45 (1.03 - 2.03)
Double vision	79 (11.4)	45 (6.9)	1.49 (1.05 - 2.11)
Feeling feverish	76 (11.0)	41 (6.3)	1.67 (1.15 - 2.42)
Increased sensitivity to smell	74 (10.6)	37 (5.7)	1.72 (1.18 - 2.51)
Nausea	71 (10.2)	43 (6.6)	1.44 (1.01 - 2.07)
Feeling disorientated	69 (9.9)	30 (4.6)	2.14 (1.42 - 3.21)
Tender/painful swelling of lymph glands	56 (8.1)	33 (5.0)	1.40 (0.93 - 2.12)
Loss of control over bladder or bowels	53 (7.6)	25 (3.8)	1.95 (1.24 - 3.08)
Lump in throat	52 (7.5)	30 (4.6)	1.51 (0.98 - 2.33)
Difficulty speaking	51 (7.3)	30 (4.6)	1.52 (1.00* - 2.34)
Skin ulcers	41 (5.9)	13 (2.0)	2.55 (1.37 - 4.73)
Burning sensation in sex organs	31 (4.5)	17 (2.6)	1.50 (0.86 - 2.63)
Vomiting	27 (3.9)	19 (2.9)	1.17 (0.64 - 2.12)
Pain on passing urine	22 (3.2)	19 (2.9)	1.06 (0.58 - 1.94)
Unintended weight loss >4kg	20 (2.9)	20 (3.1)	0.86 (0.46 - 1.59)
Seizures or convulsions	6 (0.9)	3 (0.5)	1.36 (0.33 - 5.64)

* Actual value is 0.9951

The percentage prevalence for each symptom at follow up, and for each study group, is shown in Table 23, along with the adjusted risk ratio (adj RR) representing the magnitude of the difference between the two groups. For 47 of the 63 symptoms, the prevalence difference between the two groups at follow up was statistically significantly higher in the Gulf War veteran group than the comparison group. The greatest increases in risk were for forgetfulness, avoiding doing things, loss of concentration, feeling distant or cut off, rash or skin irritation, distressing dreams, night sweats, stomach cramps, increased sensitivity to light, feeling disoriented and skin ulcers, where the lower values of the 95% CIs indicated an increased risk of at least 25%. The symptoms in Table 23 are ordered from most frequent to

least frequent for Gulf War veterans at follow up. The symptoms most prevalent in the Gulf War veterans were typically also those which were most prevalent in the comparison group. For example; the 21 symptoms most prevalent in the Gulf War group at follow up were the same, although in a slightly different order of frequency, as the 21 symptoms which were most prevalent in the comparison group.

Change in prevalence, also persistence and incidence of symptom reporting since baseline

All male participants at follow up had completed the 63-item past-month symptom checklist at both baseline and follow up. Table 24 shows that the mean number of past-month symptoms endorsed by Gulf War veterans, from the 63 possible items, increased significantly from 14.0 at baseline to 16.9 at follow up, and the mean number of past-month symptoms endorsed by the comparison group increased significantly from 10.9 at baseline to 12.4 at follow up. Additional analysis (not tabulated) showed that there was a marginally significant difference between the two groups in regard to change over time, with the average increase observed in the Gulf War veterans over time being very slightly larger than the average increase observed in the comparison group over time (Ratio of the ratios of means 1.07; 95% CI >1.00-1.14).

Table 24 Mean number of past-month symptoms endorsed at baseline and follow up						
	Gulf War veterans (N=698)			Con	nparison grou	o (N=659)
	Baseline mean (sd)	Follow up mean (sd)	Ratio of means (95% CI)	Baseline mean (sd)	Follow up mean (sd)	Ratio of means (95% CI)
Number of symptoms	14.0 (10.7)	16.9 (11.8)	1.21 (1.16–1.26)	10.9 (9.0)	12.4 (10.0)	1.13 (1.07–1.19)

Table 24 Mean number of	past-month symptoms en	dorsed at baseline and follow up

Figure 16 represents the baseline and follow up prevalence for each of the 63 symptoms for Gulf War veterans (in the chart to the left) and for the comparison group (in the chart to the right). In these charts the dashed diagonal line represents equal symptom prevalence at baseline and follow up. In the Gulf War veteran group it was evident that most symptoms were more prevalent at follow up than at baseline (with most crosses visibly above the line), whilst a very small number of symptoms were less prevalent (below the line) or equally prevalent (on or very close to the line) at baseline and follow up. In the comparison group there was also a pattern of most symptoms being more prevalent at follow up, however the proportion of symptoms above the line was lesser than that observed in the Gulf War veteran group. The comparison group had noticeably more symptoms which were less

prevalent at follow up (below the line) or similarly prevalent (on or very close to the line) than the Gulf War veterans.



Figure 16 Comparison of baseline and follow-up symptom prevalence

For each symptom, Table 25 shows the Risk Ratios representing the change in prevalence from baseline to follow up for the Gulf War veterans and for the comparison group separately, and also p values representing the statistical significance of the difference between groups in regard to change over time. In the Gulf War veteran group, 35 of 63 symptoms were statistically significantly more prevalent at follow up relative to baseline. For most other symptoms there was a pattern of increased prevalence from baseline to follow up in the Gulf War veteran group however those did not achieve statistical significance. In the comparison group 22 of 63 symptoms were statistically significantly more prevalent at follow up relative to baseline, and two symptoms were statistically significantly less prevalent. For 58 of the 63 symptoms, the difference between groups in regard to change over time was not significant, indicating that prevalence change over time was similar for the two groups for almost all symptoms.

Symptom	Gulf War veterans N=698	Comparison group N=659	Comparison of prevalence change in the two study groups
	Adj RR (95% CI)	Adj RR (95% CI)	p-value
Unrefreshed after sleep	1.10 (1.04 - 1.16)	1.06 (0.98 - 1.14)	0.474
Fatigue	1.05 (0.99 - 1.11)	1.12 (1.04 - 1.21)	0.179
Sleeping difficulties	1.17 (1.09 - 1.25)	1.20 (1.10 - 1.31)	0.655
Muscle aches or pains	1.21 (1.13 - 1.31)	1.36 (1.24 - 1.50)	0.057
Headaches	1.01 (0.94 - 1.09)	0.97 (0.89 - 1.05)	0.445
Low back pain	1.15 (1.07 - 1.23)	1.16 (1.07 - 1.25)	0.843
Irritability/outbursts of anger	1.00 (0.93 - 1.08)	0.94 (0.85 - 1.04)	0.321
Stiffness in several joints	1.39 (1.27 - 1.52)	1.43 (1.29 - 1.59)	0.664
Ringing ears	1.67 (1.51 - 1.85)	1.67 (1.49 - 1.88)	0.994
Flatulence or burping	1.14 (1.05 - 1.25)	0.93 (0.84 - 1.03)	0.003
Difficulty finding the right word	1.09 (1.00 - 1.18)	1.00 (0.90 - 1.12)	0.251
Forgetfulness	1.06 (0.97 - 1.16)	0.98 (0.87 - 1.11)	0.298
Pain in several joints without swelling or redness	1.30 (1.17 - 1.44)	1.22 (1.07 - 1.39)	0.478
Avoiding doing things or situations	1.38 (1.24 - 1.53)	1.46 (1.26 - 1.69)	0.565
Loss of concentration	1.07 (0.97 - 1.17)	1.13 (0.98 - 1.29)	0.530
Loss of interest in sex	1.90 (1.67 - 2.18)	2.06 (1.71 - 2.47)	0.505
Itchy or painful eyes	1.07 (0.96 - 1.20)	1.10 (0.95 - 1.27)	0.817
Feeling distant or cut-off from others	1.45 (1.27 - 1.65)	1.69 (1.38 - 2.07)	0.201
Rash or skin irritation	0.98 (0.87 - 1.10)	0.79 (0.67 - 0.93)	0.036
Shortness of breath	1.15 (1.02 - 1.31)	1.01 (0.85 - 1.20)	0.210
Problems with sexual functioning	2.42 (2.01 - 2.91)	3.03 (2.37 - 3.89)	0.150
Distressing dreams	1.47 (1.28 - 1.69)	1.45 (1.17 - 1.79)	0.910
Indigestion	1.15 (1.01 - 1.30)	0.94 (0.79 - 1.11)	0.066
Increased sensitivity to noise	1.67 (1.41 - 1.98)	1.35 (1.10 - 1.66)	0.117
Feeling jumpy/easily startled	1.20 (1.05 - 1.38)	1.32 (1.08 - 1.61)	0.453
Tingling or burning sensation in hands/feet	1.31 (1.12 - 1.54)	1.31 (1.07 - 1.59)	0.989
Rapid or pounding heart beat	1.35 (1.15 - 1.57)	1.23 (0.99 - 1.53)	0.512
Diarrhoea	1.03 (0.88 - 1.21)	0.97 (0.79 - 1.20)	0.646
Dry mouth	1.49 (1.26 - 1.77)	1.32 (1.07 - 1.63)	0.377
Night sweats	1.26 (1.07 - 1.47)	1.36 (1.09 - 1.71)	0.569
Chest pain	0.93 (0.79 - 1.09)	0.88 (0.72 - 1.09)	0.710
Persistent cough	1.15 (0.95 - 1.38)	1.05 (0.85 - 1.30)	0.536
Loss of sensation in hands/feet	1.53 (1.24 - 1.89)	1.85 (1.43 - 2.40)	0.268
Stomach cramps	1.20 (0.99 - 1.46)	0.91 (0.71 - 1.17)	0.094
Passing urine more often	1.68 (1.33 - 2.11)	1.50 (1.19 - 1.88)	0.492
Increased sensitivity to light	1.18 (0.99 - 1.42)	0.92 (0.71 - 1.19)	0.113
Symptom	Gulf War veterans N=698	Comparison group N=659	Comparison of prevalence change in the two study groups
--	----------------------------	---------------------------	---
	Adj RR (95% CI)	Adj RR (95% CI)	p-value
Wheezing	1.24 (1.02 - 1.52)	1.14 (0.88 - 1.47)	0.597
Sore throat	0.66 (0.55 - 0.80)	0.52 (0.42 - 0.65)	0.111
Unintended weight gain > 4kg	1.36 (1.08 - 1.70)	1.12 (0.85 - 1.46)	0.281
Loss of balance or coordination	1.72 (1.36 - 2.18)	1.73 (1.27 - 2.36)	0.989
Toothache	1.28 (1.00 - 1.62)	1.28 (0.95 - 1.73)	0.979
Alcohol intolerance	0.98 (0.80 - 1.22)	1.08 (0.80 - 1.46)	0.629
Loss of, or decrease in, appetite	1.19 (0.96 - 1.49)	1.09 (0.81 - 1.47)	0.632
Constipation	1.49 (1.17 - 1.90)	1.38 (1.03 - 1.83)	0.669
Dizziness or blackouts	1.13 (0.90 - 1.41)	1.17 (0.85 - 1.60)	0.869
Shaking	1.17 (0.95 - 1.44)	1.02 (0.75 - 1.41)	0.479
Skin infections	1.11 (0.87 - 1.41)	0.59 (0.41 - 0.84)	0.004
Mouth ulcers	0.79 (0.62 - 1.00)	0.86 (0.63 - 1.17)	0.657
Double vision	1.51 (1.11 - 2.05)	1.26 (0.86 - 1.84)	0.468
Feeling feverish	1.19 (0.90 - 1.57)	0.94 (0.65 - 1.34)	0.297
Increased sensitivity to smell	1.76 (1.32 - 2.35)	1.29 (0.86 - 1.94)	0.219
Nausea	1.13 (0.87 - 1.45)	1.06 (0.73 - 1.52)	0.778
Feeling disorientated	1.21 (0.92 - 1.59)	1.12 (0.72 - 1.74)	0.765
Tender/painful swelling of lymph glands	1.08 (0.78 - 1.49)	0.76 (0.52 - 1.11)	0.165
Loss of control over bladder or bowels	2.65 (1.68 - 4.17)	1.26 (0.77 - 2.05)	0.029
Lump in throat	1.48 (1.02 - 2.16)	1.12 (0.68 - 1.85)	0.378
Difficulty speaking	1.31 (0.92 - 1.86)	1.01 (0.67 - 1.53)	0.349
Skin ulcers	1.95 (1.21 - 3.16)	1.46 (0.68 - 3.16)	0.525
Burning sensation in sex organs	1.94 (1.13 - 3.31)	2.86 (1.29 - 6.38)	0.431
Vomiting	0.87 (0.55 - 1.39)	0.76 (0.47 - 1.23)	0.699
Pain on passing urine	1.05 (0.62 - 1.78)	1.06 (0.65 - 1.73)	0.979
Unintended weight loss >4kg	1.02 (0.58 - 1.81)	1.27 (0.67 - 2.42)	0.607
Seizures or convulsions	5.99 (0.99 - 36.05)	3.00 (0.31 - 28.89)	0.642

Persistent symptoms

Symptoms which were endorsed by participants at both baseline and follow up were termed 'persistent' for the purpose of this study, however, whether such symptoms remitted and recurred between baseline and follow up is not known. The percentage of participants in each study group, who reported a symptom at baseline which was persistent at follow up, is shown in Table 26 for the 20 symptoms which were most prevalent at follow up among Gulf War veterans. Nine of these 20 symptoms were statistically significantly more persistent in the Gulf War veterans than in the comparison group. None of these symptoms were more persistent in the comparison group.

Symptom	Gulf	War veterans	Comp	parison group	GWVs vs CG [‡]
	N*	Persistence [†] (%)	N*	Persistence [†] (%)	adj RR (95% CI)
Feeling unrefreshed after sleep	448	(84)	357	(75)	1.12 (1.04 - 1.20)
Fatigue	450	(79)	349	(74)	1.05 (0.97 - 1.14)
Sleeping difficulties	388	(81)	312	(76)	1.06 (0.98 - 1.15)
General muscle aches or pains	361	(78)	274	(75)	1.00 (0.92 - 1.09)
Headaches	413	(71)	331	(68)	1.04 (0.94 - 1.14)
Low back pain	357	(79)	318	(78)	1.01 (0.93 - 1.09)
Irritability / outbursts of anger	392	(72)	286	(63)	1.12 (>1.00 - 1.24)
Stiffness in several joints	273	(78)	219	(75)	1.07 (0.97 - 1.18)
Ringing in the ears	213	(85)	175	(83)	1.03 (0.94 - 1.13)
Flatulence or burping	311	(71)	270	(62)	1.14 (1.01 - 1.29)
Difficulty finding the right word	317	(73)	230	(63)	1.18 (1.05 - 1.34)
Forgetfulness	314	(71)	216	(59)	1.20 (1.05 - 1.37)
Pain, without swelling or redness, in several joints	247	(69)	194	(58)	1.20 (1.03 - 1.39)
Avoiding doing things or situations	226	(73)	131	(67)	1.10 (0.95 - 1.27)
Loss of concentration	288	(6)	172	(59)	1.16 (>1.00 - 1.35)
Loss of interest in sex	157	(76)	101	(60)	1.25 (1.04 - 1.50)
Itchy or painful eyes	248	(60)	174	(51)	1.18 (0.98 - 1.43)
Feeling distant or cut-off from others	172	(67)	88	(56)	1.19 (0.96 - 1.47)
Rash or skin irritation	248	(58)	184	(36)	1.59 (1.27 - 1.98)
Shortness of breath	202	(58)	143	(45)	1.21 (0.97 - 1.51)

Table 26 Percentage of participants who reported a symptom at baseline which was persistent (repeated) at follow up, for the 20 most prevalent symptoms among Gulf War veterans

* N = the total number of participants reporting each symptom as present at baseline

† Percentage of participants who reported a symptom at baseline, who also reported this symptom at follow up

‡ The ratio of persistence in the Gulf War veterans compared to the ratio of persistence in the comparison group

Incident symptoms

Symptoms which were not reported by participants at baseline but which were present at follow up were termed 'incident'. The percentage of participants in each study group who did not report a symptom at baseline, but which was incident at follow up, is shown in Table 27 for the 20 symptoms which were most prevalent at follow up among Gulf War veterans. Eleven of the 20 symptoms shown were statistically significantly more incident in the Gulf War veteran group than in the comparison group. None of these symptoms was more incident in the comparison group.

Symptom	Gulf War veterans		Comparison group		GWVs vs CG [‡]
	N*	Incidence [†] (%)	N*	Incidence [†] (%)	adj RR (95% CI)
Feeling unrefreshed after sleep	245	(45)	295	(36)	1.20 (0.97 - 1.48)
Fatigue	242	(47)	305	(43)	1.10 (0.91 - 1.33)
Sleeping difficulties	302	(46)	337	(41)	1.10 (0.92 - 1.31)
General muscle aches or pains	331	(46)	377	(44)	1.05 (0.89 - 1.24)
Headaches	280	(43)	322	(29)	1.43 (1.14 - 1.78)
Low back pain	334	(38)	331	(36)	1.11 (0.91 - 1.35)
Irritability / outbursts of anger	301	(36)	363	(25)	1.42 (1.12 - 1.81)
Stiffness in several joints	420	(39)	432	(34)	1.09 (0.91 - 1.30)
Ringing in the ears	482	(36)	478	(31)	1.15 (0.96 - 1.37)
Flatulence or burping	384	(34)	383	(22)	1.50 (1.18 - 1.89)
Difficulty finding the right word	375	(30)	422	(21)	1.44 (1.12 - 1.85)
Forgetfulness	377	(29)	436	(20)	1.44 (1.12 - 1.86)
Pain, without swelling or redness, in several joints	447	(33)	458	(27)	1.22 (0.99 - 1.49)
Avoiding doing things or situations	467	(31)	518	(21)	1.48 (1.19 - 1.84)
Loss of concentration	407	(27)	481	(19)	1.33 (1.04 - 1.69)
Loss of interest in sex	538	(33)	553	(27)	1.25 (1.04 - 1.51)
Itchy or painful eyes	444	(26)	478	(22)	1.15 (0.91 - 1.45)
Feeling distant or cut-off from others	522	(25)	563	(18)	1.36 (1.08 - 1.72)
Rash or skin irritation	445	(23)	468	(17)	1.31 (>1.00 - 1.72)
Shortness of breath	493	(23)	511	(16)	1.51 (1.17 - 1.96)

Table 27 Percentage of participants who did not report a sympt	om at baseline which was
incident at follow up, for the 20 most prevalent symptoms amo	ng Gulf War veterans

* N = the total number of participants without each symptom at baseline

† Percentage of participants who did not report a symptom at baseline, who then reported this symptom at follow up ‡ The ratio of incidence in the Gulf War veterans compared to the ratio of incidence in the comparison group

Symptom attribution

The Symptom Interpretation Questionnaire (SIQ) assesses whether respondents have a typically Psychologising, Somatising or Normalising attribution style. Participants were deemed to have a predominant attribution style if they responded to the 13 somatic questions with seven or more answers from any one particular attribution style. The majority of participants (67.4%) were categorised as Normalisers, whereas 6.9% were predominantly Somatisers, 6.1% were Psychologisers and 19.6% were categorised as 'No predominance'. The predominant styles for each study group are shown in Figure 17. When the predominant attribution styles were compared, there was no significant difference between the Gulf War veterans and the comparison group; χ^2 (3, N=1302) = 5.87, p = 0.12.



Figure 17 Proportion of participants by symptom attribution style

5.5.2 Multisymptom illness

The prevalence of multisymptom illness among participants at follow up was assessed using two different definitions. They are explained in more detail in the Methods chapter. To summarise, the first definition of multisymptom illness uses the same criteria as those utilised in the baseline study,²⁰ which was based on the CDC definition of multisymptom illness,³⁴ and facilitates investigation of change in prevalence over time, also persistence, remittance and incidence of multisymptom illness since baseline.

The second definition of multisymptom illness (termed 'multisymptom illness-exclusionary') differs from the first only in that it excludes people with medical or psychological conditions that may explain their multiple symptom reporting, or interfere with the person's ability to interpret or report symptoms,³⁷ This second definition was used in the follow up study only, and not at baseline.

Multisymptom illness at follow up

Figure 18 shows the percentages of participants who met criteria for multisymptom illness, or multisymptom illness-exclusionary, based on the above definitions.



Figure 18 Percentage of participants who met criteria for multisymptom illness or multisymptom illness-exclusionary at follow up

Two hundred and three Gulf War veterans (29.3%) and 117 comparison group participants (17.9%) met criteria for multisymptom illness at follow up (RR 1.64, adj RR = 1.60, 95% CI 1.31 – 1.95). When cases with explanatory conditions were excluded, the prevalences dropped slightly in both groups, with 26% of Gulf War veterans and 16% of comparison group participants meeting criteria for multisymptom illness-exclusionary (RR 1.65, adj RR = 1.60, 95% CI 1.26 – 2.03). Gulf War veterans were 60% more likely than the comparison group to have multisymptom illness at follow up, and the increased risk among veterans was the same regardless of which definition was used.

Association between Gulf War-deployment characteristics and multisymptom illness in veterans at follow up

The associations between Gulf War deployment characteristics and occurrence of multisymptom illness at follow up in male Gulf War veterans are shown in Table 28. Risk of multisymptom illness was statistically significant higher among Gulf War veterans who

served with non-supervisory ranks compared to Officers. Risk of multisymptom illness was slightly higher in the youngest age group and in the Army compared with other groups of Gulf War veterans, however those differences did not achieve statistical significance.

	Gulf War veterans with multisymptom illness at follow up								
Gulf War exposure	Ν	n (%)	RR	Adj RR (95% CI)					
Age at deployment									
< 20	62	22 (35.5)	1.00	1.00					
20-24	170	48 (28.2)	0.80	0.91 (0.59 - 1.38)					
25-34	361	98 (27.2)	0.77	1.05 (0.66 – 1.67)					
>=35	101	35 (34.7)	0.98	1.42 (0.83 – 2.41)					
Service branch									
Navy	596	172 (28.9)	1.00	1.00					
Army	46	18 (39.1)	1.36	1.41 (0.96-2.10)					
Air Force	52	13 (25.0)	0.87	0.94 (0.57-1.56)					
Rank category									
Officer	148	35 (23.6)	1.00	1.00					
Other rank-supervisory	352	101 (28.7)	1.21	1.35 (0.96-1.91)					
Other rank - non supervisory	193	67 (34.7)	1.47	1.82 (1.19-2.79)					

Table 28 Association between Gulf War-deployment characteristics and multisymptom illne	SS
at follow up in male Gulf War veterans	

Change in prevalence, also persistence, remittance and incidence of multisymptom illness since baseline

For male participants who had sufficient data for assessing multisymptom illness at both baseline and follow up (n=681 Gulf War veterans and n=598 comparison group) Table 29 shows that for both groups the prevalence of multisymptom illness increased from baseline to follow up, but this increase was statistically significant only for the Gulf War veterans. There was no statistically significant difference between the two groups (RR 1.06; 95% CI 0.83-1.35) in regard to change over time.

Table 29 Fleva	rable 29 Frevalence of multisymptom liness at baseline and follow up							
	Gulf War veterans (N=681)			Comparison group (N=598)			98)	
	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR	95% CI	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR	95% CI
Multisymptom illness	158 (23.1)	203 (29.6)	1.27	1.11-1.44	90 (14.9)	117 (17.9)	1.19	0.97-1.47

* includes only those participants who were also able to be assessed for multisymptom illness at follow up

Table 20 Providence of multicumptem illness at becaling and follow up

Table 30 shows the proportion of Gulf War veteran and comparison group participants who met criteria (present) or did not meet criteria (absent) for multisymptom illness at baseline and at follow up. Incident cases are shown in the first row of data in Table 30 as *absent* at baseline and *present* at follow up. A greater proportion of Gulf War veterans (17.5%) than comparison group participants (12.4%) were incident cases who did not meet criteria for multisymptom illness at baseline, but did meet criteria at follow up, and this difference was statistically significant.

Persistent cases are shown in the second row of data in Table 30 as *present* at baseline and *present* at follow up, whilst remitted cases were *present* at baseline and *absent* at follow up. Of the 156 Gulf War veterans and 89 comparison group members who met criteria for multisymptom illness at baseline, 69.2% and 50.6% respectively were persistent cases who also met this criteria at follow up, whereas 30.8% and 49.4% respectively had remitted at follow up. The increased risk of persistence of multisymptom illness in Gulf War veterans was statistically significant. Consistent with this, the decreased risk of remittance of multisymptom illness in Gulf War veterans was statistically significant.

assessed at baseline and follow up								
	Gulf War vete	erans (N=681)	Comparison	group (N=598)				
Multisymptom illness	Follow Up		Follow Up					
Baseline	n (%) absent	n (%) present	n (%) absent	n (%) present				
absent	433 (82.5)	92 (17.5)*	446 (87.6)	63 (12.4)*				
present	48 (30.8) [‡]	108 (69.2) [†]	44 (49.4) [‡]	45 (50.6) [†]				
	RR	Adj RR	95% CI					
Incidence	1.42	1.41	1.05-1.89					
Remittance	0.62	0.61	0.44-0.83					
Persistence	1.37	1.39	1.11-1.75					

Table 30 Persistent, remitted and incident cases of multisymptom illness among participants assessed at baseline and follow up

* Incident cases

† Persistent cases ‡ Remitted cases

5.5.3 Patterns of symptom reporting

In section 5.5.1 above, it was shown that almost all symptoms were more frequently reported by the Gulf War veterans than by the comparison group. However, this does not preclude the co-occurrence of self-reported symptoms being similar in the two groups. At baseline, exploratory factor analysis was conducted to establish whether the pattern of co-occurrence of self-reported symptoms was the same in the Gulf War veteran and comparison groups. A reproducible factor solution with three moderately correlated factors was identified to be underlying the pattern of symptom reporting among Gulf War veterans and the comparison group. The three indicative factors were labelled psycho-physiological distress, somatic distress and arthro-neuromuscular distress. The pattern of co-occurrence of symptoms was shown to be similar between the Gulf War veterans and the comparison group. Hence, it was concluded that the pattern (but not frequency) of self-reported symptoms among Gulf War veterans was not unique at baseline.

Using data from follow-up participants, the above analyses were repeated with the aim of establishing whether the three factors observed at baseline were still evident at follow-up in Gulf War veterans and the comparison group, and whether the pattern of co-occurrence of symptoms differed between the Gulf War veterans and the comparison group at follow-up.

Using the exclusionary criteria presented in the methods section, exploratory factor analysis (EFA) was conducted on about 99% of Gulf War veterans (N=691 for baseline data EFA and N=685 for follow-up data EFA) and comparison group participants (N=652 for both baseline and follow-up). Due to few participants (less than 4%) reporting some symptoms at baseline or follow-up as at least mildly present, seven symptoms were excluded in the EFA and these are listed in Table 31. Therefore, only 56 symptoms were included in the factor analysis.

Symptoms	Gulf War vete	erans (N=697)	Comparison group (N=659)		
	Baseline	Follow-up	Baseline	Follow-up	
	n (%)	n (%)	n (%)	n (%)	
Skin ulcers	21 (3.0)	41 (5.9)	9 (1.4)	13 (2.0)	
Seizures and convulsions	1 (0.4)	6 (0.9)	1 (0.2)	3 (0.5)	
Pain in passing urine	21 (3.0)	33 (3.2)	18 (2.7)	19 (2.9)	
Loss of control over bladder or bowels	20 (2.9)	53 (7.6)	20 (3.0)	25 (3.8)	
Burning sensation in the sex organs	16 (2.3)	31 (4.5)	6 (0.9)	17 (2.6)	
Vomiting	20 (2.9)	27 (3.9)	25 (3.8)	19 (2.9)	
Unintended weight loss ≥ 4kg	31 (4.5)	20 (2.9)	16 (2.4)	20 (3.1)	

Table 31 Symptoms with low prevalence (<4%) in at least one dataset, e	excluded from
exploratory factor analysis	

5.5.4 Symptom patterns at follow-up

Exploratory factor analysis methods, including scree plots on each of the two datasets of follow-up study data, yielded a structure suggesting that a three factor solution would be the best fit to the data.

The three factor structure on follow-up symptom reporting yielded factor loadings as presented in Table 32. The symptoms are presented according to the magnitude of the loadings among Gulf War veterans. Inter-factor correlations for the three factors among Gulf War veterans were 0.624, 0.683 and 0.577 for factors 1 and 2, 1 and 3 and 2 and 3, respectively, and these were 0.575, 0.610 and 0.598 among the comparison group, indicating moderate correlation between the factors.

	Gulf War veterans			Comparison group			
Symptom	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)	
Lump In throat	1.011	-0.250	-0.093	0.714	-0.200	0.060	
Sore Throat	0.842	-0.245	-0.090	0.735	-0.293	0.052	
Wheezing	0.767	0.136	-0.225	0.764	-0.152	0.014	
Persistent cough	0.754	0.056	-0.338	0.591	-0.204	0.088	
Stomach cramps	0.724	-0.017	0.044	0.657	0.049	-0.029	
Diarrhoea	0.636	0.007	-0.031	0.637	-0.054	-0.048	
Constipation	0.633	0.001	0.097	0.461	0.044	0.102	
Tender/Painful swelling of lymph glands	0.628	-0.023	0.219	0.560	0.001	0.119	
Nausea	0.593	0.247	-0.052	0.741	0.158	-0.189	
Flatulence or burping	0.557	0.017	0.031	0.528	0	0.116	
Indigestion	0.534	0.064	0.048	0.615	0.001	0.003	
Loss of balance or coordination	0.502	0.204	0.135	0.092	0.499	0.250	
Shortness of breath	0.498	0.239	0.063	0.496	0.244	0.026	
Dry Mouth	0.488	0.156	0.079	0.592	0.184	0.046	
Dizziness or blackouts	0.487	0.190	0.054	0.230	0.408	0.140	
Double vision	0.484	0.193	0.074	0.45	0.187	0.073	
Itchy or painful eyes	0.460	0.046	0.130	0.476	0.172	-0.044	
Feeling feverish	0.453	0.300	0.094	0.587	0.279	-0.006	
Increased sensitivity to light	0.449	0.341	0.090	0.247	0.333	0.220	
Skin infections	0.432	0.041	0.087	0.274	0.126	0.015	
Difficulty speaking	0.426	0.349	0.077	0.197	0.653	-0.086	
Passing urine more often	0.426	-0.003	0.177	0.487	0.176	0.005	
Increased sensitivity to smell	0.404	0.450	0.039	0.164	0.488	0.173	
Unrefreshed after sleep	-0.142	0.905	0.115	0.396	0.671	-0.193	

Table 32 Factor loadings by study group based on follow-up symptom reporting

	Gulf War veterans			Comparison group			
Symptom	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)	
Feeling jumpy/easily startled	0.072	0.835	0.007	0.134	0.709	0.023	
Feeling distant or cut-off from others	0.056	0.826	-0.056	-0.023	0.874	-0.061	
Sleeping difficulties	-0.097	0.819	0.115	0.356	0.618	-0.141	
Loss Of concentration	0.158	0.814	-0.067	-0.019	0.842	0.056	
Fatigue	-0.074	0.810	0.160	0.399	0.580	-0.113	
Avoiding doing things or situations	0.080	0.799	-0.013	-0.087	0.854	0.111	
Irritability/Outbursts of anger	0.030	0.755	0.021	0.104	0.764	-0.060	
Loss of interest in sex	-0.094	0.750	-0.007	-0.201	0.769	0.110	
Forgetfulness	0.222	0.674	-0.043	-0.022	0.761	0.086	
Distressing dreams	0.143	0.666	0.018	0.058	0.602	0.157	
Problems with sexual functioning	-0.064	0.621	0.049	-0.216	0.732	0.178	
Difficulty finding the right word	0.248	0.591	-0.016	0.076	0.661	0.008	
Rapid or pounding heart beat	0.339	0.549	-0.103	0.349	0.514	-0.201	
Increased sensitivity to noise	0.292	0.498	0.047	0.008	0.566	0.217	
Loss of or decrease in appetite	0.397	0.493	-0.101	0.289	0.625	-0.185	
Shaking	0.382	0.476	-0.040	0.268	0.632	-0.111	
Feeling disoriented	0.313	0.451	0.101	0.038	0.644	0.083	
Stiffness in several joints	-0.177	0.021	1.057	0.041	-0.085	0.965	
Pain in several joints without swelling or redness	-0.070	0.079	0.848	-0.023	-0.015	0.895	
Muscle aches or pains	0.028	0.084	0.737	0.095	0.025	0.709	
Loss of sensation in hands/feet	0.331	-0.115	0.609	0.211	0.192	0.468	
Low back pain	0.068	0.140	0.502	0.144	0.088	0.531	
Tingling or burning sensation in hands/feet	0.318	-0.017	0.501	0.179	0.158	0.493	
Toothache	0.315	-0.045	0.212	0.209	-0.002	0.178	
Rash or skin irritation	0.342	0.047	0.158	0.336	0.101	0.058	

	(Gulf War veterans	5	C	comparison group)
Symptom	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)	Factor 1 (psychophysiolo gy)	Factor 2 (cognitive)	Factor 3 (arthro-neuro- muscular)
Mouth ulcers	0.350	-0.038	0.142	0.231	0.030	0.154
Night sweats	0.329	0.278	0.139	0.403	0.278	0.114
Ringing ears	0.166	0.294	0.132	0.027	0.263	0.365
Unintended weight gain > 4kg	0.182	0.358	0.068	0.195	0.349	0.184
Chest Pain	0.397	0.174	0.054	0.374	0.155	0.050
Headaches	0.371	0.163	0.049	0.456	0.192	0.067
Alcohol intolerance	0.240	0.364	-0.037	0.313	0.249	0.135

5.5.5 Comparison of baseline and follow up symptom patterns

Almost all symptoms clearly loaded on to a single factor in the Gulf War veteran group, implying a relatively straightforward factor interpretation. For the comparison group, although there was also a clear differentiation between factors, some symptoms loaded on to more than one factor and this resulted in a slightly more complex structure. Hence, to quantify the degree of concordance of factor solutions, Tucker's Congruence Coefficient (TCC)^{122,123} was used to compare the factor loadings of each factor and study group across time and between study groups. Table 33 shows the congruence between the factor loadings. Based on suggestions by Lorenza-Seva *et al* (2006)¹²² the factor congruence was generally fair to excellent. That is, the overall pattern of symptom reporting, as measured by the co-occurrence of symptoms, was similar between the Gulf War veteran and comparison groups at baseline, and it was similar between the Gulf War veteran and comparison groups at follow up. The pattern of co-occurrence of symptoms was also similar between the baseline and follow up studies for the Gulf War veteran group, however there was slightly less congruence in symptom reporting between the baseline and follow up studies for the comparison group.

Comparison	Factors	Congruence between
Companson	Factors	factor loadings
	1	0.88
Baseline: Gulf War veterans vs comparison group	2	0.95
	3	0.79
	1	0.90
Follow-up: Gulf War veterans vs comparison group	2	0.96
	3	0.87
	1	0.91
Gulf War veterans: Baseline vs Follow-up	2	0.94
	3	0.90
	1	0.81
Comparison group: Baseline vs Follow-up	2	0.95
	3	0.76

Table 33 Comparisons of factors using Tucker's Congruence Coefficient

Lorenza-Seva et al (2006) suggested assessment of factor similarity based on the following cut-off points: TCC \geq 0.95=equal factor structures; 0.85 \leq TCC \leq 0.94 = fairly similar factor structures.

5.5.6 Key findings

All of the 63 past-month symptoms which were measured were more prevalent in the Gulf War veteran group at follow up than in the comparison group, and for 47 of those symptoms the increased prevalence was statistically significant. The types of symptoms reported most frequently at follow up were similar across the two groups. The average number of pastmonth symptoms reported by each group increased from baseline to follow up, however the magnitude of the increase was slightly, but statistically significantly, larger in the Gulf War veteran group than in the comparison group. Relative to the comparison group, the Gulf War veterans reported a larger proportion of symptoms which had increased in prevalence from baseline to follow up, and fewer symptoms which were equally prevalent or less prevalent. Individual symptoms were more likely to be persistent in Gulf War veterans, and more likely to be incident in Gulf War veterans, than in the comparison group. In summary, while the types of symptoms reported frequently by both groups were similar, prevalence, persistence and incidence of symptoms was greater in Gulf War veterans than in the comparison group.

There were no differences between the two study groups in regard to symptom attribution style. Most participants were categorised as having a Normalising symptom attribution style whilst less than 7% of participants in both study groups had Psychologising or Somatising styles.

More than 20 years after the Gulf War, the Gulf War veterans were at 60% greater risk of multisymptom illness than the comparison group. Excluding participants who had a medical or psychological condition that could explain their symptoms, or interfere with their ability to interpret or report their symptoms, made no difference to the magnitude of the difference in multisymptom illness between groups. The prevalence of multisymptom illness in both study groups has increased since the baseline study, however the increase over time has only been statistically significant in the Gulf War veteran group. The increase over time in Gulf War veterans has likely been due to both an increased persistence and incidence of multisymptom illness since baseline. Gulf War veterans serving under non-supervisory ranks at the time of the Gulf War were at greatest risk of multisymptom illness at follow up relative to those who served at higher ranks.

Whilst the Gulf War veterans continued to report health symptoms with greater frequency than the comparison group at follow up, the pattern of co-occurrence of symptoms reported at follow up by the two groups was similar. Analogous to the result found at baseline, this suggested that the pattern of co-occurrence (but not frequency) of self-reported symptoms among Gulf War veterans was not unique. Similarly, there was little evidence of changes over time in symptom co-occurrence in either the Gulf War or comparison group.

5.6 Neuropathic Symptoms

5.6.1 Neuropathic symptoms at follow up

From a list of 17 neuropathic symptoms, Figure 19 and Table 34 show the number and type of neuropathic symptoms which participants reported having experienced in the month prior to follow up. The mean number of reported symptoms was similar in the two groups. Approximately 60% of Gulf War veterans and 52% of the comparison group reported at least one neuropathic symptom in the previous month, and approximately 24% and 18%, respectively, reported at least four neuropathic symptoms. These differences between groups were statistically significant. Gulf War veterans were also significantly more likely to report one or more symptom of muscle weakness and marginally significantly more likely to report at least one symptom of sensory disturbance. Specific symptoms which were reported significantly more frequently by Gulf War veterans were 'difficulty lifting objects above the head', 'difficulty getting up from sitting in a chair', 'problems with feet tripping or feet slapping when walking', 'difficulty feeling pain, cuts or injuries' and 'unusual sensitivity or tenderness of your skin when rubbed by clothes or bedclothes'.



Figure 19 Number of neuropathic symptoms reported at follow up

	Gulf War veterans N=686	Comparison group N=651		
	Mean (sd)	Mean (sd)	Ratio of means*	Adj ratio of means [†]
Number of neuropathic symptoms	2.2 (3.0)	1.7 (2.5)	1.21	1.14 (0.96 – 1.36)
	n (%)	n (%)	RR	Adj RR (95% CI) ^b
One or more	409 (59.62)	339 (52.07)	1.14	1.13 (1.03-1.25)
Four or more	164 (23.91)	114 (17.51)	1.37	1.32 (1.07-1.64)
Symptoms of muscle weakness				
One or more symptom of muscle weakness	307 (44.05)	234 (35.51)	1.24	1.23 (1.08-1.41)
Difficulty lifting objects above head	161 (23.10)	105 (15.93)	1.45	1.42 (1.13-1.79)
Difficulty undoing buttons	45 (6.46)	29 (4.40)	1.47	1.38 (0.86-2.20)
Difficulty turning doorknobs/unscrewing jars	68 (9.78)	48 (7.32)	1.34	1.28 (0.89-1.83)
Difficulty getting up from sitting in a chair	234 (33.77)	179 (27.37)	1.23	1.25 (1.06-1.48)
Problems with tripping or feet slapping while walking	48 (9.60)	20 (3.05)	1.62	1.54 (1.07-2.22)
Difficulty swallowing food (more than occasionally)	25 (3.59)	15 (2.29)	1.57	1.65 (0.83-3.28)
Symptoms of sensory disturbance				
One or more symptom of sensory disturbance	316 (45.34)	259 (39.30)	1.15	1.14 (>1.00-1.29)
Difficulty recognising hot from cold water	11 (1.58)	2 (0.31)	5.18	4.59 (0.96-21.91)
Difficulty feeling pain, cuts or injuries	33 (4.74)	9 (1.37)	3.45	3.25 (1.45-7.30)
Numbness, "asleep feeling" or prickling sensation in hands or arms	198 (28.49)	156 (23.85)	1.19	1.14 (0.95-1.37)
Numbness, "asleep feeling" or prickling sensation in feet or legs	160 (23.02)	129 (19.69)	1.17	1.13 (0.92-1.39)
Burning, deep aching pain or tenderness in hands or arms	76 (10.95)	55 (8.40)	1.30	1.19 (0.85-1.66)
Burning, deep aching pain or tenderness in feet or legs	103 (14.80)	91 (13.89)	1.07	1.02 (0.78-1.34)
Unusual sensitivity or tenderness of your skin when clothes or bedclothes rub against you	48 (6.90)	20 (3.05)	2.26	2.07 (1.23-3.46)
Feeling unsteady walking on even ground	83 (11.93)	65 (9.92)	1.20	1.18 (0.87-1.61)
Feeling unsteady walking in the dark	75 (10.79)	57 (8.70)	1.24	1.16 (0.83-1.63)
Feeling like you might fall over because of unsteadiness	60 (8.62)	42 (6.42)	1.34	1.18 (0.80-1.73)
Symptom of autonomic dysfunction				
Feeling faint when standing up from lying or sitting	97 (13.94)	64 (9.77)	1.43	1.34 (0.99-1.83)

Table 34 Number and type of neuronathic symptoms at follow up

* Obtained using zero-inflated negative binomial regression † Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks), each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

5.6.2 Association between Gulf War deployment characteristics and neuropathic symptoms in veterans at follow up

Table 35 shows that, relative to Officers, Gulf War veterans who served under the two lower rank categories; 'other rank supervisory' and 'other rank-non supervisory'; reported a significantly higher average number of neuropathic symptoms at follow up. There was no association between average number of neuropathic symptoms reported at follow up and service branch or age category during the Gulf War.

Gulf War deployment	Total number of neuropathic symptoms at follow up in						
cnaracteristic	N	N mean (SD) ratio Adi ratio* (95% Cl					
Age at deployment							
< 20	62	2.5 (3.4)	1.00	1.00			
20-24	166	2.0 (3.6)	0.87	0.93 (0.61 – 1.44)			
25-34	358	2.2 (3.0)	0.87	0.95 (0.61 – 1.50)			
>=35	100	2.5 (2.6)	0.77	0.96 (0.57 – 1.61)			
Service branch							
Navy	589	2.2 (3.0)	1.00	1.00			
Army	46	2.8 (3.5)	1.15	1.19 (0.79 – 1.77)			
Air Force	51	1.6 (2.1)	0.77	1.00 (0.64 – 1.56)			
Rank category							
Officer	147	1.4 (2.4)	1.00	1.00			
Other rank-supervisory	348	2.3 (3.0)	1.38	1.50 (1.07 – 2.11)			
Other rank - non supervisory	190	2.6 (3.2)	1.50	1.64 (1.07 – 2.51)			

Table 35 Association between Gulf War deployment characteristics and average number of neuropathic symptoms at follow up in Gulf War veterans

*Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks), each estimated as at August 1990, alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

5.6.3 Key findings

The mean number of neuropathic symptoms in the previous month, reported by both study groups, was approximately two of the 17 symptoms measured. Gulf War veterans were significantly more likely than the comparison group to report at least one neuropathic symptom (60% vs 52%), or at least four neuropathic symptoms (24% vs 18%), one or more symptom of muscle weakness (44% vs 36%) and one or more symptom of sensory disturbance (45% vs 39%). Individual symptoms which were reported significantly more frequently by Gulf War veterans were 'difficulty lifting objects above the head', 'difficulty getting up from sitting in a chair', 'problems with feet tripping or feet slapping when walking', 'difficulty feeling pain cuts or injuries' and 'unusual sensitivity or tenderness of your skin when rubbed by clothes or bedclothes'.

In Gulf War veterans, increasing number of neuropathic symptoms reported at follow up was associated with lower rank category during the Gulf War, but it was not associated with service branch or age category during the Gulf War.

5.7 Chronic Fatigue

5.7.1 Fatigue at follow up

In the follow up study questionnaire, participants were asked whether they had experienced extreme tiredness or fatigue following normal activities in the previous 12 months and whether they had experienced prolonged fatigue (extreme tiredness or fatigue of at least one month's duration) in the previous 12 months and chronic fatigue (extreme tiredness or fatigue of at least six month's duration) in the previous 12 months. These questions comprised a subset of a larger structured questionnaire administered by the assessing doctor in the baseline study medical assessment. The Chalder Fatigue Scale (CFQ)⁴⁷ was used as an additional measure of fatigue, but in the follow up study only.

Extreme tiredness or fatigue, prolonged fatigue and chronic fatigue at follow up

Figure 20 and Table 36 show the prevalence of participants who reported fatigue related outcomes in the past 12 months at follow up. Gulf War veterans reported all of the fatigue outcomes in the past 12 months statistically significantly more commonly than did the comparison group, with the risk in Gulf War veterans estimated to be between 37% and 41% higher than that in the comparison group (Table 36).



Figure 20 Percentage of participants who reported extreme tiredness or fatigue, prolonged fatigue (at least 1 month duration) or chronic fatigue (at least 6 months duration) in the past 12 months

Table 36 Prevalence and Risk Ratios for fatigue, prolonged fatigue and chronic fatigue at follow up

Fatigue outcome in the past 12 months	Gulf War veterans N=697	Comparison group N=659		
	n (%)	n (%)	RR	Adj RR (95% CI)
Extreme tiredness/fatigue in past 12 months	228 (32.8)	150 (22.9)	1.43	1.38 (1.15-1.65)
Prolonged fatigue (≥ 1 month)	117 (16.9)	74 (11.3)	1.49	1.37 (1.04-1.80)
Chronic fatigue (≥ 6 months)	86 (12.4)	53 (8.1)	1.53	1.41 (1.02-1.96)

Fatigue severity assessed using the Chalder Fatigue Scale at follow up

Table 37 shows that the median total CFQ scores, and the median Physical- and Mentalfatigue component scores, each indicative of severity, were very similar between the two study groups. However, a greater proportion of Gulf War veterans (33%) than comparison group participants (26%) were defined as CFQ cases. This difference between groups was significant with the risk of CFQ caseness estimated to be 23% higher in Gulf War veterans than in the comparison group.

Chalder Fatigue Scale measure	Gulf War veterans N= 697	Comparison group N= 659	
	Median (IQR)	Median (IQR)	Adj Median diff (95% CI)
Total fatigue score	12 (11-16)	11 (11-15)	0.5 (0.01–0.99)
Physical fatigue score	7 (7-11)	7 (7-9)	0 (-0.31, 0.31)
Mental fatigue score	4 (4-6)	4 (4-5)	0 (-0.07, 0.07)
	n (%)	n (%)	Adj RR (95% CI)
CFQ fatigue caseness	232 (33.3)	170 (25.8)	1.23 (1.04–1.45)

Table 37 Chalder Fatigue Scale (CFQ) fatigue scores and caseness by study group

5.7.2 Association between Gulf War deployment characteristics and chronic fatigue in veterans at follow up

The associations between Gulf War deployment characteristics and chronic fatigue at follow up in male Gulf War veterans are shown in Table 38. In general, the risk of chronic fatigue was highest in Army Gulf War veterans relative to the Navy and Air Force, and amongst those veterans who served under non-supervisory ranks relative to higher ranks, however these differences did not achieve statistical significance. Age at the time of the Gulf War deployment was also not associated with chronic fatigue at follow up.

Gulf War exposure	Gulf War veterans with chronic fatigue				
Age at deployment	N	n (%)	RR	Adj RR (95% CI)	
< 20	62	9 (14.5)	1.00	1.00	
20-24	170	25 (14.7)	1.01	1.18 (0.57-2.42)	
25-34	364	41 (11.3)	0.78	1.11 (0.48-2.55)	
>=35	100	11 (11.0)	0.76	1.07 (0.40-2.90)	
Service branch					
Navy	599	76 (12.7)	1.00	1.00	
Army	45	7 (15.6)	1.22	1.35 (0.63-2.86)	
Air Force	52	3 (5.8)	0.45	0.50 (0.16-1.54)	
Rank category					
Officer	148	16 (10.8)	1.00	1.00	
Other rank-supervisory	354	39 (11.0)	1.02	0.99 (0.56-1.74)	
Other rank - non supervisory	193	31 (16.1)	1.49	1.43 (0.70-2.91)	

Table 38 Association between Gulf War-deployment characteristics and chronic fatigue at follow up in male Gulf War veterans

5.7.3 Change in prevalence, also persistence, remittance and incidence of chronic fatigue since baseline

In male participants who completed questions relating to fatigue outcomes at baseline and follow up (697 Gulf War veterans and 659 comparison group) Table 39 shows that the prevalence of prolonged fatigue and chronic fatigue more than doubled from baseline to follow up, and these increases were statistically significant.

Additional analysis showed that there was no difference between the two groups with respect to change over time for prolonged fatigue (RR=0.88; 95% CI 0.55-1.39) or chronic fatigue (RR=0.76; 95% CI 0.43 - 1.35).

Table 39 Prevalence of prolonged fatigue and chronic fatigue at baseline and follow up						
	Gulf War veterans (N=697)			Comparison Group (N=659)		
	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR (95% CI)	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR (95% CI)
Prolonged fatigue	50 (7.3)	117 (16.9)	2.32 (1.77–3.05)	26 (4.3)	74 (11.3)	2.66 (1.82–3.88)
Chronic fatigue	41 (6.0)	86 (12.4)	2.08 (1.52–2.85)	18 (3.0)	53 (8.1)	2.72 (1.68–4.39)

* Includes only those participants who were assessed for fatigue at follow up

Table 40 shows the proportion of Gulf War veteran and comparison group participants with chronic fatigue present or absent at baseline and at follow up. Incident cases are shown in the first row of data in Table 40 as absent at baseline and present at follow up. Of the 643

Gulf War veterans and 582 comparison group participants who had not reported chronic fatigue at baseline, 10.4% and 7.4%, respectively, were incident cases who met criteria for chronic fatigue at follow up. This difference between groups in incidence risk was not statistically significant.

Persistent cases are shown in the second row of data in Table 40 as *present* at baseline and *present* at follow up, whilst remitted cases are *present* at baseline and *absent* at follow up. Of the 41 Gulf War veterans and 18 comparison group members who had reported chronic fatigue at baseline, 18 (43.9%) Gulf War veterans and 7 (38.9%) comparison group participants were persistent cases who also reported chronic fatigue at follow up, whereas 56.1% and 61.1% remitted. The differences in persistence and remittance, between the Gulf War veterans and the comparison group, were not statistically significant.

Table 40 Persistent, remitted and incident cases of chronic fatigue among participants at baseline and follow up					
Chronic fatigue	Gulf War veterans (N=682)	Comparison group (N=597)			
	Follow up	Follow up			

Baseline	n (%) absent	n (%) present	Baseline	n (%) absent	n (%) present
Absent (n = 643) Present (n = 41)	576 (89.6) 23 (56.1) ^{††}	67 (10.4)* 18 (43.9) [†]	Absent (n = 582) Present (n = 18)	539 (92.6) 11 (61.1) ^{††}	43 (7.4)* 7 (38.9) [†]
Between groups					
	RR	Adj RR	95% CI		
Incidence	1.41	1.36	0.94 – 1.97		
Remittance	0.92	1.08	0.71 – 1.65		
Persistence	1.13	0.87	0.46 – 1.66		

* Incident cases

† Persistent cases

†† Remitted cases

5.7.4 Key findings

All fatigue related outcomes in the past 12 months; extreme tiredness or fatigue, prolonged fatigue of at least one month duration, and chronic fatigue of at least six months duration; were increased in Gulf War veterans at follow up relative to the comparison group, based on the same definitions that were used at baseline. Furthermore, fatigue caseness was also increased as defined by the Chalder Fatigue Scale although fatigue severity was similar between the study groups.

The prevalence of prolonged fatigue and chronic fatigue more than doubled in both groups at follow up compared with baseline. Amongst Gulf War veterans there was a greater incidence of new chronic fatigue cases since baseline than in the comparison group, however this difference was not statistically significant, while remittance and persistence were similar in the two groups. There was no clear association between chronic fatigue at follow up and Gulf War-related service branch, rank or age category.

5.8 Sleep

Sleeping pattern and daytime sleepiness are measures which were included at follow up only.

5.8.1 Sleeping pattern

Participants' ratings of their sleeping pattern in the previous two weeks are shown in Table 41. Relative to the comparison group, Gulf War veterans were significantly more likely to report difficulty falling asleep. The difference between the two groups increased with increasing severity of this sleeping pattern difficulty. Gulf War veterans were also significantly more likely than the comparison group to report moderate, severe or very severe difficulty in staying asleep. Further, Gulf War veterans were significantly more likely than the comparison group to report moderate.

Sleep guelity	Gulf War	Comparison		
Sleep quality	veterans N=692	group N=652		
	n (%)	n (%)	RR*	Adj RR* (95% CI)
Difficulty falling asleep				
None	313 (45.23)	373 (57.21)	1.00	1.00
Mild	218 (31.50)	174 (26.69)	1.49	1.51 (1.16-1.95)
Moderate	113 (16.33)	79 (12.12)	1.70	1.57 (1.12-2.20)
Severe/very severe	48 (6.94)	26 (3.99)	2.20	1.78 (1.07-2.97)
Difficulty staying asleep				
None	228 (32.81)	253 (38.69)	1.00	1.00
Mild	206 (29.64)	210 (32.11)	1.09	1.09 (0.83-1.43)
Moderate	168 (24.17)	134 (20.49)	1.39	1.37 (1.02-1.85)
Severe/very severe	93 (13.38)	57 (8.72)	1.81	1.66 (1.12-1.85)
Problem waking up early				
None	334 (48.34)	349 (53.86)	1.00	1.00
Mild	159 (23.01)	170 (26.23)	0.98	0.99 (0.75-1.30)
Moderate	125 (18.09)	82 (12.65)	1.59	1.56 (1.12-2.16)
Severe/very severe	73 (10.56)	47 (7.25)	1.62	1.45 (0.97-2.18)

Table 41 Sleeping pattern in the two weeks prior to follow up

* These RRs and the associated 95% CIs were calculated using multinomial logistic regression

5.8.2 Daytime sleepiness

Figure 21 shows the pattern of scores achieved on the Epworth Sleepiness Scale⁵⁰ for daytime sleepiness at follow up. From a total score range of 0-24, where higher scores indicate greater daytime sleepiness, the Gulf War veterans' mean score was 7.13 (sd 4.57)

whilst the mean score for the comparison group was 6.52 (sd 4.17). This difference in mean scores between groups did not reach statistical significance; adj mean diff 0.61, 95% CI 0.14 – 1.09 (not tabulated). Both groups had the same median score of 6.



Figure 21 Pattern of scores achieved on the Epworth Sleepiness Scale for daytime sleepiness

However, Figure 21 also shows that Gulf War veterans were more likely to achieve scores at the severe end of the scale than the comparison group. For example, 4.74% of Gulf War veterans and 2.44% of comparison group participants achieved a score greater than 16, which Johns (1991)⁵⁰ observed only in patients with narcolepsy, idiopathic hypersomnia or moderately severe obstructive sleep apnoea. This difference between the two groups, in the proportion scoring 16 or above, is statistically significant; adj RR 1.91 95% CI 1.04-3.48 (not tabulated).

5.8.3 Sleep apnoea

Sleep apnoea was included as one of the medical conditions that participants could report being diagnosed with, or treated for by a medical doctor, in the time since the baseline study (January 2001). At follow up, 70 (10.23%) Gulf War veterans and 63 (9.68%) comparison group participants reported sleep apnoea. This difference between groups did not reach statistical significance; RR 1.06, adj RR 1.04 (95% CI 0.75-1.45).

5.8.4 Key findings

At the time of the follow up study, Gulf War veterans were significantly more likely than the comparison group to report difficulty falling asleep, difficulty staying asleep and problems with waking early. The general level of daytime sleepiness was similar between the two study groups, however very severe daytime sleepiness was more likely amongst Gulf War veterans than comparison group participants. Doctor diagnosed sleep apnoea was similarly reported in the two groups.

5.9 Pain

5.9.1 Pain at follow up

Participants were categorised in to one of five Chronic Pain Grades based on responses to Von Korff's $(1992)^{40}$ questions about pain intensity and disability in the previous six months (Table 42). The Gulf War veteran group was slightly less likely to be pain free than the comparison group and, relative to those who were pain free, Gulf War veterans were slightly more likely than the comparison group to be categorised in each of the higher Pain Grades, however these differences between groups did not meet statistical significance. Almost 1 in 5 Gulf War veterans and 1 in 6 comparison group participants reported pain that was graded as being high in disability and moderately or severely limiting. A large proportion of both Gulf War veterans and comparison group participants (42% and 40% respectively) reported being kept from their usual activities because of pain for one or more days in the previous six months (p=0.506; not tabulated).

Chronic Pain Grade	Gulf War veterans N=602	Comparison group N=584		
	n (%)	n (%)	RR	Adj RR (95% CI)
Grade 0, Pain free	64 (10.63)	78 (13.36)	1.00	1.00
Grade I, Low disability, low intensity	366 (60.80)	363 (62.16)	1.23	1.14 (0.79-1.68)
Grade II, Low disability, high intensity	66 (10.96)	51 (8.73)	1.58	1.50 (0.89-2.51)
Grade III, High disability, moderately limiting	48 (7.97)	51 (8.73)	1.15	1.10 (0.64-1.88)
Grade IV, High disability, severely limiting	58 (9.63)	41 (7.02)	1.72	1.61 (0.93-2.78)

Table 42 Chronic Pain Grade at follow up

Two questions, drawn from the pain subscale of the SF36 investigated how much bodily pain respondents had experienced (Figure 22), and the extent to which pain interfered with normal work, including work outside the home and house work (Figure 23), during the previous four weeks. The comparison group were slightly more likely than the Gulf War veterans to report no bodily pain, and to report that pain had not interfered with their work at all, but these differences were not tested for statistical significance.



Figure 22 The severity of bodily pain in the four weeks prior to follow up



Figure 23 The extent to which pain interfered with normal work in the four weeks prior to follow up

From a list of 19 body areas, the number of areas that participants reported having pain or tenderness in, over the previous 7 days, is shown in Table 43. Gulf War veterans were one and a half times more likely than comparison group participants to endorse between four and six body areas of pain, and more than two and half times more likely to endorse 11 or more body areas of pain. These differences between groups were statistically significant.

Widespread Pain	Gulf War veterans N=693	Comparison group N=652		
Number of body areas	n (%)	n (%)	RR	Adj RR (95% CI)
0-3	451 (65.08)	477 (73.16)	1.00	-
4-6	169 (24.39)	127 (19.48)	1.40	1.47 (1.12-1.93)
7-10	58 (8.37)	43 (6.60)	1.42	1.46 (0.95-2.26)
11+	15 (2.16)	5 (0.77)	3.17	2.89 (1.01-8.28)

In the 63-item symptom questionnaire, for which results are presented in the Symptoms chapter, there were a number of pain-related symptoms which were reported statistically significantly more frequently by the Gulf War veterans relative to the comparison group. They include headaches (60% vs 49%, adj RR 1.19, 95% CI 1.08-1.31), pain without swelling or redness in several joints (46% vs 36%, adj RR=1.27, 95% CI 1.11-1.44), itchy or painful eyes (38% vs 29%, adj RR=1.27, 95% CI 1.09-1.48) and stomach cramps (19% vs 11%, adj RR=1.67, 95% CI 1.27-2.19). A number of additional pain-related symptoms were reported more frequently by Gulf War veterans however these differences just failed to achieve statistical significance; they were chest pain (21% vs 15%, adj RR 1.25, 95% CI 0.99-1.58) and general muscle aches or pains (63% vs 57%, adj RR 1.07, 95% CI 0.98-1.17). The most frequently reported pain-related health symptoms in both study groups were general muscle aches or pains, headaches and low back pain; each reported by more than half of all participants.

5.9.2 Key findings

A large proportion of Gulf War veteran and comparison group participants have been adversely affected by pain in the 6 months prior to the follow up study. More than 40% of all participants reported being kept from their usual activities because of pain for one or more days in the six month period. For the same time period, almost 1 in 5 Gulf War veterans and 1 in 6 comparison group participants reported pain that was graded as being high in disability and moderately or severely limiting. Gulf War veterans were slightly less likely than comparison group participants to be pain free in the last six months, and slightly more likely to score a higher Chronic Pain Grade, however these differences between groups did not meet statistical significance.

In the four week period prior to the follow up study, Gulf War veteran participants were, again, very slightly less likely to report no pain, and slightly more likely to report some interference with their normal work activities as a result of pain.

From a list of 19 body areas, Gulf War veterans were one and a half times more likely than comparison group participants to report pain in four to six body areas in the previous seven days, and more than two and half times more likely to report 11 or more body areas of pain. These differences between groups, in number of body areas affected by pain, were statistically significant.

Gulf War veterans were statistically significantly more likely than the comparison group to report a number of pain-related health symptoms in the past month; they included headaches, pain without swelling or redness in several joints, itchy or painful eyes and stomach cramps. The most frequently reported pain-related health symptoms in the past month, for both study groups, were general muscle aches or pains, headaches and low back pain; each reported by more than half of all participants.

5.10 Respiratory health

Respiratory health was assessed at both baseline and follow up. There were some differences between the two studies, however, in regard to the scope of respiratory health data collected and the mode of data collection, which limited our ability to assess change over time on those variables. At follow up a brief list of respiratory symptoms and medical conditions were assessed via self-report questionnaire. The questions included at follow up were pared down or modified from a larger set of respiratory symptom and condition questions administered by a nurse in the baseline study. The baseline study also included lung function testing using a spirometer, which was not included at follow up. The follow up study included an assessment of respiratory health medications dispensed to participants under the PBS or RPBS, which was not included at baseline.

5.10.1 Respiratory symptoms and conditions at follow up

The respiratory symptoms and conditions assessed at follow up are shown in Table 44. Gulf War veterans were statistically significantly more likely than the comparison group to report all measured symptoms of wheeze, cough and sputum. The difference between groups was the greatest in magnitude for morning cough, with Gulf War veterans 67% more likely than the comparison group to report this symptom. Whilst statistical significance was not achieved for the differences between groups on the respiratory conditions shown in Table 44, such as measures of doctor diagnosed asthma, chronic bronchitis and emphysema or Chronic Obstructive Pulmonary Disease (COPD), the pattern was such that all point estimates were higher in the Gulf War veteran group. The greatest difference was for COPD, but numbers were very small.

Respiratory symptoms and medical conditions	Gulf War veterans (N=659)	Comparison group (N=697)		
	n (%)	n (%)	RR	Adj RR* (95% CI)
Wheeze in last 12 months	182 (26.73)	106 (16.43)	1.63	1.44 (1.15-1.80)
Wheeze with breathlessness	96 (55.17)	43 (43.43)	1.27	1.34 (1.02-1.75)
Wheeze present but not a cold	134 (77.91)	65 (64.36)	1.21	1.23 (1.03-1.47)
Woken by nocturnal cough in last 12 months	201 (29.26)	133 (20.46)	1.43	1.37 (1.11-1.69)
Morning cough	127 (18.35)	71 (10.99)	1.67	1.67 (1.26-2.23)
Day or night time cough	166 (24.16)	108 (16.64)	1.45	1.36 (1.09-1.70)
Symptom-based definition of Chronic bronchitis [§]	144 (20.78)	84 (12.90)	1.61	1.51 (1.17-1.96)
Morning sputum in Winter	156 (23.01)	99 (15.57)	1.48	1.38 (1.10-1.74)
Day or night time sputum in Winter	160 (23.85)	110 (17.32)	1.38	1.31 (1.06-1.63)
Sputum most days for 3 months in two successive years	105 (66.04)	52 (47.71)	1.38	1.31 (1.04-1.65)
Self-reported asthma	100 (14.41)	80 (12.18)	1.18	1.13 (0.86-1.50)
Self-reported doctor confirmed asthma	87 (12.57)	73 (11.18)	1.12	1.09 (0.81-1.47)
Asthma attack in last 12 months	33 (33.33)	16 (20.78)	1.60	1.56 (0.89-3.74)
Currently taking asthma medication [†]	42 (42.42)	23 (30.26)	1.40	1.42 (0.91-2.21)
Self-reported doctor confirmed Chronic bronchitis	75 (10.84)	69 (10.57)	1.03	1.03 (0.74-1.43)
Self-reported doctor confirmed emphysema or COPD [‡]	8 (1.15)	4 (0.61)	1.89	2.14 (0.60-7.66)

Table 44 Self-reported respiratory symptoms and medical conditions at follow up

* Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks), each estimated as at August 1990, any atopy at baseline and current smoking status (never; former; current smoker) † 5 participants who reported taking asthma medication did not specify which ones they took.

‡ COPD is Chronic Obstructive Pulmonary Disease

§ Defined as morning, day or night time cough for as much as three months in each of the previous two years

Prescribed respiratory health medications recorded on the PBS and RPBS

Where participants had provided consent, linked PBS and RPBS data was evaluated to determine the prevalence of participants who had been dispensed a medication for obstructive lung disease, including asthma and COPD, since the baseline study and in the past 12 months. In adults, the majority of inhaled corticosteroids are prescribed in combination with long-acting B-agonists, e.g. Fluticasone/Salmeterol (Seretide) or Budesonide/Eformoterol (Symbicort), and administered through inhalers, or puffers. In the PBS and RPBS it was not possible to distinguish between medications dispensed for asthma from those for other obstructive lung diseases, such as COPD.⁴⁴ However, for these combination inhalers the dispensed price is greater than or equal to the co-payment for those without a concession card, therefore all prescriptions, regardless of concession card possession, are captured in the database⁴⁴ and were used to compare use of medications for obstructive airways disease including asthma and COPD in the two study groups. Medications such as

short-acting beta-agonists, e.g. Ventolin inhalers and about half of the inhaled corticosteroids, cost less than the PBS copayment amount for general patients and do not appear on the PBS or are only subsidised by the PBS when the patient is a concession cardholder. Therefore these medications were not compared. Tiotropium bromide (Spiriva) is a long acting inhaled anticholinergic approved only for use in treatment of COPD and this was also used to compare use of medication for COPD⁴⁴ in the two study groups.

The PBS and/or RPBS data showed that 44 Gulf War veterans (8.2%) and 32 comparison group members (6.5%) had been dispensed a medication listed under the ATC code R03AK for "Adrenergics and other drugs for obstructive airway diseases" or Tiotropium (ATC code R03BB) in the period since the baseline study. In the 12 month period prior to the follow up study only 3.5% of Gulf War veterans and 2.4% of the comparison group had been dispensed one of these medications and this difference between the groups was not significant (RR 1.45, adj RR 1.19, 95% CI 0.59-2.41).

5.10.2 Key findings

Respiratory symptoms in relation to wheeze, cough and sputum were all reported significantly more frequently by Gulf War veterans than the comparison group. Self-reported doctor-confirmed respiratory medical conditions including asthma, chronic bronchitis and emphysema or COPD were also reported more frequently by Gulf War veterans, but these differences between groups were not statistically significant. There was no significant difference between the two groups in regard to respiratory medication use in the 12 months prior to follow up, as measured using PBS and RPBS data.

5.11 Irritable Bowel Syndrome and other gastrointestinal disorders

5.11.1 Irritable Bowel Syndrome and other gastro-intestinal disorders at follow up

Irritable Bowel Syndrome measured using Rome III criteria at follow up

Ninety Gulf War veterans (13.3%) and 52 comparison group participants (8.1%) met Rome III criteria for Irritable Bowel Syndrome (IBS)⁵⁸ in the three months prior to follow up. The difference between the two groups was statistically significant with Gulf War veterans at 64% greater risk of Rome III IBS; RR 1.65, adj RR 1.64, 95% CI 1.18-2.27. Additional analysis excluding participants who reported that they had Colitis or Crohn's disease, which might explain IBS symptoms, caused little change in the difference between the two groups; adj RR 1.67, 95% CI 1.19-2.38. Among those who met Rome III IBS criteria, 4% of the Gulf War veterans and 8% of the comparison group participants had constipation; 25% in both groups had diarrhoea; and 70% and 67% respectively had IBS of mixed type.

Self-reported doctor diagnosed or treated gastro-intestinal disorders at follow up IBS and other gastrointestinal disorders which were self-reported by respondents to have been diagnosed, or treated, by a medical doctor since January 2001 are shown in Figure 24.



Figure 24 Self-reported doctor diagnosed or treated gastrointestinal disorders since 2001

The most prevalent gastro-intestinal disorders were stomach or duodenal ulcers, reported by 5% of the Gulf War veterans and 3.7% of the comparison group. Other gastro-intestinal disorders were very infrequently reported. Only 6 participants in total (1.7%) reported doctor-diagnosed, or treated, IBS. There were no statistically significant differences between the two groups in regard to any of the self-reported doctor-diagnosed gastro-intestinal disorders in Figure 24.

5.11.2 Association between Gulf War-deployment characteristics and Irritable Bowel Syndrome in veterans at follow up

The associations between Gulf War deployment characteristics and the presence of Rome III IBS at follow up in Gulf War veterans are shown in Table 45.

up in male oun trai telerai	15					
		Gulf War veterans with IBS at follow up				
Gulf War exposure	Ν	n (%)	RR	Adj RR (95% CI)		
Age at deployment						
< 20	61	7 (11.48)	1.00	1.00		
20-24	161	25 (15.53)	1.35	1.74 (0.79-3.83)		
25-34	355	48 (13.52)	1.18	2.19 (0.95-5.04)		
>=35	98	10 (10.20)	0.89	1.98 (0.70-5.64)		
Service branch						
Navy	580	77 (13.28)	1.00	1.00		
Army	44	6 (13.64)	1.03	1.29 (0.60-2.76)		
Air Force	51	7 (13.73)	1.03	1.22 (0.59-2.49)		
Rank category						
Officer	144	11 (7.64)	1.00	1.00		
Other rank-supervisory	346	45 (13.01)	1.70	1.76 (0.90-3.42)		
Other rank - non supervisory	184	34 (18.48)	2.42	3.34 (1.58-7.05)		

Table 45 Association between Gulf War-deployment characteristics and Rome III IBS at follow up in male Gulf War veterans

Gulf War veterans with Rome III defined IBS at follow up were significantly more likely to have been in a non-supervisory rank at the time of the Gulf War deployment, compared to higher ranks. There was no association between Rome III defined IBS at follow up and age or service type at deployment.

5.11.3 Key findings

Thirteen percent of Gulf War veterans and 8% of comparison group participants met Rome III criteria for IBS in the three months prior to follow up. This represented a statistically

significant 64% increase in risk of IBS amongst Gulf War veterans relative to the comparison group. Less than one percent of participants in both study groups, however, reported doctor-diagnosed or treated IBS since 2001. While it is acknowledged that the instrument used to identify IBS is not a diagnostic instrument, these findings could indicate that study participants are not reporting symptoms of IBS to medical doctors, or that medical doctors are not identifying IBS as the condition underlying the reported symptoms or a combination of both.

There were no statistically significant differences between the groups in regard to any of the self-reported doctor-diagnosed or treated gastro-intestinal disorders, but numbers were small. The most frequently reported doctor-diagnosed or treated gastro-intestinal disorder was stomach/duodenal ulcer which was reported by approximately 4% of all participants and for which the difference between the two groups was the greatest. Other gastro-intestinal disorders were very infrequently reported in each group.

Relative to Officers, Gulf War veterans who served with a non-supervisory rank at the time of the Gulf War were in excess of three times more likely to have met Rome III criteria for IBS. There was no association between Rome III IBS at follow up and age or service branch at deployment.
5.12 Reproductive health

Information about fertility difficulties and pregnancies fathered was collected by questionnaire at the time of the baseline study for the period commencing 1 January 1992, and at follow up for the period commencing 1 January 2000. These two data sources were pooled so as to collate reproductive health information for the complete period from 1992 to the time of the follow up study.

5.12.1 Fertility difficulties since 1992

Table 46 shows that a significantly higher proportion of Gulf War veterans than comparison group participants (13% versus 8% respectively) reported difficulty fathering a pregnancy since January 1992, despite trying for at least 12 months. Of those, Gulf War veterans were also significantly less likely than the comparison group participants to report having a cause for their infertility found (24% versus 41%). However, Gulf War veterans and comparison group participants who reported difficulty fathering a pregnancy since January 1992, were equally likely to have sought or undertaken infertility treatment and to have fathered a pregnancy since the time of their difficulties with fertility.

	Gulf War veterans N=697	Comparison group N=659		
	n (%)	n (%)	RR	Adj RR (95% CI)
Difficulty fathering a pregnancy since 1992	93 (13.4)	55 (8.4)	1.60	1.44 (1.05-1.99)
Sought or undertaken infertility treatment	48 (51.6)	34 (61.8)	0.83	0.84 (0.61-1.14)
Cause for infertility found	21 (24.4)	19 (41.3)	0.59	0.55 (0.34-0.87)
Fathered a pregnancy since then	59 (64.8)	27 (50.0)	1.30	1.34 (0.99-1.82)

Table 46 Difficulty fathering a pregnancy and treatment for infertility since January 1992

5.12.2 Pregnancies fathered since 1992

In total, 57% of Gulf War veterans (n=399) and 50% of comparison group participants (n=331) reported fathering at least one pregnancy since 1992. This difference between the two groups was not statistically significant (RR 1.14, adj RR 1.05, 95% CI 0.96-1.15). For those who had fathered a pregnancy, the average numbers of pregnancies fathered per

participant was the same for the two groups; equalling 2.1 (sd 1.4) in the Gulf War veteran group and 2.1 (sd 1.4) in the comparison group (RR 0.99, adj RR 0.98, 95% CI 0.89-1.07).

The total number of fathered pregnancies reported since 1992 was 910 by the Gulf War veteran group and 760 by the comparison group. The outcomes of these pregnancies are shown in Table 47. Gulf War veterans and comparison group participants were equally likely to father a pregnancy that resulted in a live birth, miscarriage, still birth or termination. Further information, about those pregnancies which resulted in a live birth, is shown in Table 48. There was no statistically significant difference between the two study groups in regard to the proportion of live births which were premature, of low birth weight or of very low birth rate. Approximately 90% of live born Gulf War veteran babies, and 85% of live born comparison group babies were full-term and normal birth weight.

Pregnancy outcomes	Gulf War veterans' pregnancies N=910	Comparison group pregnancies N=760		
	n (%)	n (%)	RR	Adj RR (95% CI)
Live birth	736 (80.9)	611 (80.4)	1.00	1.00
Miscarriage	132 (14.5)	112 (14.7)	0.98	0.99 (0.75-1.31)
Still birth	5 (0.6)	6 (0.8)	0.69	0.64 (0.20-2.12)
Termination	37 (4.1)	31 (4.1)	0.99	1.02 (0.63-1.67)

Table 48 Live birth outcomes since 1992

Live birth outcomes	Gulf War veterans' live births N=736	Comparison group live births N=611		
	n (%)	n (%)	RR	Adj RR (95% CI)
Premature birth (<= 36 weeks)	78 (10.6)	94 (15.4)	0.69	0.67 (0.42-1.05)
Low birth weight (<2500 grams)	65 (8.8)	76 (12.4)	0.71	0.70 (0.42-1.17)
Very low birth weight (<1500 grams)	16 (2.2)	12 (2.0)	1.11	0.84 (0.26-2.73)

5.12.3 Reproductive health at follow up

In the postal questionnaire, significantly more Gulf War veterans than comparison group participants reported impotence which had been doctor-diagnosed or treated since January 2001 (the approximate time of the baseline study); 8.5% versus 4.5% respectively, RR 1.89, adj RR 2.06, 95% CI 1.30-3.29. Gulf War veterans were also more likely than the comparison group participants to report problems with sexual functioning in the month prior

to follow up (32% versus 24%, RR 1.35, adj RR 1.39, 95% CI 1.17-1.65) and loss of interest in sex in the month prior to follow up (43% versus 32%, RR 1.33, adj RR 1.34, 95% CI 1.16-1.54).

5.12.4 Key findings

Gulf War veterans were significantly more likely than comparison group participants to report difficulty fathering a pregnancy since January1992, despite trying for at least 12 months (13% vs 8% respectively). Of those who reported difficulty fathering a pregnancy, Gulf War veterans were significantly less likely than comparison group participants to have had a cause for their infertility found (24% vs 41%) but equally likely to have sought or undertaken infertility treatment, and to have fathered a pregnancy, since the time of their difficulties with fertility.

Approximately one half of all male participants had fathered a pregnancy at some time since 1992 and the average number of pregnancies, for each of those participants, was just above two. There was no difference between the two groups on these reproductive health measures.

Approximately 80% of all fathered pregnancies since 1992 were reported to have resulted in a live birth, approximately 15% resulted in a miscarriage, less than 1% resulted in a still birth and 4% were terminated. Approximately 90% of live born Gulf War veteran babies, and 85% of live born comparison group babies were full-term and normal birth weight. There were no statistically significant differences between the two study groups in regard to these pregnancy outcomes.

Since the baseline study a larger proportion of Gulf War veterans than comparison group participants reported doctor-diagnosed or treated impotence (8.5% vs 4.5%). Further, in the month prior to the follow up study, Gulf War veterans were more likely than the comparison group to report problems with sexual functioning (32% vs 24%) and loss of interest in sex (43% vs 32%).

5.13 Injuries

Information about injuries was collected at follow up only.

5.13.1 Injury events in the 12 months prior to follow up

Figure 25 shows the numbers of injuries in the 12 months prior to follow up which were "*bad enough to interfere with* [the respondents'] *daily activities*", reported by Gulf War veterans and comparison group participants. Two hundred and sixty seven (38.81%) Gulf War veterans and 244 (37.48%) comparison group participants reported at least one injury in that time period.



Figure 25 Number of injuries, in the 12 months prior to follow up, bad enough to interfere with daily activities

Two hundred and fifty Gulf War veterans and 226 comparison group participants provided information about the event type resulting in up to two most recent injuries in the previous 12 months. The results are shown in Figure 26. Rather than selecting from the event types listed in the questionnaire, many participants selected "Other" and then wrote that the event type was sport or exercise-related, or that the injury was a sprain/strain or muscle tear.

These are shown as separate categories in Figure 26, however technically these entries should have been made under the event type categories listed in the questionnaire. It is likely, for example, that the event type for many of the injuries listed as 'Other-sport/exercise', or 'Other-sprains/strains/tear', would more accurately have been listed in the falls or collisions categories. Observing the data as it was provided, however, the most prevalent event types reportedly leading to injury were falls of less than a metre; being cut or pierced by an object such as a knife or tool; and sport or exercise related activities. The only differences between the two study groups, which reached statistical significance, were for falls of less than a metre (p=0.041) (higher in Gulf War veterans), and sport/exercise related activities (p=0.038) (higher in the comparison group).



Figure 26 Event reported for the two most recent injuries in the 12 months prior to follow up

Table 49 shows the activity type that participants were involved in when injured, the outcomes in terms of health services attended and any resulting time off work/study, and whether alcohol or other substances were involved in the injury. Participants could attribute each injury to more than one activity type. Sports was the activity-type most frequently reported, with one third of recent injuries attributed to this. Leisure, working for an income outside of the ADF and other work were also frequently reported with more than 20% of injuries attributed to these. The two study groups did not differ in regard to the activity types to which their injuries were attributed.

Participants could report more than one health service type which they attended as a result of their injury. Approximately 41% of participants in both groups did not attend any health service, whereas 57% in both groups attended a general practitioner or specialist, and approximately one quarter in both groups attended a hospital emergency/casualty department. Attendance at hospital as an inpatient, which could possibly be an indicator for the most severe injuries, was reported by 14% of Gulf War veterans and 9% of the comparison group; this and other differences between the two study groups, in regard to health service attendance, did not meet statistical significance.

Forty two percent of Gulf War veterans and 39% of comparison group participants took time off work or study as a result of their injury. This difference also did not meet statistical significance. Very small numbers of participants indicated that they were under the influence of alcohol or other substances when injured.

	Gulf War	Comparison	
	veterans	group	
	N=267	N=244	
	n (%)*	n (%)*	p value
Activity when injured			
Working for an income while in ADF	28 (10.49)	25 (10.25)	0.929
Working for an income not in ADF	62 (23.22)	53 (21.72)	0.685
Other work e.g. volunteer, housework	63 (23.60)	46 (18.85)	0.191
Sports	86 (32.21)	85 (34.84)	0.530
Leisure	70 (26.22)	61 (25.00)	0.753
Formal educational	2 (0.75)	0	not computed
Other	10 (3.75)	10 (4.10)	0.837
Health services attended			
Hospital as inpatient	25 (13.89)	14 (9.21)	0.187
Hospital Emergency / casualty	44 (23.66)	46 (27.06)	0.461
Hospital outpatient clinic	18 (10.53)	21 (14.09)	0.330
General practitioner or specialist	127 (57.47)	116 (57.43)	0.993
Other health professional	79 (41.36)	55 (36.42)	0.353
None of these	68 (41.46)	58 (40.56)	0.872
Time off work or study due to the injury	109 (42.08)	88 (37.29)	0.276
Reduced activity because of injury	189 (70.8)	175 (24.6)	0.655
Under the influence of alcohol or other substance when injured	10 (3.85)	4 (1.70)	0.151

Table 49 Activities and outcomes associated with	partici	pant's two	most	recent injuries
		-	-	

* Percentage calculated out of those participants reporting at least one injury in the 12 months preceding the study.

5.13.2 Injuries in the past three years which potentially involved concussion

Respondents were asked to report whether any injuries received in the past three years involved being dazed, confused or seeing stars; not remembering the injury; or losing consciousness (knocked out). These possible indicators of concussion were all more frequently reported by Gulf War veterans than comparison group participants, as shown in Figure 27. The Gulf War veterans were statistically significantly more likely, than the comparison group, to report at least one of the three concussion-related consequences of injury (11% vs. 7%; p=0.013).



Figure 27 Percentage of participants with any injuries in the last three years which potentially involved concussion

5.13.3 Key findings

Recent injury was common amongst participants at follow up. More than a third of participants in both study groups reported at least one injury in the previous 12 months which had been bad enough to interfere with their daily activities. There were few differences between the two groups in regard to the event which led to the injury, such as

motor vehicle/cycle accident, bicycle accident, being struck by or colliding with a person or object, being cut by a knife or tool, operating machinery or a bite or sting. However, Gulf War veterans were slightly more likely than the comparison group to have been injured as a result of a fall of less than one meter, while comparison group members were more likely to be injured as a result of sport/exercise. In both study groups, injuries were most frequently attributed to sports activities compared to paid work, unpaid work or leisure activities.

Injury resulting in attendance at hospital as an inpatient, which could possibly be an indicator for the most severe injuries, was reported by slightly more Gulf War veterans than comparison group participants, however this difference did not meet statistical significance. The two groups were equally likely to attend other types of health services, or to have required time off from work/study, as a result of their injury. Injuries in the previous 12 months which were sustained when respondents were under the influence of alcohol or other substances, were very infrequently reported.

Gulf War veterans were slightly, but statistically significantly, more likely than the comparison group to report an injury which potentially involved concussion.

5.14 Musculoskeletal disorders

In the baseline study, participants were asked about quite broad categories of musculoskeletal disorders; those being 'arthritis or rheumatism', 'back or neck problems' and 'joint problems' which were doctor-diagnosed or treated since January 2001. In the follow up study questionnaire, participants reported on several more-specific categories of musculoskeletal disorders which were doctor-diagnosed or treated since January 2001; they were 'osteoarthritis', 'rheumatoid arthritis', 'other inflammatory arthritis', 'gout' and 'osteoporosis'. Participants were also asked to identify the body sites affected. Because the same method of measuring musculoskeletal disorders was not used across the two studies, longitudinal change over time in musculoskeletal disorders could not be analysed.



5.14.1 Musculoskeletal disorders at follow up

Figure 28 Musculoskeletal disorders which were reported to be doctor-diagnosed or treated since January 2001

Figure 28 shows the five categories of musculoskeletal disorders which were reported, by participants at follow up, as being doctor-diagnosed or treated since January 2001. There

were no statistically significant differences between groups in regard to any of these categories of musculoskeletal disorders. The most prevalent disorder was osteoarthritis, affecting 16% of Gulf War veterans and 14% of the comparison group. Additional investigation of the body sites reported to be affected by osteoarthritis (not tabulated) showed that 57% of the Gulf War veterans and 65% of the comparison group reported osteoarthritis of the knee, 32% and 30% respectively reported osteoarthritis of the lower back, 24% and 15% respectively reported osteoarthritis of the neck, 21% and 22% reported osteoarthritis of the hand and 21% and 17% reported osteoarthritis of the shoulder. The ankle was affected in 16% and 21% of Gulf War veteran and comparison group cases respectively, the feet in 18% and 10%, the hip in 9% and 18% and the elbow in 6% and 7%. With the exception of osteoarthritis of the hip, which was significantly less prevalent amongst Gulf War veteran cases relative to the comparison group cases (adj RR 0.44, 95% CI 0.20-0.95), there were no other statistically significant differences between groups in regard to the body sites affected by osteoarthritis.

5.14.2 Key findings

Participants reported whether, since January 2001, they had been diagnosed with, or treated for, osteoarthritis, rheumatoid arthritis, other inflammatory arthritis, gout or osteoporosis. There were no statistically significant differences between groups in regard to the prevalence of any of these categories of musculoskeletal disorder. The most prevalent musculoskeletal disorder was osteoarthritis, reported by 16% of Gulf War veterans and 14% of the comparison group. The body site most commonly affected by osteoarthritis was the knee which was reported by 61% of all participants with osteoarthritis. Other body sites commonly affected were the lower back which was reported by 31% of participants with osteoarthritis, the hand (21%), neck (20%) and shoulder (20%). Gulf War veterans with osteoarthritis were significantly less likely than the comparison group to report osteoarthritis of the hip (9% and 18% respectively; adj RR 0.44, 95% CI 0.20-0.95). Approximately 3% of all participants reported rheumatoid arthritis, 9% reported other inflammatory arthritis or gout, and approximately 1% reported osteoporosis.

5.15 Depression

5.15.1 Depression at follow up

A number of data sources were used to determine whether or not a participant was likely to have had depression in the 12 months prior to the follow up study. These include the CIDI, PBS and RPBS linkage, and self-reported doctor diagnosis and treatment from the postal questionnaire. Figure 29 shows the percentages of participants who possibly have current depression based on these measures.

CIDI-defined 12-month major depression at follow up

Sixty-three (9.7%) Gulf War veterans and 47 (7.7%) comparison group participants met CIDI criteria for 12 month major depression. This difference between groups at follow up was not statistically significant (RR 1.3, adj RR = 1.2, 95% CI 0.8 - 1.7).

Prescribed anti-depressant medications recorded on the PBS and RPBS

Data received from the PBS and/or RPBS showed that 11.2% of Gulf War veterans and 6.5% of comparison group members had been dispensed a medication listed under the ATC code NO6A for anti-depressives in the 12 month period prior to the study. This difference between groups at follow up was statistically significant, with Gulf War veterans around 56% more likely to have been dispensed an anti-depressant medication (RR 1.73, adj RR = 1.56, 95% CI 1.05 - 2.32).

Self-reported doctor-diagnosed depression and treatment

In the postal questionnaire 76 Gulf War veterans (10.9%) and 57 comparison group members (8.6%) reported that a medical doctor had diagnosed them with, or treated them for, depression in the period since January 2001, and that they had been treated by a doctor for this condition in the past 12 months. This difference between groups at follow up was not statistically significant (RR 1.26, adj RR = 1.15, 95% CI 0.82 - 1.62).



Figure 29 Percentage of participants who possibly have depression based on the CIDI interview, PBS and RPBS records of scripts being dispensed for anti-depressive medications, and self-reported doctor diagnosed and treated depression in the past 12 months

Whilst the observed pattern across Figure 29 is for depression to be more likely in Gulf War veterans than the comparison group across all three measures, the only difference between groups which met statistical significance was that for the proportions of participants in each group being dispensed an anti-depressive medication under the PBS and RPBS in the 12 months prior to the study. The differences between groups in CIDI-defined 12 month depression, and in self-reported doctor diagnosed and treated depression in the previous 12 months, did not achieve statistical significance.

Severity of depressive symptoms

Depressive symptom severity at follow up was measured using the PHQ-9 in the self-report questionnaire. The resulting total scores were positively skewed with 75% of respondents scoring seven or less from a maximum total score of 27. The difference between groups in the median total score was small but statistically significant (Gulf War veterans' median 3, IQR 0.5-7; comparison group median 2, IQR 0-5; adj difference 1, 95% CI 0.35 – 1.70). Figure 30 shows that Gulf War veterans were more likely to be categorised as having mild or

moderate depressive symptoms, and less likely to be categorised as having minimal depressive symptoms, than the comparison group.



Figure 30 Depressive symptom severity derived from the PHQ-9 for participants at follow up

5.15.2 Association between Gulf War-deployment characteristics and depression in veterans at follow up

The associations between Gulf War deployment characteristics and occurrence of CIDIdefined 12 month major depression at follow up in male Gulf War veterans are shown in Table 50. An apparent difference across age category, with Gulf War veterans over 35 years at deployment half as likely to have major depression compared with veterans who were less than 20 years, was not statistically significant either with, or without, service branch and rank included in the model. There were also no significant associations between service branch, or rank category at the time of the Gulf War, and major depression at follow up.

Gulf War deployment characteristic	Gulf V	Var veterans v	vith 12-m follow	onth major depression at up
	Ν	n (%)	RR	Adj RR (95% CI)
Age at deployment				
< 20	58	7 (12.1)	1.0	1.0
20-24	156	19 (12.2)	1.0	1.3 (0.5-2.9)
25-34	336	31 (9.2)	0.8	1.2 (0.5-3.1)
>=35	97	6 (6.2)	0.5	0.9 (0.3-2.8)
Service branch				
Navy	552	54 (9.8)	1.0	1.0
Army	45	4 (8.9)	0.9	0.8 (0.3-2.5)
Air Force	50	5 (10.0)	1.0	1.2 (0.5-2.7)
Rank category				
Officer	139	12 (8.6)	1.0	1.0
Other rank-supervisory	330	25 (7.6)	0.9	0.8 (0.4-1.6)
Other rank - non supervisory	177	25 (14.1)	1.6	1.5 (0.7-3.4)

 Table 50 Association between Gulf War-deployment characteristics and 12 month

 major depression at follow up in Gulf War veterans

5.15.3 Change in prevalence, also persistence, remittance and incidence of 12 month major depression since baseline

For male participants who completed the CIDI at both baseline and follow up (n=637 Gulf War veterans and n=555 comparison group) Table 51 shows that for both groups the prevalence of 12 month major depression increased by approximately 2% from baseline to follow up, but this change over time was not statistically significant in either study group. Additional analysis showed that there was no difference between the two groups (RR 0.85; 95% CI 0.50-1.45) in regard to change over time.

Table 51 Prevalence of 12 month major depression at baseline and follow up for participants who completed the CIDI at both time points

	Gulf War veterans (N=637)			Comparison group (N=555)		
	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR (95% CI)	Baseline prevalence n (%)*	Follow up prevalence n (%)	RR (95% CI)
12 month major depression	50 (7.8)	61 (9.6)	1.22 (0.89-1.66)	28 (5.0)	40 (7.2)	1.43 (0.93-2.20)

* Includes only those participants who also completed the CIDI at follow up

12 month major	Gulf Wa	r veterans		Comparis	on group	
depression	(N=	:637)		(N=555)		
	Follo	ow up		Follo	w up	
Baseline Absent (n = 587)	n (%) absent 543 (92.5)	n (%) present 44 (7.5) [*]	Baseline Absent (n = 527)	n (%) absent 494 (93.7)	n (%) present 33 (6.3) [*]	
Present (n =-50)	33 (66.0) [‡]	17 (34.0) [†]	Present (n = 28)	21 (75.0) [‡]	7 (25.0) [†]	
		Between	groups			
	RR	Adj RR (9	5% CI)			
Incidence	1.2	1.2 (0.8	-1.9)			
Remittance	0.9	0.9 (0.6	-1.2)			
Persistence	1.4	1.4 (0.6	-3.2)			
*						

Table 52 Persistent,	remitted and incident case	s of 12 month maj	or depression among
participants who co	mpleted the CIDI at baseline	e and follow up	

* Incident cases

† Persistent cases

‡ Remitted cases

Table 52 shows the proportions of Gulf War veteran and comparison group participants with a diagnosis (present) or without a diagnosis (absent) of 12 month major depression at baseline and at follow up. Relatively few of the large proportion (>90%) of Gulf War veterans and comparison group members who had no diagnosis of 12 month major depression at baseline, then had this diagnosis at follow up. Incident cases are shown in the first row of data in Table 52 as *absent* at baseline and *present* at follow up. The percentage of incident cases was 7.5 in the Gulf War group and 6.3 in the comparison group; this difference between groups in incidence was not statistically significant. Persistent cases are shown in the second row of data in Table 52 as *present* at baseline and *present* at follow up, whilst remitted cases are *present* at baseline and *absent* at follow up. Of the 50 Gulf War veterans and 28 comparison group members who had a diagnosis of 12 month major depression at baseline, 34% and 25% respectively were persistent cases who also met this criteria at follow up, whereas 66% and 75% remitted. The differences between groups in persistence and remittance were not statistically significant.

5.15.4 Key findings

More than 20 years after the Gulf War, veterans were more likely than the comparison group to report depression symptoms which were mild or moderate in severity, and less likely to report symptoms of minimal severity. Gulf War veterans were also more likely than the comparison group to have been dispensed an anti-depressive medication under the PBS and RPBS in the 12 months prior to the Follow Up study, but higher numbers of CIDI diagnosed major depression and doctor-diagnosed depression did not reach statistical significance.

At follow up, the Gulf War veterans and the comparison group were similar in regard to the change in depression prevalence (as measured by the CIDI) since baseline, and the rates of persistent, incident and remitted cases of depression since baseline. However, the pattern was such that the Gulf War veterans consistently achieved slightly poorer results on these outcomes even though statistical significance was not achieved.

There were no statistically significant associations between major depression in Gulf War veterans at follow up and Gulf War-related age, service branch or rank category.

5.16 Posttraumatic Stress Disorder

5.16.1 PTSD at follow up

Three data sources were used to determine whether or not a participant had PTSD in the 12 months prior to the follow up study. These were the CIDI, and the PCL-S and self-reported doctor diagnosis and treatment questions in the postal questionnaire. Figure 31 shows the percentages of participants who had current PTSD based on these three measures.



Figure 31 Percentage of participants who had PTSD based on the CIDI interview, the PCL and self-reported doctor diagnosed and treated PTSD in the past 12 months

CIDI defined 12 month PTSD at follow up

Forty-seven (7.3%) Gulf War veterans and 17 (2.8%) comparison group participants met criteria for 12 month PTSD at follow up using the CIDI. This difference between groups was statistically significant, with the risk of PTSD in Gulf War veterans estimated to be more than two times higher than the risk in the comparison group (RR 2.59, adj RR = 2.37, 95% CI 1.37 - 4.09).

PCL-defined PTSD at follow up

Using the PCL data, a slightly larger proportion of participants in both study groups (compared to CIDI-defined PTSD) met criteria for PTSD at follow up; 8.2% and 4.8% respectively; and this difference between groups just met statistical significance (RR 1.73, adj RR = 1.56, 95% CI 1.02 – 2.38). Table 53 shows that the PCL total mean score was higher on average for Gulf War veterans, as was the mean score for each of the PCL subscales.

group members at follow up							
	Gulf Wa	Gulf War veterans		Comparison group			
	mean	(%)	mean	(%)	mean diff	Adj mean diff (95% CI)	
PCL Total score	28.3	(13.6)	24.3	(10.5)	4.01	3.62 (2.29-4.94)	
Intrusion	7.7	(4.0)	6.7	(3.1)	1.05	1.01 (0.62-1.40)	
Hyperarousal	9.3	(4.7)	7.9	(3.6)	1.39	1.21 (0.76-1.66)	
Avoidance	11.3	(5.8)	9.7	(4.7)	1.55	1.40 (0.82-1.98)	

Table 53 PCL total and subscale mean scores in male Gulf War veterans and compa	arison
group members at follow up	

Self-reported doctor-diagnosed PTSD

In the postal questionnaire 55 Gulf War veterans (7.9%) and 18 comparison group members (2.7%) reported that a medical doctor had diagnosed them with, or treated them for, PTSD in the period since January 2001, and that they had been treated by a doctor for this condition in the past 12 months. This difference between groups represented a statistically significant, almost three-fold, increase in the Gulf War veterans (RR 2.89, adj RR = 2.94, 95% CI 1.70 – 5.08).

5.16.2 Association between Gulf War-deployment characteristics and 12 month PTSD in veterans at follow up

The associations between Gulf War deployment characteristics and occurrence of 12 month PTSD at follow up in male Gulf War veterans are shown in Table 54. The results indicate that the risk of 12 month PTSD was higher in Army Gulf War veterans compared to Navy or Air Force veterans, however the total number of cases in the Army was small. Whilst 12 month PTSD appears to be more prevalent in younger Gulf War veterans, differences across age were not statistically significant either with, or without, service branch and rank included in the model. Similarly, a noticeable difference across rank category, with the lowest ranked Gulf War veterans more than twice as likely to have PTSD compared to Officers, just reached statistical significance but not after service branch and age were included in the model.

	Gulf W	ar veterans wi	th 12-mon	th PTSD at follow up
Gulf War exposure	Ν	n (%)	RR	Adj RR (95% CI)
Age at deployment				
< 20	58	7 (12.1)	1.00	1.00
20-24	156	15 (9.6)	0.79	0.93 (0.38-2.29)
25-34	336	18 (5.4)	0.44	0.69 (0.26-1.88)
>=35	97	7 (7.2)	0.60	0.93 (0.28-3.19)
Service branch				
Navy	552	39 (7.1)	1.00	1.00
Army	45	6 (13.3)	1.88	2.29 (>1.00-5.24)
Air Force	50	2 (4.0)	0.57	0.77 (0.18-3.18)
Rank category				
Officer	139	6 (4.3)	1.00	1.00
Other rank-supervisory	330	21 (6.4)	1.47	1.66 (0.66-4.21)
Other rank - non supervisory	177	20 (11.3)	2.62	2.54 (0.87-7.43)

 Table 54 Association between Gulf War-deployment characteristics and 12 month PTSD at

 follow up in male Gulf War veterans

5.16.3 Change in prevalence, also persistence, remittance and incidence of 12 month PTSD since baseline

For male participants who completed the CIDI PTSD module at both baseline and follow up (n=637 Gulf War veterans and n=555 comparison group) Table 55 shows the change in prevalence of 12 month PTSD, from baseline to follow up, in both study groups. These results indicate that, in the decade or so since the baseline study, the risk of 12 month PTSD in Gulf War veterans has significantly increased. In contrast the risk of PTSD in the comparison group has remained relatively stable in the period since the baseline study. Additional analysis showed that there was no significant difference between the two groups (RR 1.31; 95% CI 0.56-3.04) in regard to change over time.

Table 55 Prevalence of 12 month PTSD at baseline and follow up for male participants who
completed the CIDI at both time points

	Gul	f War veterans	(N=637)	Con	nparison group	(N=555)
	Baseline prevalence (%) [*]	Follow up prevalence (%)	RR (95% CI)	Baseline prevalence (%) [*]	Follow up prevalence (%)	RR (95% CI)
12 month PTSD	24 (3.8)	47 (7.4)	1.96 (1.29-2.97)	10 (1.8)	15 (2.7)	1.50 (0.72-3.12)

*Includes only those participants who also completed the CIDI at follow up

Table 56 shows the proportions of Gulf War veterans and comparison group participants with a diagnosis (present) or without a diagnosis (absent) of 12 month PTSD at baseline and at follow up. Relatively few of the large proportion (>94%) of Gulf War veterans and comparison group members who had no diagnosis of 12 month PTSD at baseline, then had

this diagnosis at follow up. Incident cases are shown in the first row of data in Table 56 as *absent* at baseline and *present* at follow up. The percentage of incident cases in the Gulf War group (6.0%) was higher than that in the comparison group (2.4%) and this difference between groups was statistically significant. Persistent cases are shown in the second row of data in Table 56 as *present* at baseline and *present* at follow up, whilst remitted cases are *present* at baseline and *absent* at follow up. Of the 24 Gulf War veterans and ten comparison group members who had a diagnosis of 12 month major depression at baseline, 42% and 20% respectively were persistent cases who also met this criteria at follow up, whereas 58% and 80% remitted. These differences between groups in persistence and remittance were not statistically significant, but the number of cases, especially for the persistence analysis, were very small.

Table 56 Persistent and new incident cases of 12 month PTSD among male Gulf War veterans and comparison group members who completed the CIDI at baseline and follow up

12-month PTSD	Gulf War vet	erans (N=637)		Comparison g	roup (N=555)
	Follo	ow up		Follov	v up
Baseline	n (%) absent	n (%) present	Baseline	n (%) absent	n (%) present
absent (n = 613)	576 (94.0)	37 (6.0)*	absent (n = 545)	532 (97.6)	13 (2.4)*
present (n = 24)	14 (58.3) [‡]	10 (41.7) [†]	present (n = 10)	8 (80.0) [‡]	2 (20.0) [†]
		Between g	roups		
	RR	Ad	dj RR (95% CI)	_	
Incidence	2.53	2.	29 (1.24–4.24)		
Remittance	0.73	0.	72 (0.44–1.16)		
Persistence	2.08	2.	48 (0.76–8.08)		
* Incident cases				-	

+ Persistent cases

‡ Remitted cases

5.16.4 Key findings

More than 20 years after the Gulf War, and based on a number of different methods of measuring PTSD, the risk of PTSD in Gulf War veterans was between 1 ½ and three times higher than the risk in the comparison group. Gulf War veterans also had more symptoms across all PTSD domains. Since the baseline study, new cases of PTSD have been more likely to occur in Gulf War veterans than in the comparison group. There was also a pattern of PTSD being more likely to persist, and less likely to remit, in Gulf War veterans relative to the comparison group, however those findings did not reach statistical significance. There was a possible association between Army service at the time of the Gulf War and PTSD at follow up.

5.17 Alcohol and other substance use

5.17.1 Alcohol disorders at follow up

A number of data sources were used to determine whether or not a participant was likely to have had alcohol or other substance abuse or dependency disorders in the 12 months prior to the follow up study. These sources comprised the CIDI, AUDIT questionnaire and self-reported doctor diagnosis and treatment from the postal questionnaire. Only five (0.8%) Gulf War veterans and two (0.3%) comparison group participants met DSM-IV diagnostic criteria for drug disorders using the CIDI, while only four (0.6%) Gulf War veterans and none (0%) of the comparison group participants reported doctor diagnosed and treated substance disorders. As the substance disorder figures were too small for valid statistical analyses, only alcohol disorders are examined further.

Figure 32 shows the percentages of participants who possibly have a current alcohol disorder based on the above measures.



Figure 32 Percentage of participants with possible alcohol disorder in the past 12 months based on CIDI, AUDIT and self-report doctor-diagnosis data

CIDI defined 12 month Alcohol disorders at follow up

Forty (6.2%) Gulf War veterans and 17 (2.8%) comparison group participants met DSM-IV diagnostic criteria for 12 month alcohol disorders using the CIDI. This difference between groups at follow up was statistically significant, with the risk of alcohol disorders in Gulf War

veterans estimated to be almost twice as high as the risk in the comparison group (RR 2.21, adj RR = 1.93, 95% Cl 1.10 - 3.38).

AUDIT caseness at follow up

One hundred and ninety-nine (28.8%) Gulf War veterans and 138 (21.1%) comparison group participants met past year AUDIT caseness criteria for possible harmful or hazardous drinking. The difference in levels of AUDIT caseness between the groups at follow up was statistically significant, with the risk of caseness in Gulf War veterans estimated to be around 26% higher than the risk in the comparison group (RR 1.36, adj RR = 1.26, 95% CI 1.05 – 1.52).

The relative risk for Gulf War veterans compared with the comparison group was higher for CIDI alcohol disorders than for AUDIT caseness. The AUDIT is a self-report screening instrument for harmful or hazardous levels of drinking or drinking-related behaviour, rather than an actual diagnosis, and so prevalence would be expected to be higher for this measure, rather than for the more comprehensive CIDI DSM-IV diagnosis of alcohol disorders.

Self-reported doctor-diagnosis and treatment for alcohol abuse or dependence

Twenty (2.9%) Gulf War veterans and eight (1.2%) comparison group participants reported that a medical doctor had diagnosed them with, or treated them for, alcohol abuse or dependency in the period since January 2001, and that they had been treated by a doctor for that condition in the past 12 months. Although the risk of doctor diagnosed alcohol disorders treated in the past 12 months was estimated to be almost one and a half times as high as the risk in the comparison group, this difference between groups at follow up was not statistically significant, (RR 1.45, adj RR = 1.55, 95% CI 0.64 – 2.81), as numbers were small. Similar results were obtained for exact Poisson regression, performed due to small cell sizes.

The overall levels of doctor diagnosed and treated alcohol disorder was far lower than that of either CIDI-defined alcohol disorders or AUDIT caseness in both groups, suggesting the possibility of a response bias in not self-reporting diagnoses of alcohol disorder at interview, or not reporting alcohol symptoms to medical doctors in the first place, or doctors missing these diagnoses.

5.17.2 Association between Gulf War-deployment characteristics and alcohol disorders in veterans at follow up

The associations between Gulf War deployment characteristics and occurrence of CIDIdefined 12 month alcohol disorders at follow up in male Gulf War veterans are shown in Table 57. Alcohol disorders at follow up were associated with lower ranks, with the highest risks being observed for other rank – non supervisory, followed by other rank – supervisory, when compared with Officers. The overall differences in risk associated with each rank were statistically significant (p < 0.01). There were not any apparent differences in risk of alcohol disorders between age category (p = 0.21), and service branch (p = 0.93).

Gulf War deployment characteristic	Veterans with 12-month alcohol disorders at follow up				
	Ν	n (%)	RR	Adj RR (95% CI)	
Age at deployment					
< 20	58	6 (10.3)	1.0	1.0	
20-24	156	13 (8.3)	0.8	1.1 (0.4-2.8)	
25-34	336	14 (4.2)	0.4	0.9 (0.3-2.3)	
>=35	97	7 (7.2)	0.7	2.1 (0.7-6.1)	
Service branch					
Navy	552	35 (6.3)	1.0	1.0	
Army	45	3 (6.7)	1.0	1.2 (0.4-3.7)	
Air Force	50	2 (4.0)	0.6	0.9 (0.2-3.6)	
Rank category					
Officer	139	2 (1.4)	1.0	1.0	
Other rank-supervisory	330	19 (5.8)	4.0	5.0 (1.3-19.4)	
Other rank - non supervisory	177	19 (10.7)	7.4	9.7 (2.5-37.4)	

 Table 57 Association between Gulf War-deployment characteristics and 12 month alcohol

 disorders at follow up in Gulf War veterans

5.17.3 Change in prevalence, also persistence, remittance and incidence of 12 month alcohol disorder since baseline

For male participants who completed the CIDI Alcohol module at both baseline and follow up (n=637 Gulf War veterans and n=555 comparison group), Table 58 shows the change in prevalence of 12 month alcohol disorder, from baseline to follow up, in both study groups. These results indicate that, in the decade or so since the baseline study, the risk of 12 month alcohol disorder in Gulf War veterans approximately doubled, and this was a statistically significant increase. In contrast the risk of alcohol disorder in the comparison group has increased since the baseline study, but not significantly so. Additional analysis showed,

however, that any difference in risk of developing alcohol disorder across time between Gulf War veterans and the comparison group was not statistically significant (RR 1.13; 95% CI 0.46 - 2.72).

Table 58 Prevalence of 12 month alcohol disorders at baseline and follow up for male
participants who completed the CIDI at both time points

	Gul	f War veterans	(n=637)	Com	parison group	(n=555)
	Baseline prevalence (%) [*]	Follow up prevalence (%)	RR (95% CI)	Baseline prevalence (%)	Follow up prevalence (%)	RR (95% CI)
12 month Alcohol	20 (3.1)	40 (6.3)	2.0 (1.25-3.20)	9 (1.6)	16 (2.9)	1.78 (0.84-3.76)

*Includes only those participants who also completed the CIDI at follow up

Table 59 shows the proportions of Gulf War veterans and comparison group participants with a diagnosis (present) or without a diagnosis (absent) of 12 month alcohol disorders at baseline and at follow up. Due to the small cell sizes, exact Poisson regressions were performed. Relatively few of the large proportion (>94%) of Gulf War veterans and comparison group participants who had no diagnosis of 12 month alcohol disorders at baseline, then had this diagnosis at follow up. Incident cases are shown in the first row of data in Table 59, and consist of those participants for whom 12 month alcohol disorders were *absent* at baseline and *present* at follow up. The percentage of incident alcohol disorders (2.6%). The adjusted difference between the groups narrowly missed statistical significance, although the unadjusted differences were due to possible confounders such as age and military rank when included in the exact Poisson regression model.

Persistent cases are shown in the second row of data Table 59, and consist of those participants for whom 12 month alcohol disorders were *present* at baseline and *present* at follow up, while remitted cases are those for whom 12 month alcohol disorders were *present* at baseline but *absent* at follow up. Of the 20 Gulf War veterans and 9 comparison group members who had a 12 month diagnosis of alcohol disorder at baseline, 35% and 22.2% respectively were persistent cases who met this criteria at follow up, whereas 65% and 77.8% remitted. These differences between groups in persistence and remittance were not statistically significant, but numbers were small and these analyses had limited statistical power.

Table 59 Persistent veterans and compa	and incident c arison group n	ases of 12 month A nembers who comp	Alcohol disorders a pleted the CIDI at b	among Gulf W aseline and f	/ar ollow up
12-month Alcohol	Gulf W	ar veterans		Comparis	on group
	Fo	llow up		Follo	w up
Baseline	n (%) absent	n (%) present	Baseline	n (%) absent	n (%) present
absent (n = 617)	584 (94.7)	33 (5.3)*	absent (n = 546)	532 (97.4)	14 (2.6) [*]
present (n = 20)	13 (65.0) [‡]	7 (35.0) [†]	present (n = 9)	7 (77.8) [‡]	2 (22.2) [†]
	Betwo	een groups			
	RR	Adj RR [§] (95% CI)	_		
Incidence	2.09	1.85 (0.96–3.77)			
Remittance	0.84	0.81 (0.28–2.51)			
Persistence	1.58	1.66 (0.29–16.96)			

*Incident cases

†Persistent cases

‡Remitted cases

SThese RRs are adjusted for binary age category (<25, >=25), service type (Navy, Army/Air Force) and rank (Officer, non-Officer) category at August 1990, using exact Poisson regression due to small cell sizes.

5.17.4 Key findings

The risk of current alcohol disorders in Gulf War veterans was significantly higher than that in the comparison group, as ascertained using both DSM-IV CIDI-defined 12-month diagnosis and AUDIT caseness, but not doctor diagnosed and treated alcohol disorders. In addition, Gulf War veterans were twice as likely to have a CIDI diagnosis at follow-up compared with baseline.

Among Gulf War veterans, risk of CIDI-defined 12 month alcohol disorders was highest for lower ranks. Since the time of the baseline study, CIDI-defined 12 month alcohol disorders in Gulf War veterans are suggestive of being more persistent, less likely to remit and new cases of alcohol disorders have been more likely to occur relative to the comparison group, although numbers were small and these differences were not statistically significant.

5.18 Other indicators of psychological health

5.18.1 CIDI defined disorders at follow up other than major depression, PTSD and alcohol

The results for CIDI-defined 12-month major depression, PTSD and alcohol disorders have been presented in previous sections of this report. The results for additional CIDI-defined disorders present in the 12 months prior to follow up are shown in Table 60. There were no statistically significant differences between the two groups in regard to the disorders included in the Table. In both study groups the most prevalent, of the shown CIDI-defined disorders, was specific phobia which occurred in only 4.8% of all participants, followed by social phobia (3.6%), bipolar disorder (3.3%) and obsessive compulsive disorder (2.9%). Other disorders in the Table occurred in less than 2% of all participants.

	Gulf War veterans	Comparison group		
CIDI-defined disorder	N=697	N=659		
	n (%)	n (%)	RR	Adj RR⁺ (95% CI)
Dysthymia	4 (0.62)	1 (0.16)	3.75*	(0.37–184.81)*
Bipolar disorder	21 (3.25)	11 (1.81)	1.79	2.82 (0.53-28.38)
Generalised anxiety disorder	3 (0.46)	5 (0.82)	0.56*	(0.09-2.89)*
Obsessive Compulsive Disorder	19 (2.94)	8 (1.32)	2.22	2.02 (0.83-5.44)
Specific phobia	31 (4.79)	17 (2.80)	1.71	0.89 (0.43-1.86)
Social phobia	23 (3.55)	16 (2.64)	1.35	1.34 (0.66-2.76)
Panic disorder/agoraphobia	11 (1.70)	6 (0.99)	1.72	1.54 (0.51-5.16)
Drug dependence/abuse	5 (0.77)	2 (0.33)	2.34*	(0.25-2.59)*
Any somatic disorder	9 (1.39)	13 (2.14)	0.65	0.63 (0.23-1.64)
Somatization	1 (0.15)	0	0.94*	(0.02-infinity)*
Conversion disorder	0	3 (0.49)	0.24*	(0.00-2.27)*
Pain disorder	1 (0.15)	3 (0.49)	0.31*	(0.01-3.89)*
Hypochondriasis	7 (1.08)	8 (1.32)	0.82	0.84 (0.25-2.69)
Any CIDI-defined disorder [‡]	163 (25.19)	105 (17.30)	1.46	1.37 (1.09-1.71)

Table 60 CIDI-defined 12-month disorders, other than major depression, PTSD and alcohol disorder, for Gulf War veterans and comparison group participants at follow up

* Due to very small numbers only crude RRs and their associated 95% CIs were calculated and tabulated

† Due to small cell sizes these RRs are calculated using exact Poisson regression and adjusted for binary age category

(<25, >=25), service type (Navy, Army/Air Force) and rank (Officer, non-Officer) at August 1990.

‡ Includes all disorders in this table plus CIDI-defined 12-month major depression, PTSD or alcohol disorder.

The prevalence of Gulf War veteran and comparison group participants who met criteria for any CIDI-defined 12-month disorder at follow up, including those disorders shown in the Table and 12-month major depression, PTSD or alcohol disorders, is also shown in Table 60. One in four Gulf War veterans and one in six comparison group participants met criteria for at least one CIDI-defined 12-month disorder at follow up. This difference between groups was statistically significant. Importantly, these latter figures also indicated that 75% of the Gulf War veterans and 83% of the comparison group participants did not meet criteria for any CIDI-defined 12 month disorder.

Figure 33 shows that the Gulf War veterans were more likely than the comparison group participants to meet criteria for one, two and three or more CIDI-defined 12-month disorders at follow up, including those disorders shown in Table 60 and 12-month major depression, PTSD or alcohol disorders.



Figure 33 Percentages of participants with any one, any two or any three or more CIDI-defined 12-month disorders

5.18.2 Screening instruments for psychosis, Intermittent Explosive Disorder and eating disorders

As described in the Methods chapter, CIDI interviewees were asked a short set of questions in relation to psychosis, Intermittent Explosive Disorder and eating disorders The responses to these questions only allow the researchers to determine whether the respondents would have met sufficient preliminary criteria for the full CIDI module (for each disorder type) to have run if the interview were to continue or, alternatively, to determine that the CIDI would have skipped this module with the respondent not meeting sufficient criteria to continue. The responses to these screening questions in no way indicate whether a participant has the disorder in question or not.

Psychosis Screener

Of the male participants who completed the CIDI, 3.7% of Gulf War veterans and 4% of comparison group members answered affirmatively to one or more of the psychosis screening questions (RR 0.94 adj RR 0.92 95% CI 0.53 – 1.60).

The probe questions in this module of the CIDI were asked if a participant responded affirmatively to a screening question; 22 participants (12 Gulf War veterans and 10 comparison group) were asked probe questions, 15 participants (6 Gulf War veterans and 9 comparison group) answered in a way that may have led to the full psychosis module being run.

The psychosis module of the CIDI includes a question regarding Schizophrenia. Less than five participants indicated that a doctor told them that they may have Schizophrenia. Due to low numbers, no further analysis was conducted.

Intermittent Explosive Disorder Screener

The stem questions for Intermittent Explosive Disorder (IED) were drawn from the World Mental Health Initiative (WMHI) version of the CIDI¹²⁵ as this disorder was not included in the CIDI v.2.0. Just less than one quarter (22.5%) of all participants endorsed sufficient items such that they met minimum criteria for the full IED module to have been run if the interview had continued. They comprised 25.2% of the Gulf War veterans and 19.6% of the comparison group (RR 1.28, adj RR 1.19 95% CI 0.96 – 1.47).

Eating Disorders Screener

Just less than half of all male respondents (45.4%) endorsed sufficient items such that they met minimum criteria for the full Eating Disorders module to have been run if the interview had continued. They comprised 44.1% of the Gulf War veterans and 46.3% of the comparison group (RR 0.95, adj RR 0.92 95% CI 0.81 – 1.04).

Of those who met criteria to complete the Eating Disorders module:

 91.4% answered affirmatively for having lost a lot of weight either through dieting or not meaning to (but not through childbirth or an operation). They comprised 88.5% of Gulf War veterans and 94.3% of comparison group members (RR 0.89, adj RR 0.86 95% CI 0.75 – 0.98).

- 26.8% answered affirmatively that friends or relatives had commented that they were too thin or looked skeletal. They comprised 27.3% of the Gulf War veterans and 26.3% of the comparison group (RR 0.98, adj RR 0.97 95% CI 0.71 – 1.32).
- 5.1% answered affirmatively that they have binged on food. They comprised 5.6% of the Gulf War veterans and 4.6% of the comparison group (RR 1.15, adj RR 1.01 95% CI 0.47 – 2.15).

5.18.3 12-item General Health Questionnaire

General Health Questionnaire (GHQ-12) caseness criteria, indicating psychiatric morbidity, were met by 264 Gulf War veterans (38.0%) and 204 comparison group participants (31.1%). This represented a 19% increase in risk of psychiatric morbidity in the Gulf War veteran group (adj RR 1.19; 95% CI 1.02-1.39) relative to the comparison group.

The associations between Gulf War deployment characteristics and GHQ-12 caseness at follow up in male Gulf War veterans are shown in Table 61. Psychiatric morbidity was higher amongst the youngest Gulf War veterans, however the difference between the older and younger age categories was only marginally significant for those aged 25-34 years, at the time of the Gulf War deployment, compared with those aged less than 20 years. GHQ-12 caseness was not associated with service branch or rank category at deployment.

Gulf War deployment characteristic	Veterans	meeting criteria	a for GHC	Q-12 caseness at follow up
	Ν	n (%)	RR	Adj RR (95% Cl)
Age at deployment				
< 20	61	31 (50.8)	1.00	1.00
20-24	170	65 (38.2)	0.75	0.74 (0.52-1.04)
25-34	363	129 (35.5)	0.70	0.68 (0.46-<1.00)
>=35	101	39 (38.6)	0.76	0.72 (0.46-1.15)
Service branch				
Navy	597	228 (38.19)	1.00	1.00
Army	46	17 (36.96)	0.97	1.00 (0.67-1.50)
Air Force	52	19 (36.54)	0.96	0.99 (0.68-1.45)
Rank category				
Officer	148	56 (37.84)	1.00	1.00
Other rank-supervisory	354	129 (36.44)	0.96	0.97 (0.74-1.26)
Other rank - non supervisory	192	79 (41.15)	1.09	0.94 (0.66-1.34)

Table 61 Association between Gulf War-deployment characteristics and G	HQ-12
caseness at follow up in Gulf War veterans	

5.18.4 Demoralisation

The distribution of Demoralization Scale total scores for both study groups are shown in Figure 34. It can be observed that Gulf War veterans were more likely to achieve high total scores, representing greater levels of demoralisation, and less likely to achieve lower scores.



Figure 34 Distribution of Demoralization Scale scores at follow up

Table 62 shows the median score achieved by each group at the 10th, 25th, 50th, 75th and 90th percentiles. At the 10th percentile, there was no significant difference between the groups in regard to median Demoralization Scale score. However, at each of the 25th, 50th, 75th and 90th percentiles, Gulf War veterans had significantly higher median Demoralization Scale scores than the comparison group.

Percentile	Gulf War veterans	Comparison group	
	Demoralization se	cale median score	Adj diff (95% CI)
10 th	4	4	1 (-0.22, 2.22)
25 th	8	6	2 (0.86 – 3.13)
50 th	16	11	4 (1.83 – 6.17)
75 th	31	21	8 (4.18 – 11.81)
90 th	46	38	9 (1.59 – 16.40)

Table 62 Demoralization Scale median scores at the 10th, 25th, 50th, 75th and 90th percentiles

Table 63 shows the median total scores achieved by each study group for the Demoralization Scale and each of its subscales. The differences between Gulf War veterans and comparison group participants were all in the direction of greater demoralisation in veterans, and were each statistically significant except for 'sense of failure' and 'helplessness'.

Demoralization Scale	Gulf War veterans	Comparison group		
	median (IQR)	median (IQR)	diff	Adj diff (95% CI)
Total score	16 (8-31)	11 (6-21)	5.00	4.00 (1.99-6.00)
Loss of meaning	1 (0-4)	0 (0-2)	1.00	1.00 (0.77-1.23)
Dysphoria	5 (2-8)	3 (1-6)	2.00	1.00 (0.30-1.70)
Disenheartenment	4 (1-9)	2 (1-6)	2.00	1.50 (0.78-2.21)
Sense of failure	5 (4-8)	5 (3-7)	0.00	0.33 (-0.01, 0.68)
Helplessness	1 (0-4)	0 (0-2)	1.00	Could not be computed

Table 63 Demoralization Scale median total score and subscale scores at follow	up
--	----

5.18.5 Resilience

Gulf War veterans and comparison group participants were equally resilient, achieving similar mean resilience scores on the 10-item Connor Davidson Resilience Scale;¹²⁶ veteran mean 27.88 sd 7.24 vs comparison group mean 29.61 sd 6.69; adj diff -1.31 95%CI -2.07, -0.57.

5.18.6 Suicidality

Figure 35 shows the differences between the Gulf War veterans and comparison group in suicidal thoughts and behaviours in the 12 months prior to follow up. Gulf War veterans were significantly more at risk of feeling that life was not worth living (adj RR 1.40; 95% CI 1.07-1.83) and significantly more at risk of making a suicide plan (adj RR 2.44, 95% CI 1.10-5.42). Statistically, the two groups were similar in their risk of feeling so low that they thought about committing suicide (adj RR 1.22, 95% CI 0.87-1.71) or attempting suicide (adj RR 1.08, 95% CI 0.26-4.43).

Mortality Study results which are presented in the Mortality and Cancer Incidence chapter, indicate that 0.3% of cohort members in both study groups are deceased with a cause of death given as 'intentional self-harm'. These deceased cohort members are not represented in the results presented about suicidal thoughts and behaviours among study participants.



Figure 35 Suicidality in the 12 months prior to follow up

5.18.7 Risk taking propensity

Based on the EVAR-B scale, the risk taking propensity of participants was assessed and categorised as either *average*, *above average* or *severe*. Figure 36 shows that the distribution of Gulf War veterans and comparison group participants across each of the three categories was very similar. Additional analyses (not tabulated) found no statistically significant differences between the two groups in relation to category of risk taking propensity.



Figure 36 Risk taking propensity of Gulf War veteran and comparison group participants at follow up

The total mean score for the EVAR-B, the mean scores achieved for each of five factors described by the French authors Sicard *et al* 1999⁶⁹ (termed FF1 to FF5) and the mean scores achieved for each of three factors described by the American authors Kilgore *et al* 2006⁷⁰ (termed AF1 to AF3) are shown in Table 64. There were very small, but statistically significant, differences between the two groups with Gulf War veterans scoring slightly lower on the factors labelled *self-control* and *self*-confidence, and slightly higher on the factor labelled *invincibility*, relative to the comparison group. The smaller differences between the two groups on total score and the other risk-taking propensity factors in Table 64 did not reach statistical significance.

EVAR-B risk taking propensity	Gulf War veterans N=688	Comparison group N=652		
	mean (sd)	mean (sd)	diff	Adj diff (95% Cl)
Total scores	12.20 (2.29)	12.04 (2.10)	0.16	0.09 (-0.14, 0.33)
FF1-Self-control	15.18 (3.35)	15.60 (3.13)	-0.42	-0.37 (-0.72, -0.02)
FF2-Danger seeking	10.43 (3.77)	10.03 (3.49)	0.40	0.26 (-0.13. 0.66)
FF3-Energy	14.22 (2.95)	14.11 (2.83)	0.11	0.05 (-0.26, 0.37)
FF4-Impulsiveness	7.69 (2.97)	7.40 (2.70)	0.29	0.18 (-0.13, 0.49)
FF5-Invincibility	12.57 (3.42)	12.04 (3.17)	0.53	0.42 (0.07 – 0.78)
AF1- Risk/Thrill seeking	11.20 (2.85)	10.84 (2.63)	0.36	0.23 (-0.06, 0.53)
AF2- Self confidence	8.08 (2.86)	8.59 (2.52)	-0.51	-0.46 (-0.76, -0.17)
AF3- Need for control	9.41 (2.86)	9.40 (2.19)	0.01	0.01 (-0.23, 0.24)

Table 64 EVAR-B mean total score and mean factor scores for	partici	pants at	follow ι	Jp
---	---------	----------	----------	----

5.18.8 Key findings

Other than major depression, PTSD and alcohol disorders which are described in previous chapters, other CIDI-defined 12-month disorders were not common in the two study groups. The most prevalent of the other CIDI-defined disorders present in the 12 months prior to follow up, was specific phobia which occurred in only 4.9% of all participants, followed by social phobia (3.6%), bipolar disorder (3.3%) and obsessive compulsive disorder (2.9%). There was no difference between the groups for these and other less frequent CIDI-defined disorders. Gulf War veterans were significantly more likely than the comparison group to have at least one CIDI-defined 12 month disorder (25% vs 17%) when all CIDI-defined 12 month disorders.

Thirty eight percent of Gulf War veterans and 31% of comparison group participants met GHQ-12 caseness criteria, representing a 1.2-fold increase in the risk of psychiatric morbidity in Gulf War veterans. There was a weak association between age at deployment and psychiatric morbidity at follow up, with Gulf War veterans aged 20 years or less at

deployment 32% more likely to meet GHQ-12 caseness compared with Gulf War veterans aged 25-34 years at deployment. Psychiatric morbidity in Gulf War veterans at follow up was not associated with Gulf War deployment-related service branch or rank category.

There was no difference between the groups in regard to their likelihood of meeting screening criteria for full administration of any of the Psychosis, Intermittent Explosive Disorder or Eating Disorders modules of the CIDI. However, Gulf War veterans were slightly less likely than the comparison group to have met criteria for full administration of the Eating Disorders module due to having lost weight.

Gulf War veterans were more likely to have higher levels of demoralisation, but they were equally resilient. Gulf War veterans were also 1.4 times more likely to have felt that life was not worth living and 2.4 times more likely to have made a suicide plan, but there were no differences between the groups on attempted suicide.

Gulf War veterans and comparison group participants were similar in regard to their likelihood of being *average-*, *above average-* or *severe* risk takers. Relative to the comparison group, Gulf War veterans scored slightly lower on risk-taking propensity factors labelled *self-control* and *self-*confidence, and slightly higher on the factor labelled *invincibility*.

5.19 Other medical conditions

In addition to the medical conditions already presented in this report, Table 65 shows other medical problems or conditions which were reported by participants as being doctordiagnosed or treated since January 2001 (in order of most prevalent to least prevalent for Gulf War veterans).

or treated since bandary 2001				
Medical condition	Gulf War veterans (N=697)	Comparison group (N=659)		
	n (%)	n (%)	RR	Adj RR (95% CI)
High cholesterol	243 (35.4)	216 (33.2)	1.07	1.13 (0.98-1.32)
High blood pressure	185 (27.0)	160 (24.5)	1.10	1.14 (0.95-1.37)
Hearing loss	148 (21.5)	148 (22.8)	0.95	0.98 (0.80-1.20
Other skin cancer [†]	142 (20.7)	153 (23.7)	0.87	0.98 (0.80-1.20)
Anxiety or stress	130 (18.9)	95 (14.7)	1.29	1.25 (0.97-1.61)
Depression	128 (18.6)	94 (14.4)	1.29	1.19 (0.93-1.53)
Eye or vision problems	92 (13.5)	69 (10.7)	1.26	1.27 (0.94-1.72)
Posttraumatic Stress Disorder	88 (12.9)	28 (4.3)	2.98	2.86 (1.88-4.35)
Sinus problems	83 (12.1)	51 (7.8)	1.54	1.51 (1.07-2.15
Sleep apnoea	70 (10.2)	63 (9.7)	1.06	1.04 (0.75-1.44)
Polyp/s in the bowel	70 (10.2)	58 (8.9)	1.15	1.34 (0.96-1.88)
Dermatitis	59 (8.6)	23 (3.6)	2.43	2.21 (1.35-3.59)
Impotence	58 (8.5)	29 (4.5)	1.89	2.06 (1.30-3.29)
Other kind of cancer [‡]	38 (5.7)	29 (4.6)	1.23	1.30 (0.81-2.10)
Diabetes	38 (5.5)	48 (7.4)	0.75	0.76 (0.51-1.14)
Pneumonia	38 (5.5)	17 (2.6)	2.11	1.87 (1.03-3.39)
Other psychiatric or psychological condition	37 (5 6)	27 (4 2)	1 22	1 30 (0 79 2 17)
Migraines	37 (5.4)	32 (4.9)	1.10	1.06 (0.66-1.70)
Eczema	35 (5.1)	11 (1.7)	3.00	2.84 (1.43-5.65)
Alcohol abuse or dependency	34 (5.0)	18 (2.8)	1.79	1.60 (0.91-2.83)
Psoriasis	30 (4.4)	26 (4)	1.09	1.11 (0.66-1.85)
Kidney disease	27 (4.0)	14 (2.2)	1.83	1.83 (0.95-3.53)
Carpal tunnel syndrome	23 (3.4)	25 (3.9)	0.87	0.80 (0.46-1.4)
Heart attack/myocardial infarction	20 (2.9)	22 (3.4)	0.86	0.91 (0.51-1.63)
Malignant melanoma	19 (2.8)	13 (2)	1.38	1.25 (0.62-2.52)
Bladder disease	16 (2.3)	11 (1.7)	1.38	1.65 (0.74-3.67)
Chronic fatigue syndrome	15 (2.2)	4 (0.6)	3.56	2.88 (0.92-9.08)
Angina	11 (1.6)	9 (1.4)	1.16	1.26 (0.51-3.10)
Drug abuse or dependency	8 (1.2)	1 (0.2)	*	*

Table 65 Medical problems or conditions which participants reported to be doctor-diagnosed or treated since January 2001

Medical condition	Gulf War veterans (N=697)	Comparison group (N=659)		
	n (%)	n (%)	RR	Adj RR (95% CI)
Stroke	6 (0.9)	5 (0.8)	1.14	1.20 (0.41-3.53)
Cirrhosis of the liver	4 (0.6)	2 (0.3)	*	*
Epilepsy	4 (0.6)	0 (0)	*	*
Traumatic brain injury	4 (0.6)	5 (0.8)	*	*
Motor Neurone Disease	2 (0.3)	0 (0)	*	*
Multiple Sclerosis	1 (0.1)	1 (0.2)	*	*
Temporomandibular joint (TMJ) dysfunction	2 (0.3)	2 (0.3)	*	*
Fibrositis or fibromyalgia	2 (0.3)	2 (0.3)	*	*
Multiple Chemical Sensitivity	2 (0.3)	2 (0.3)	*	*
Hepatitis	2 (0.3)	0 (0)	*	*
Heart failure/cardiac failure	1 (0.1)	3 (0.5)	*	*

* These RRs, adj RRs and associated 95% CIs were not calculated due to small numbers

† Skin cancer other than malignant melanoma

‡ Cancer other than malignant melanoma and other skin cancers

There was a statistically significant difference between groups in regard to six of the 40 medical conditions shown in Table 65. Posttraumatic Stress Disorder, sinus problems, dermatitis, impotence, pneumonia and eczema were all reported between 1 ½ and 3 times more frequently in the Gulf War veteran group relative to the comparison group. In regard to the other 34 conditions shown in Table 65, the pattern of reporting in both groups was similar. The most prevalent medical conditions in both groups were high cholesterol, reported by one in three participants, and high blood pressure, reported by one in four participants, both of which are important predictors of cardiovascular disease. Hearing loss and skin cancers other than melanoma were also common, reported by more than one in five participants. Overall patterns of frequency were similar between the two groups, with the seven most prevalent medical conditions reported by Gulf War veterans (i.e. the first seven conditions listed in Table 65) being also the seven most prevalent conditions reported by the comparison group. Medical conditions which were very rarely reported by Gulf War veterans were also rarely reported by the comparison group.

5.19.1 Key findings

Posttraumatic Stress Disorder, sinus problems, dermatitis, impotence, pneumonia and eczema, all reported to have been diagnosed or treated by a doctor since the time of the baseline study, were between 1½ and 3 times more likely in Gulf War veterans relative to the comparison group. The Gulf War veterans and comparison group participants were similar in regard to their pattern of reporting the other medical conditions included in this
assessment. High cholesterol was the most prevalent medical condition in both groups, reported by 34% of all participants, followed by high blood pressure (26%), hearing loss (22%) and skin cancers other than melanoma (22%).

5.20 Life Events

The life events which are included in this chapter were measured at follow up only.

5.20.1 Events due to shortage of money

From the list of seven items shown in Table 66, participants selected any events which had happened to them or to their household because of a shortage of money. One in five Gulf War veterans, and one in six comparison group participants, reported that at least one of the events had happened as a result of a shortage of money. This difference between the two study groups was not statistically significant.

Table 66 Events which happened because of a shortage of money						
Event	Gulf War veterans	Comparison group				
Event	N=670	N=649				
	n (%)	n (%)				
Could not pay utilities	99 (14.77)	65 (10.01)				
Could not pay car registration or insurance on time	59 (8.80)	52 (8.01)				
Pawned or sold something	33 (4.92)	32 (4.93)				
Unable to heat home	9 (1.34)	12 (1.85)				
Sought financial help from friends or family	65 (9.70)	41 (6.32)				
Went without meals	30 (4.47)	24 (3.69)				
Sought assistance from welfare/community org	15 (2.23)	15 (2.31)				
			RR	Adj RR (95% CI)		
None of above	539 (80.45)	550 (84.75)	1.00	1.00		
Any of the above	131 (19.55)	99 (15.25)	1.28	1.16 (0.92-1.47)		

5.20.2 Homelessness

Less than ten participants in total reported staying one or more nights in a homeless shelter, on the street, in a park or in an abandoned building. There was no statistically significant difference between the two study groups.

5.20.3 Convictions or incarcerations

Table 67 shows the numbers of participants who indicated whether they had ever been convicted of a crime in a court of law, including civil court, criminal court or military court. The proportion of Gulf War veterans being convicted of a crime in the period after August

1990 was slightly larger than the proportion in the comparison group, and this difference just met statistical significance. The numbers before August 1990 were similar in the two groups.

Convicted of a crime	Gulf war veterans N=705	Comparison group N=669		
	n (%)	n (%)	RR	Adj RR (95% CI)
Ever	127 (18.01)	93 (13.90)	1.30	1.24 (0.97-1.59)
Before Aug 1990	69 (9.77)	64 (9.54)	1.02	1.08 (0.78-1.51)
After Aug 1990	70 (9.89)	37 (5.51)	1.79	1.50 (1.01-2.20)

Table 67	7 Participants	convicted	of a crir	ne in a	court of	law
		CONVICIEU		пеша	COULTON	10,00

Fewer than five participants in total reported being sent to jail by a judge in a court, or spending time on remand awaiting a court hearing in the time since the Gulf War. The statistical difference between the groups was not calculated due to the small numbers.

5.20.4 Potentially traumatic events

Exposure to potentially traumatic events (PTE's) since January 1991 is shown in Table 68, ordered by frequency of reporting for Gulf War veterans. For the privacy of participants, individual PTEs which were reported by less than ten participants in total were grouped together and included under the heading "other". More than half of the participants in both study groups reported at least one of the PTEs listed. The pattern of PTE exposure was similar between the two groups.

Potentially traumatic event since January 2001	Gulf War veterans (N=695)	Comparison group (N=657)				
	n (%)	n (%)	RR	Adj RR (95% CI)		
Did you see someone being badly injured or killed, or unexpectedly see a dead body?	126 (18.13)	120 (18.24)	0.99	0.96 (0.77-1.22)		
Did someone very close to you die unexpectedly; for example, they were killed in an accident, murdered, committed suicide, or had a fatal heart attack at a young age?	112 (16.14)	97 (14.72)	1.10	1.10 (0.85-1.41)		
Did you serve as a peacekeeper or relief worker in a war zone or in a place where there was ongoing terror of people because of political, ethnic, religious or other conflicts?	88 (12.68)	81 (12.29)	1.03	1.04 (0.77-1.41)		
Were you involved in a major natural disaster, like a devastating flood, hurricane or earthquake?	81 (11.67)	68 (10.32)	1.13	1.11 (0.80-1.53)		
Were you exposed to a toxic chemical or substance that could cause you serious harm?	79 (11.45)	64 (9.80)	1.17	1.07 (0.77-1.49)		
Did you have any other life- threatening accident, including on your job?	65 (9.37)	51 (7.79)	1.20	1.10 (0.77-1.59)		
Did you participate in combat, either as a	57 (8.21)	43 (6.54)	1.25	1.37 (0.91-2.05)		

Table 68 Potentially traumatic events since January 2001

Potentially traumatic event since January 2001	Gulf War veterans (N=695)	Comparison group (N=657)		
	n (%)	n (%)	RR	Adj RR (95% CI)
member of a military, or as a member of an organised non-military group?				
Did you have a life threatening illness?	55 (7.95)	46 (7.00)	1.14	1.14 (0.78-1.69)
Did you have a son or daughter who had a life threatening illness or injury?	38 (5.47)	37 (5.61)	0.97	1.07 (0.68-1.70)
Were you involved in a life threatening automobile accident?	32 (4.62)	32 (4.87)	0.95	0.81 (0.50-1.53)
Were you in a man-made disaster, like a fire started by a cigarette, or a bomb explosion?	31 (4.47)	24 (3.65)	1.22	0.98 (0.57-1.69)
Were you mugged, held up, or threatened with a weapon?	28 (4.04)	25 (3.80)	1.06	0.99 (0.56-1.72)
Did you see atrocities or carnage such as mutilated bodies or mass killings?	28 (4.03)	20 (3.04)	1.32	1.25 (0.70-2.25)
Were you an unarmed civilian in a place where there was a war, revolution, military coup or invasion? (By this we mean a civilian not directly involved in the armed conflict)	25 (3.60)	19 (2.89)	1.24	1.50 (0.79-2.85)
Did you live as a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious or other reasons?	19 (2.73)	24 (3.64)	0.75	0.89 (0.49-1.59)
Did anyone very close to you have an extremely traumatic experience, like being kidnapped, tortured or raped?	14 (2.01)	15 (2.28)	0.88	0.82 (0.39-1.73)
Other	87 (12.25)	70 (10.39	1.18	1.09 (0.81-1.49)
None of the above	285 (40.89)	284 (43.10)	1.00	1.00
Any of the above	412 (59.11)	375 (56.90)	1.04	1.02 (0.93-1.12)

5.20.5 Key findings

Gulf War veterans and comparison group participants were equally likely to have experienced financial difficulty which had led to events such as the inability to pay utilities, car registration or insurance on time, or the need to seek financial assistance from friends or family or welfare organisations. Events such as these were reported by 17% of all participants. Very small numbers of participants reported homelessness or incarcerations and there was no difference between the study groups on these measures. Gulf War veterans were very slightly more likely to have received a criminal conviction in the period since August 1990, which may be indicative of social dysfunction or maladaptive behaviours which are related to war deployment or connected to chronic morbidity. More than half of the participants in both study groups had experienced at least one potentially traumatic event. The pattern of exposure to potentially traumatic events was similar for the two groups.

5.21 Health risk factors

5.21.1 Health risk factors at follow up

Table 69 Health risk factor	s at ionow up	_		
Health risk factor	Gulf War veterans N=694*	Comparison group N=658*		
	Mean (SD)	Mean (SD)	diff	Adj diff (95% Cl)
Weight in kilograms	91.50 (14.51)	91.13 (15.24)	0.38	-0.37 (-2.01, 1.27)
Body Mass Index	29.08 (4.05)	28.95 (4.34)	0.13	-0.05 (-0.51, 0.42)
Waist in centimetres	102.82 (11.37)	102.35 (11.44)	0.47	0.01 (-1.24, 1.26)
Smoker status	n (%)	n (%)	$\mathbf{R}\mathbf{R}^{\dagger}$	Adj RR † (95% CI)
Never	312 (45.02)	319 (48.70)	1.00	1.00
Former	296 (42.71)	272 (41.53)	1.11	1.07 (0.84-1.37)
Current	85 (12.27)	64 (9.77)	1.36	1.14 (0.78-1.66)
Exercise level				
Sedentary	172 (24.78)	128 (19.45)	1.00	1.00
Low	242 (34.87)	269 (40.88)	0.67	0.68 (0.50-0.91)
Moderate	205 (29.54)	187 (28.42)	0.82	0.84 (0.61-1.15)
High	75 (10.81)	74 (11.25)	0.75	0.70 (0.46-1.05)
Body Mass Index				
Normal 18.5 <25	89 (13.51)	104 (17.66)	1.00	1.00
Overweight >25 <30	334 (50.68)	270 (45.76)	1.45	1.47 (1.05-2.06)
Obese >=30	236 (35.81)	215 (36.44)	1.28	1.18 (0.83-1.67)
Waist circumference risk indicator				
Not at risk (<94 cm)	134 (19.91)	143 (22.27)	1.00	1.00
Increased risk (94-<102 cm)	192 (28.53)	199 (31.00)	1.03	1.06 (0.77-1.46)
Substantially increased risk (>=102 cm)	347 (51.56)	300 (46.73)	1.23	1.16 (0.86-1.56)

Table 69 Health risk factors at follow up

* Actual N varies by up to 10% fewer respondents

† Calculated using multinomial logistic regression

‡ Not calculated due to small numbers

Table 69 shows that Gulf War veterans and comparison group participants are similar in regard to a number of health-related risk factors. There were no statistically significant differences between the two groups on mean body weight, mean Body Mass Index (BMI), mean waist circumference and associated categories, and smoking status. More than 80% of participants in both study groups were categorised as overweight or obese based on their BMI, and a similar proportion were categorised as being at increased risk, or substantially increased risk, of obesity-related health complications based on their waist circumference. Almost one half of all participants have never been cigarette smokers, and only approximately 10% reported being current smokers at follow up, with the balance reporting being former smokers. Relative to the comparison group, Gulf War veterans were a little more likely to be sedentary than low level exercisers, and a little more likely to be overweight

than normal weight, However, approximately 40% of all participants exercised at a moderate or high level, and this did not differ between the two study groups.



Figure 37 Usual number of serves of fruit eaten per day

Figure 37 and Figure 38 show that the usual number of serves of fruit and vegetables eaten per day was similar in the two study groups. Only five percent of all participants reported that they ate five or more serves of vegetables per day, which is the minimum recommended for adults in the Australian Dietary Guidelines.⁸⁴ A much larger proportion of participants, more than 55% in both groups, reported that they ate two or more serves of fruit per day which is the minimum recommended.⁸⁴



Figure 38 Usual number of serves of vegetables eaten per day

5.21.2 Change in health risk factors since baseline

Table 70 shows the change in health risk factors from baseline to follow up, for those participants who were assessed at both time points. In both study groups average body weight, BMI and waist circumference had significantly increased in the ten year interim from baseline to follow up. The proportion of participants who were in the overweight or obese BMI categories had significantly increased by 10% in the Gulf War veteran group and 7% in the comparison group since the baseline study. Both study groups, however, were noticeably less likely to be smokers at follow up relative to baseline, with the proportion reporting to be current smokers approximately halved. Additional statistics (not tabulated) measured whether the change in risk factors over time was different for the Gulf War veterans than it was for the comparison group. These showed that the increase in average body weight was greater for Gulf War veterans than for the comparison group (diff 1.3; 95% CI 0.5-2.1), the increase in BMI was greater for Gulf War veterans than for the comparison group (diff 0.4; 95% CI 0.1-0.7) and the increase in waist circumference was greater for Gulf War veterans than for the comparison group (diff 1.2; 95% CI 0.3-2.1). There was no significant difference between the two groups in the rate of change in smoking status over time (diff 0.94; 95% CI 0.73-1.21) or the rate of change in BMI category over time (diff 1.03, 95% CI 0.98-1.08). It should be noted that at baseline, weight and waist circumference was measured by a nurse whereas at follow up these measurements were self-reported by the participants. Systematic differences between the measurements taken at baseline and

subsequently at follow up could affect the assessment of changes in these variables over time.

	Gulf War veterans N=695*		Comparison group N=659*			
	Baseline mean	Follow up mean	Diff (95% CI)	Baseline mean	Follow up mean	Diff (95% CI)
Weight	87.86	91.50	3.64 (3.10-4.20)	88.90	91.12	2.32 (1.73-2.91)
BMI	27.94	29.08	1.16 (<1.0-1.33)	28.19	28.95	0.75 (0.57-0.94)
Waist	97.29	102.82	5.54 (4.92-6.16)	98.01	102.35	4.36 (3.71-5.02)
	Baseline prevalence %	Follow up prevalence %	RR (95% CI)	Baseline prevalence %	Follow up prevalence %	RR (95% CI)
Current smoker	24.03	13.13	0.55 (0.46-0.64)	16.84	9.77	0.58 (0.48-0.70)
BMI category overweight or obese	78.83	86.49	1.10 (1.06-1.14)	76.91	82.20	1.07 (1.03-1.11)

Table 70 Health risk factors at baseline and follow up for participants who were assessed at both time points

* Actual N varies by up to 10% fewer respondents

5.21.3 Key findings

At follow up, Gulf War veterans and comparison group participants were similar in regard to a number of health-related risk factors, including mean body weight, Body Mass Index, waist circumference and associated categories, and smoking status. Four out of five participants in both study groups were overweight or obese. In both study groups average body weight, BMI and waist circumference had significantly increased in the ten year interim from baseline to follow up. Almost half of all participants had never been cigarette smokers, and half of those who smoked at baseline were no longer smokers at follow up. Approximately 40% of all participants exercised at a moderate or high level, and this did not differ between the two study groups. Gulf War veterans and comparison group participants were similar in regard to the average number of serves of fruit and vegetables eaten per day. Only five percent of all participants ate the minimum recommended number of serves of vegetables per day according to Australian Dietary Guidelines,⁸⁴ while at least 55% of participants ate the minimum recommend number of serves of fruit.⁸⁴

5.22 Social health

5.22.1 Functional social support

The Medical Outcomes Study (MOS) Social Support Survey⁸⁵ assesses functional social support (e.g. perception of being supported) by producing an Overall Support Index score and scores for the availability of Emotional/Information Support, Tangible Support, Affectionate Support and Positive Social Interaction. Higher scores represent higher ratings of social support. The results for the two study groups are shown in Table 71. The difference between groups in the median total score for the Overall Support Index was very small and not statistically significant. There were also no significant differences between groups in their ratings of Emotional/Information Support, Tangible Support, Affectionate Support or Positive Social Interaction.

MOS Social Support	Gulf War veterans N= 697	Comparison group N= 659	
	Median (IQR)	Median (IQR)	Adj Median diff (95% CI)
Overall Support Index	3.16 (2.37-3.89)	3.32 (2.47-3.89)	-0.5 (-0.21, 0.11)
Emotional/Information Support	3.00 (2.13-3.88)	3.13 (2.25-3.88)	0 (-0.17, 0.17)
Tangible Support	3.50 (2.75-4.00)	3.50 (2.75-4.00)	0 (-0.19, 0.19)
Affectionate Support	3.67 (2.66-4.00)	4.00 (2.66-4.00)	0 (-0.22, 0.22)
Positive Social Interaction	3.33 (2.33-4.00)	3.33 (2.66-4.00)	0 (-0.17, 0.17)

Table 71 MOS Social Support scores by study group

5.22.2 Structural social support

Number of close friends and relatives

When reporting how many close friends and close relatives the participant felt they could comfortably talk to, reports ranged from 0-50 for Gulf War veterans and from 0-99 for comparison group participants. There was a very small but statistically significant difference between Gulf War veterans and comparison group participants, with Gulf War veterans reporting an average of one fewer close friend or relative (veterans' median 5, IQR 2-9; comparison group median 5, IQR 3-10; adj difference -1, 95% CI -1.55, -0.45).

Number of voluntary groups or organisations

Upon being asked how many voluntary groups or organisations they belonged to, such as parent groups, clubs or lodges and church groups, the number reported ranged from 0 - 10 for Gulf War veterans and 0-12 for the comparison group. There was no significant

difference between the Gulf War veterans and the comparison group in the number of voluntary groups or organisations reported (veterans' median 1, IQR 0-2; comparison group median 1, IQR 0-2; adj difference 0, 95% CI -0.29 – 0.29).

Level of activity in voluntary groups or organisations

Among those participants who reported belonging to at least one voluntary group or organisation (n=706) 34.5% of Gulf War veterans and 38% of the comparison group reported being very active (attend most meetings), 39.7% of Gulf War veterans and 41% of the comparison group reported being fairly active (attend fairly often, and 25.8% of the Gulf War veterans and 21% of the comparison group reported being not active (belong but hardly ever go). A chi-square test revealed no significant difference between the groups, $X^2(3, N=706) = 3.400$, p = 0.33.

5.22.3 Involvement in ex-service organisations and commemoration of military occasions

Figure 39 shows that Gulf War veterans were very slightly more likely to be involved with exservice organisations than the comparison group, however the difference was very small and only just reached statistical significance (32% vs 28%; RR 1.03, adj RR 1.04, 95% Cl >1.00 - 1.08).



Figure 39 Involvement in ex-service organisations by study group

Figure 40 shows that the two study groups were equally likely to commemorate significant military related occasion such as attending ANZAC day services (72% vs 70.4%, RR 1.01, adj RR 1.00 95% CI 0.97 – 1.03).





5.22.4 Key findings

Although we do not have information about social support from the baseline report, the results at follow-up suggest that there are very few meaningful differences in functional and structural social support between Gulf War veterans and the comparison group. There were no differences between Gulf War veterans and comparison group members in regard to measures of functional social support. In regards to measures of structural social support, there was a very small but statistically significant difference in how many close friends and relatives were reported, with Gulf War veterans reporting an average of one fewer than comparison group members. There was also a small difference in involvement in ex-service groups, with Gulf War veterans slightly more likely to be involved than comparison group members no difference only just reached statistical significance. There were no differences in the number of voluntary groups, level of activity in these groups or commemorating significant military related occasions.

5.23 Quality of life

Quality of life was measured using the Life Satisfaction Scale⁸⁹ and the WHOQOL-Bref⁸⁷ in the postal questionnaire at follow up only.

5.23.1 Quality of life at follow up

Life satisfaction

Responses to the single item Life Satisfaction Scale were positively skewed with 75% of participants responding with a score of four or less out of a total of seven, where lower scores indicate greater Life Satisfaction. In relation to their life as a whole, Gulf War veterans were less likely than the comparison group to report that they felt delighted or pleased, and more likely to report feeling unhappy, mostly dissatisfied, mixed or mostly satisfied (see Figure 41).

Participant's raw scores were transformed into Percent Life Satisfaction (PLS), where higher PLS scores represent greater life satisfaction. There was a small difference in median PLS between groups however this difference was not statistically significant when adjusted for age, rank and service branch (veterans PLS median 66.67, IQR 50-83.33; comparison group PLS median 83.33, IQR 66.67-83.33; adj diff 0, 95% CI -2.65, 2.65).

There was an observed lack of variability in the distribution of the Life Satisfaction Scale results, this was partly due to the small number of response options in the Life Satisfaction Scale. Thus, much of the variability between the 25th and 75th percentiles clustered together, and that resulted in truncated variability in the distribution.



Figure 41 Distribution of Life Satisfaction responses for participants at follow up

Overall Quality of Life and Health Satisfaction (WHOQOL-Bref)

Participants' scores for the WHOQOL-Bref's two individual measures of Overall Quality of Life and Health Satisfaction, were negatively skewed with 75% of participants responding with five out of a total of five, where higher scores indicate better quality of life and health satisfaction. For Overall Quality of Life there was little difference between Gulf War veterans and comparison group members in the distribution of their responses. Although Figure 42 shows that Gulf War veterans were less likely than the comparison group to rate their Quality of Life as 'very good' and more likely to rate their quality of life as 'very poor', 'poor', 'neither poor nor good' or 'good', the differences in distribution were not statistically significant between the groups, including when controlled for age, rank and service type (p>0.05). When rating their Health Satisfaction (Figure 43), Gulf War veterans were less likely than the comparison group to rate their satisfaction as 'very satisfied' (p<0.05), however, none of the other categories was significantly different. When controlled for age, rank and service type, the small difference between the groups in the 'very satisfied' category was no longer statistically significant (p>0.05). In a similar pattern to Overall Quality of Life, although the differences were again not significant, Figure 43 shows that Gulf War veterans were less likely to report being 'satisfied' or 'very satisfied' with their health and more likely to report being 'dissatisfied' or 'neither dissatisfied nor satisfied'.



Figure 42 WHOQOL-Bref Overall Quality of Life ratings by participants at follow up



Figure 43 WHOQOL-Bref Health Satisfaction ratings by participants at follow up

Physical, Psychological, Social and Environmental Domains of Quality of Life (WHOQOL-Bref)

The distributions of scores on the Physical, Psychological, Social and Environment domains of the WHOQOL-Bref quality of life measure are shown in Figure 44. Gulf War veterans reported poorer quality of life on the physical domain of the WHOQOL-Bref (veterans median 71.73 IQR 60.71 - 82.43, comparison group median 75.00 IQR 64.29 - 85.71, adj diff -3.57, 95% CI -5.65, -1.50). They also reported poorer quality of life on the psychological domain (veterans median 70.83 IQR 54.17 - 79.17, comparison group median 75.00 IQR 45.83 - 79.17, adj diff -4.17, 95% CI -6.34, -1.99); as well as poorer Social quality of life (veterans median 66.67 IQR 50.00 - 83.33, adj diff - 8.33, 95% CI -10.94, -5.73).

Whilst the medians for Social quality of life were the same for Gulf War veterans and the comparison group, after adjustment there was a significant difference. Consideration of the adjustment variables (age, rank and service type) indicated that either rank or service type was acting as a confounder in these results.

Although there was a small difference in medians for Environmental quality of life, this was not statistically significant when adjusted for age, rank and service type (veterans median 71.88 IQR 62.50 - 81.25, comparison group median 75.00 IQR 65.63 - 84.38, adj diff 0, 95% CI -1.84, 1.84).



Figure 44 Box plot of the WHOQOL-Bref domains showing the means and interquartile range

5.23.2 Key findings

Twenty years after the Gulf War, veterans report significantly poorer physical, psychological and social quality of life than the comparison group. On other measures of overall quality of life, health satisfaction and life satisfaction, there was a consistent pattern of Gulf War veterans generally scoring a little more poorly on these measures, however statistical significance was not met.

Health service utilisation and DVA healthcare 5.24 support

Information about health service and pharmaceutical use is drawn from both self-reported data from the postal questionnaire and data obtained from linkage with DVA-held and Medicare health databases. By collecting self-report data on health service use, it is possible to collect information on the use of various allied health services which might not be included in the Medicare or DVA databases as well as information from participants who did not agree to Medicare and/or DVA linkage. In addition, collection of recorded Medicare and DVA data allows the assessment of health service and pharmaceutical use across an extended period back in time without relying fully on participants' recall. Combined, the selfreported and linked health databases provide a more complete description of health service and pharmaceutical use than that which would be achievable with either data source alone. Linkage to DVA also provided DVA disability claims and DVA Treatment Entitlements Card data which otherwise could not be obtained elsewhere.

5.24.1 Description of linkage data obtained from Medicare and **DVA** healthcare databases

Table 72 Description of linked DVA datasets				
Dataset	Description			
Medical Benefits Scheme (MBS)*	Details of medical care provided under MBS, including speciality of care provider, date medical care was received, date care was paid for and type of consultation/service.			
DVA Treatment Entitlement Card history	History on DVA Treatment Entitlement Cards (i.e. the Gold <i>Repatriation</i> <i>Health Card – For All Conditions</i> or the White <i>Repatriation Health Card – For</i> <i>Specific Conditions</i>) issued since January 2001 - hereon referred to as Gold Cards and White Cards for brevity.			
Disability claims	Data on the type of disability claim (VEA, SRCA, MRCA, non-service related), the Statement of Principle (SOP) used to support disability claims, the year the disability claim was made, the disability claim decision, and the military service to which claim was attributed (Gulf War or other Operations).			
Non-card medical treatment (SRCA/MRCA)	Medical care paid for under SRCA & MRCA including details on amount paid for medical care, date medical care was received, date of payment and type of care.			
Hospital Data* (available only from 1/1/2007)	Hospital-stay data with variables such as length of stay, whether hospitalisation was in a public or private hospital, principal and additional diagnosis and treatment codes.			
Repatriation Pharmaceutical Benefits Scheme (RPBS)	Data on pharmaceutical claims under the RPBS including date dispensed/paid, drug details, drug body system category and amount paid.			

T-1-1- 70 D d line of DV/A state

Abbreviations: VEA=Veterans' Entitlement Act; MRCA=Military Rehabilitation & Compensation Act; SRCA=Safety, Rehabilitation & Compensation Act

* There is some overlap between the MBS and the Hospital Datasets with the latter dataset providing an additional level of detail about hospital stays.

Linkage with relevant DVA health and compensation datasets

DVA holds a number of discrete databases. For those follow up study participants who had consented, DVA-held health data was accessed to obtain information about health service utilisation and the relevant datasets accessed are described in detail in Table 72. DVA also holds a subset of MBS and PBS (i.e. RPBS) data with treatment items only accessible through DVA; these data would not be obtained through linkage with Medicare Australia.

The initial step of the DVA linkage was to link consenting participants to the DVA client database, in order for DVA to determine if they had any record for each participant and to obtain that participant's UIN (Unique Identification Number). The UINs were then used to link participants with the DVA-held health and compensation datasets relevant to the study. Figure 45 shows that of the 1,125 male participants (n=592 Gulf War veterans and 533 comparison group) who consented to DVA linkage, approximately 55% had a record with DVA, and 85% of these matched to one of the six datasets included in the linkage and described in Table 72. Fifteen percent of participants had a DVA record but no match was identified for them to any of the six DVA health-related datasets relevant to this study.



Figure 45 Flow of follow up study participants through DVA linkage

Table 73 shows the proportion of Gulf War veteran and comparison group participants who were linked to each of the DVA-held datasets accessed. The table shows that similar proportions of Gulf War veterans and comparison group participants were linked to most of the datasets except that Gulf War veterans were slightly more likely than comparison group participants to have a disability claim record and/or have a hospitalisation record.

	Gulf War veterans	Comparison group
Linked DVA dataset	(N=592)	(N=533)
	n (%)	n (%)
DVA Treatment Card history	245 (41.4)	214 (40.2)
Disability claims	215 (36.3)	163 (30.6)
MBS	155 (26.2)	124 (23.3)
RPBS	137 (23.1)	119 (22.3)
Hospital Data (from 1/1/2007)	71 (12.0)	41 (7.7)
Non-card medical treatment (SRCA/MRCA)	50 (8.5)	43 (8.1)

Table 73 Proportion of consenting participants with records in the linked DVA datasets

Linkage with the Medicare databases

Approximately 77% of male Gulf War veterans (n=542) and 75% of male comparison group participants (n=491) consented to linkage with Medicare Australia Medical Benefits Schedule (MBS) and Pharmaceutical Benefits Schedule (PBS) databases. Table 74 shows that, of those who consented, approximately 92% had an MBS record, 70% had a PBS record, and 7% had neither.

Table 74 Proportion of	f consentina	participants	with records in	the linked M	edicare datasets
Tuble 141 Toperaelle	· conconting	participarito			

	Gulf War veterans	Comparison group
Linked Medicare dataset	(N=452)	(N=491)
	n (%)	n (%)
Participants with a Medicare MBS record	500 (92.2)	456 (92.9)
Participants with a Medicare PBS record	383 (70.7)	337 (68.6)
Participants with neither MBS nor PBS record	38 (7.0)	32 (6.5)

To maximise the health service- and pharmaceuticals-utilisation information available, the MBS data from Medicare and DVA were combined, as were the PBS and RPBS datasets. For analysis presented later in this section that covers outcomes derived from both Medicare or DVA databases, proportions were calculated based on the total number of male participants who gave consent to at least one of Medicare and DVA linkages; i.e. 605 (87%) Gulf War veterans and 554 (84%) participants from the comparison group.

5.24.2 Consultations with health professionals

The health service use indicators chosen included consultations with a range of healthcare professionals such as General Practitioners (GP), medical specialists and allied health professionals. The data were accessed from the MBS (both Medicare held and DVA held data) as well as self-reported data in the postal questionnaire.

Self-reported consultations with health professionals

Table 75 shows self-reported data in regard to health professionals consulted in the 12 months preceding study participation. More than 85% of all participants had consulted a GP, and these were the most frequently consulted health professionals by both study groups. Dentists or dental professionals had been consulted by 68% of all participants, followed by specialist doctors who had been consulted by approximately 50%. Gulf War veterans reported consulting psychiatrists, dieticians or an alcohol or drug worker a little more often that the comparison group members, but there were no statistically significant differences between the two study groups in regard to their likelihood of having consulted with these types of health professionals in the previous 12 months.

· · ·	Gulf War	Comparison	•	•
	veterans	group		
Health professional	N=697	N=659		
	n (%)	n (%)	RR	adj RR (95% CI)
General Practitioner	606 (87.2)	555 (85.1)	1.02	1.03 (0.99-1.08)
Dentist or dental professional	470 (68.3)	443 (68.3)	1.00	1.04 (0.96-1.12)
Specialist doctor	350 (51.0)	309 (47.9)	1.06	1.10 (0.99-1.23)
Physiotherapist/hydrotherapist	156 (22.8)	143 (22.1)	1.03	1.03 (0.84-1.27)
Psychologist/psychiatrist	101 (14.8)	74 (11.5)	1.29	1.26 (0.94-1.68)
Chiropractor	99 (14.5)	84 (13.1)	1.11	1.04 (0.79-1.37)
Counsellor	85 (12.5)	62 (9.6)	1.30	1.22 (0.88-1.69)
Audiologist/Audiometrist	85 (12.5)	85 (13.2)	0.95	1.08 (0.81-1.44)
Dietician/Nutritionist	53 (7.8)	41 (6.4)	1.22	1.18 (0.80-1.76)
Social worker/welfare officer	23 (3.4)	21 (3.3)	1.04	0.93 (0.52-1.66)
Diabetes educator	19 (2.8)	18 (2.8)	0.99	0.95 (0.51-1.78)
Osteopathy practitioner	17 (2.5)	15 (2.3)	1.07	1.12 (0.55-2.25)
Naturotherapist	15 (2.2)	13 (2.0)	1.09	0.90 (0.44-1.84)
Alcohol and drug worker	10 (1.5)	7 (1.1)	1.35	1.10 (0.43-2.80)

Table 75 Self-reported health professional consultations in the 12 months prior to follow up

MBS recorded consultations with health professionals

Data on GP consultations are presented in Table 76 and Figure 46. Close to a tenth of participants had visited a GP in the two weeks preceding study participation while close to two-thirds had seen a GP in the preceding year. The average number of GP consultations by Gulf War veterans in the year preceding study participation was 4.4 (standard deviation 4.5) and similarly the average number of consultations among the comparison group was 4.2 (standard deviation 3.6) (adj. RR 0.98 (95% CI 0.83-1.14). As observed with self-reported GP consultations, there was no evidence of differential GP attendances for the two study groups.

	Gulf War	Comparis		
	veterans	on group		
	(N=605)	(N=554)		
	n (%)*	n (%)*	RR	adj RR (95% CI)
Consulted a General Practitioner:				
Past 2 weeks	61 (10.1)	61 (11.0)	0.92	0.83 (0.59-1.15)
Past 12 months	392 (64.8)	350 (63.2)	1.03	1.02 (0.93-1.11)
Last consulted a General Practitioner [†] :				
< 3 months ago	215 (35.5)	207 (37.4)	1.00	1.00
3-6 months ago	98 (16.2)	73 (13.2)	1.29	1.37 (0.95-1.98)
> 6 months -12 months ago	79 (13.1)	70 (12.6)	1.09	1.06 (0.72-1.57)
> 12 months ago	115 (19.0)	112 (20.2)	0.99	1.01 (0.71-1.42)

Table 76 General Practitioner consultations since 2001 as recorded on MBS

* Percentages based on the total number of participants who gave consent to both Medicare and DVA linkages

† 16.2% Gulf War veterans and 16.6% comparison group participants had not consulted a GP at all since 2001.



Figure 46 Number of MBS recorded GP visits in the 12 months preceding study participation

A medical practitioner can utilise an MBS 'health assessment' item to undertake a more comprehensive assessment of a patient with complex care needs. These health assessments can be classified as brief, standard, long or prolonged consultations depending on the complexity of the patient's needs. Analysis was conducted to compare whether Gulf War veterans had more health assessments undertaken by GPs than the comparison group.

Two percent of participants had a 'brief' (less than 30 minutes) or 'standard' (30 to less than 45 minutes) 'health assessment'; 2.2% of Gulf War veterans and 1.8% of the comparison group (p=0.68). 'Long' (45 to less than 60 minutes) or 'prolonged' (more than 60 minutes) 'health assessments' were even less common, received by 0.8% of the Gulf War veterans and 0.5% of the comparison group (p=0.56). A small percentage of participants had received an MBS-funded GP annual 'cycle of care' plan, which is a detailed set of patient management steps undertaken over 12 months.¹²⁷ A diabetes 'cycle of care' plan had been completed by 1.2% of veterans and 1.8% of comparison group participants, while an asthma 'cycle of care' plan had been undertaken by 0.5% and 0.2% respectively.

	Gulf War	Comparison		
	veterans	group		
Specialist	(N=605)	(N= 554)		
	n (%)	n (%)	RR	Adj RR (95% CI)*
Dermatologist				
Past 12 months	25 (4.1)	23 (4.2)	1.00	0.94 (0.54-1.64)
Past 10 years	69 (11.4)	74 (13.4)	0.85	0.94 (0.68-1.29)
Psychiatrist				
Past 12 months	25 (4.1)	12 (2.2)	1.91	1.65 (0.85-3.18)
Past 10 years	57 (9.4)	34 (6.1)	1.54	1.46 (0.96-2.21)
Gastroenterologist				
Past 12 months	20 (3.3)	22 (4.0)	0.83	1.03 (0.54-1.96)
Past 10 years	78 (12.9)	88 (15.9)	0.81	0.92 (0.69-1.23)
Neurologist				
Past 12 months	14 (2.3)	6 (1.1)	2.14	1.92 (0.75-4.90)
Past 10 years	47 (7.8)	37 (6.9)	1.16	1.13 (0.75-1.72)
Respiratory physician				
Past 12 months	11 (1.8)	15 (2.7)	0.67	0.60 (0.28-1.29)
Past 10 years	60 (9.9)	50 (9.0)	1.10	1.02 (0.70-1.49)

Table 77 DVA.	- and Modicaro-MRS	data on snaci	alist consultations	sinca 2001

As neurological health, and also gastroenterological, psychological and respiratory health are key outcomes of interest in this study, consultations with neurologists,

gastroenterologists, psychiatrists and respiratory physicians recorded on the combined DVAheld and Medicare-MBS data are presented in Table 77. Also shown are consultations with dermatologists because dermatitis and other skin conditions were reported to be in excess in Gulf War veterans at baseline, and skin conditions, particularly rashes, have been amongst the most frequent health problems reported by Gulf War veterans in other studies.¹²⁸ There were no statistically significant differences between the two groups in regard to their likelihood of consulting any of these specialist types in the 12 months, or ten years, preceding study participation. Of those listed, the most visited specialist-type in the 12 months preceding study participation was a dermatologist, reported by 4% of all participants. About 4% of Gulf War veterans had also visited a psychiatrist in the 12 months before follow up, double the rate in the comparison group. Gulf War veterans were also more likely to have seen a neurologist in the past 12 months (2.3% vs. 1.1%). However, as stated above, none of these differences were statistically significant.

5.24.3 Hospital services

In the postal questionnaire, participants provided information about up to four hospitalisations in the previous 12 months and visits to hospital emergency department, hospital outpatients or other day clinic services. Some information on hospitalisations since January 2007 was also available from the DVA data. These two sources provided more information about hospitalisations than could be obtained from the Medicare data.

Self-reported hospital service utilisation

Table 78 shows the frequency of self-reported hospital services accessed in the 12 months prior to follow up. Approximately 15% of all participants reported having been hospitalised overnight at least once with most of these participants being hospitalised for between one and five days. Just over a tenth reported hospital outpatient attendance and/or emergency department attendance while about a third had attended a day clinic for minor surgery or diagnostic tests other than X-ray. There were no statistically significant differences between the two study groups in the use of these hospital services.

• •	Gulf War	Comparison	•	•
	veterans	group		
Hospital services	N=697	N=659		
	n (%)	n (%)	RR	Adj RR (95% CI)
Hospitalized overnight or longer	110 (15.9)	91 (13.9)	1.14	1.11 (0.86-1.44)
Total nights hospitalised				
None	584 (84.4)	562 (86.1)	1.00	1.00
1-5 days	79 (11.4)	72 (11.0)	1.06	1.03 (0.72-1.46)
More than 5 days	29 (4.2)	19 (2.9)	1.47	1.44 (0.80-2.59)
Other hospital sections visited				
Outpatients	108 (15.6)	107 (16.3)	0.96	0.93 (0.72-1.19)
Casualty/emergency department*	94 (13.6)	90 (13.7)	0.99	0.90 (0.69-1.18)
Day clinic [†]	225 (32.6)	229 (35.0)	0.93	0.92 (0.79-1.07)

Table 78 Self-reported hospital service utilisation in the 12 months prior to follow up

* Other than when hospitalised overnight or longer

† Respondents were specifically asked to report day clinic visits for minor surgery or diagnostic tests other than X ray

DVA recorded hospitalisations since 2007

Table 79 shows DVA data for the number of DVA-funded hospitalisations and length of stay for the period January 2007 to August 2012. The total number of participants hospitalised at least once with DVA financial support was 112; representing 10% of all participants consenting to DVA linkage. Gulf War veterans, however, were 71% more likely than comparison group participants to have been hospitalised at least once over the five and a half year period, and this difference was statistically significant. Relative to participants admitted once to hospital, Gulf War veterans were observed to be more likely than the comparison group to have been hospitalised twice, although the numbers were small and this difference did not achieve statistical significance.

In participants hospitalised at least once, the median total length of stay was two days for Gulf War veterans (range < 1 day to 422 days) and one day for the comparison group (range <1 to 134 days). The interquartile range in both groups was 0-6 days. Whilst hospitalised Gulf War veterans were proportionately more likely than hospitalised comparison group participants to have stayed in hospital for more than one day, this difference between the groups did not reach statistical significance.

where the second second second second

Table 79 DVA data on number of hospitali	sations and le	ength of stay sin	ce Janı	uary 2007
	Gulf War	Comparison		
	veterans	group		
	(N=592)	(N=533)		
	n (%)	n (%)	RR	Adj RR (95% CI)
Hospitalised at least once Jan 07 - Aug 12	71 (12.0)	41 (7.7)	1.56	1.71 (1.19-2.45)
Number of hospitalisations				
Admitted once	21 (29.6)	17 (41.5)	1.00	1.00
Admitted twice	17 (23.9)	5 (12.2)	2.75	2.24 (0.70-8.46)
Admitted \geq 3 times	33 (46.5)	19 (46.3)	1.41	1.35 (0.53-3.45)
Length of hospital stay*				
≤ 1 day	33 (46.5)	24 (58.5)	1.00	1.00
> 1 day	38 (53.5)	17 (41.5)	1.29	1.31 (0.86-1.97)

* Amongst persons hospitalised at least once between January 2007 and August 2012 only

The principal diagnoses recorded by DVA, for participants who were hospitalised, are shown in Table 80. The category of diagnosis most frequently cited for hospitalisation was 'musculoskeletal system and connective tissue', followed by 'digestive system'. The numbers for other hospitalisations, including for mental disorders, were very small in both groups. Relative to the comparison group, Gulf War veterans were significantly less likely to have been hospitalised for a neoplasm-related illness.

Table 80 Principal diagnosis in participants who were hospitalised as recorded by DVA

	Gulf War	Comparison		
Principle diagnosis	(N=71)*	(N=41)*		
	n (%)	n (%)	RR	Adj RR (95% CI) †
Musculoskeletal system and connective tissue	33 (46.5)	17 (41.5)	1.12	1.29 (0.84-2.00)
Digestive system	17 (23.9)	9 (22.0)	1.09	1.02 (0.48-2.16)
Mental and behavioural disorders	12 (16.9)	4 (9.8)	1.73	1.60 (0.58-4.41)
Injury	12 (16.9)	4 (9.8)	1.73	1.47 (0.51-4.23)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	11 (15.5)	6 (14.6)	1.06	1.15 (0.45-2.94)
Respiratory system	10 (14.1)	5 (12.2)	1.15	0.92 (0.28-3.02)
Neoplasms	8 (11.3)	15 (36.6)	0.31	0.32 (0.14-0.73)
Circulatory disease	4 (5.6)	5 (12.2)	0.46	0.62 (0.17-2.23)
Other	19 (26.8)	10 (24.4)	1.10	0.98 (0.49-1.95)

* N is the number of participants who were hospitalised.

† Adjusted for age (<35 years & ≥35 years), branch of service and rank in 1990.

5.24.4 Pharmaceuticals dispensed since 2001

As a proxy for pharmaceutical utilisation, data on pharmaceutical scripts dispensed to participants were collected from the PBS and RPBS. Table 81 shows that about a third of all participants had been dispensed at least one pharmaceutical script in the 12 months prior to follow up. Gulf War veterans and comparison group participants were equally likely to have been dispensed a prescribed medication in the two weeks, or 12 months, prior to follow up. The average number of scripts dispensed to Gulf War veterans in the 12 months before follow up, however, was significantly higher than in the comparison group. It should be noted, however, that the number of scripts dispensed may not be the same as the number of scripts written by medical practitioners nor is it the same as the number of medications actually taken by participants. Number of scripts dispensed can also depend on the medication and the duration of each dispensed medication.

· · · · ·	Gulf War	Comparison		
	veterans	group		
Pharmaceuticals dispensed	(N=605)	(N=554)		
	n (%)	n (%)	RR	adj RR (95% CI)*
Past 2 weeks	79 (13.1)	64 (11.6)	1.13	1.12 (0.82-1.54)
Past 12 months	211 (34.9)	191 (34.5)	1.01	1.05 (0.90-1.23)
	mean (sd)	mean (sd)	ratio	adj ratio (95% CI)*
Number of scripts in past 12 months	35 (56.5)	23 (47.2)	1.52	1.63 (1.20-2.22)

5.24.5 Disability claims submitted to DVA

The DVA Disability claims dataset, for the period 1 January 2001 to 15 August 2012, showed that 2,176 disability claims had been made by male study participants over this period. Amongst those who had submitted a disability claim, the median number of claims was five in the Gulf War veteran group (IQR 2-9) and four in the comparison group (IQR 2-7). The total number of claims lodged by the Gulf War veteran group (n=1,327 claims) was 56% higher than the total number of claims lodged by the comparison group (n=849 claims). Table 82 summarises further information derived from the Disability determination dataset for the 2,176 disability claims. Two-thirds of all claims for both study groups were accepted. Almost half of the claims submitted by Gulf War veterans were for illness or disabilities attributed to Gulf War service. There were no statistically significant differences between the two groups in regard to the legislation under which the claims were made.

	Gulf War	Comparison		
	veterans	group		
Disability claims		N=849 Claims"	00	
	n (%)	n (%)	КК	auj kk (95% CI)
Act under which claim made				
VEA	967 (72.9)	582 (68.6)	1.06	1.07 (0.96-1.18)
SRCA	230 (17.3)	175 (20.6)	0.84	0.83 (0.60-1.15)
MRCA	60 (4.5)	57 (6.7)	0.67	0.68 (0.38-1.21)
Non-service related	70 (5.3)	35 (4.1)	1.28	1.33 (0.87-2.04)
Service to which claim				
attributed				
Other Operations	76 (7.4)	101 (15.8)	1.00	1.00
Peacetime service only	463 (45.1)	538 (84.2)	1.02	0.99 (0.90-1.10)
Wholly or partially to Gulf War	488 (47.5)	N/A	-	-
DVA disability claim decision				
Not accepted	445 (33.5)	266 (31.3)	1.00	1.00
Accepted	882 (66.5)	583 (68.7)	0.97	0.99 (0.91-1.08)

Table 82 Summary of disability claims from 1 January 2001 to 15 August 2012

* N represents the number of disability claims by this group

Figure 47 depicts the cumulative distribution of disability claims submitted over time since January 2001. The figure shows that for the period 2004-2008 there was a slightly increased rate of claims submitted by Gulf War veterans during this time relative to the comparison group. The proportion of claims assessed in other years was very similar between the two study groups.



Figure 47 Cumulative disability claims during period 2001 to 2012

v	Gulf War	Comparison		
	Veterans (N=002)	group (11-000)		
	n (%)	n (%)	RR	Adj RR (95% CI)
Number of accepted claims				
No claim or none accepted	395 (66.7)	381 (71.5)	1.00	1.00
1-2 claims accepted	78 (13.2)	63 (11.8)	1.19	1.40 (0.96-2.04)
3-4 claims accepted	51 (8.6)	44 (8.3)	1.12	1.15 (0.74-1.80)
5-6 claims accepted	27 (4.6)	19 (3.6)	1.37	1.35 (0.70-2.58)
7 or more claims accepted	41 (6.9)	26 (4.9)	1.52	1.83 (1.09-3.08)
At least one disability claim accepted	197 (33.3)	152 (28.5)	1.17	1.24 (1.04-1.48)
Submitted at least one successful claims made under following legislation				
VEA	168 (28.4)	112 (21.0)	1.35	1.43 (1.17-1.77)
SRCA	61 (10.3)	61 (11.4)	0.90	0.96 (0.68-1.35)
MRCA *	25 (4.2)	17 (3.2)	1.32	154 (0.83-2.89)
Non-service related claims	54 (9.1)	30 (5.6)	1.62	1.76 (1.13-2.72)

Table 83 Number of accepted disability claims, and legislation type, for participants who consented to DVA-data linkage

* Adjusted for service branch category, rank category and continuous age, instead of age group, for the model to converge

Information about the accepted disability claims is shown in Table 83. Close to one third of all participants, who consented to DVA-data linkage, had made at least one disability claim which had been accepted by DVA. Gulf War veterans were 24% more likely than the comparison group to have made a disability claim which had been accepted, and this difference was statistically significant. There is also a pattern of Gulf War veterans being

more likely than the comparison group to have had multiple accepted claims. Gulf War veterans were also more likely than the comparison group to have made at least one accepted claim under VEA legislation, and to have had a non-service-related claim accepted.

Thirty percent of Gulf War veterans (n=178) and 23% of comparison group participants (n=121) who consented to DVA-data linkage had at least one successful claim submitted under the VEA or the MRCA legislation. The Statements of Principle (SOPs), used by DVA to establish a connection between service and the condition/s claimed under VEA and MRCA and under which these participants' claims were accepted, are shown in Table 84.

There were no statistically significant differences between the two study groups in regard to the proportion of participants with accepted claims under any SOP. The table shows that more than half of the participants who had a successful claim submitted under the VEA or the MRCA legislation had a claim in the 'Musculoskeletal system and connective tissue system' SOP category, and/or the 'Nervous system, Sense organs' category. No claims were submitted or accepted for either group under the SOP categories of 'Blood and blood-forming organs', 'Congenital anomalies/Hereditary conditions' or Other (not tabulated).

SOP categories	Guif War veterans (N=178)*	Comparison group (N=121)*		
	n (%)	n (%)	RR	Adj RR (95% CI)
Musculoskeletal system and connective tissue	99 (55.6)	73 (60.3)	0.92	0.90 (0.74-1.10)
Nervous System, Sense Organs	98 (55.1)	73 (60.3)	0.91	0.89 (0.72-1.09)
Skin and subcutaneous tissue	40 (22.5)	23 (19.0)	1.18	1.29 (0.81-2.07)
Mental disorders	27 (15.2)	13 (10.7)	1.41	1.49 (0.78-2.85)
Injury	25 (14.0)	24 (19.8)	0.71	0.63 (0.38-1.07)
Neoplasms	19 (10.7)	20 (16.5)	0.66	0.73 (0.40-1.34)
Digestive system	15 (8.4)	4 (3.3)	2.55	2.16 (0.77-6.05)
Infectious and parasitic diseases	14 (7.9)	12 (9.9)	0.79	0.70 (0.33-1.50)
Circulatory system	9 (5.1)	4 (3.3)	1.53	1.64 (0.58-4.61)
Genitourinary system	6 (3.4)	0 (0.0)	-	-
Respiratory system	5 (2.8)	3 (2.5)	1.13	1.42 (0.30-6.62)
Endocrine, nutritional, metabolic diseases; Disorders of the immune system	3 (1.7)	0 (0.0)	-	
SOP category not stated	48 (27.0)	25 (20.7)	1.31	1.19 (0.76-1.84)

Table 84 Proportion of participants who had at least one successful claim under each of the
broad SOP categories (VEA and MRCA claims only)

* N is the number of participants who had at least one claim submitted and accepted under MRCA or VEA.

5.24.6 DVA Treatment Card history

Table 85 shows that 41% of Gulf War veterans, and 40% of comparison group participants, who consented to DVA-held data linkage, held either a Gold Card, a White Card, or both during the period 1 January 2001 to 15 August 2012. The two participant groups were equally likely to have held a White Card only. Gulf War veterans, however, were more than twice as likely as the comparison group to have held a Gold Card. Additional analysis (not tabulated) showed that 99% of all card holders shown in Table 85 still held that card in the past 12 months, indicating that the data shown is reflective of current card-holder status at follow up.

DVA Treatment Card type	Gulf War veterans (N=592)	Comparison group (N=533)		
	n (%)	n (%)	RR	adj RR (95% CI)
Ever held a DVA Treatment Card*				
White Card only [†]	180 (30.4)	187 (35.1)	0.87	0.94 (0.79-1.11)
Gold Card [‡]	65 (11.0)	27 (5.1)	2.17	2.27 (1.49-3.45)
Either White or Gold Card	245 (41.4)	214 (40.2)	1.03	1.11 (0.97-1.28)

Table 85 DVA Treatment Card history for participants for the period 1 Jan 2001 to 15 Aug 2012

* Refers to the period 1 Jan 2001 to 15 Aug 2012

† Includes participants who never had a Gold Card

Most participants who had a Gold Card on record had a White Card previously. A person cannot have 2 cards simultaneously

Figure 48 shows the proportions of participants with, and without, a DVA Treatment Card by year from 2001 to 2012. In both study groups, the proportion of participants with a Gold Card and/or a White Card has increased slightly but steadily over time. The increase in Gold Card possession per year since January 2001, is slightly larger in the Gulf War veteran group (approximately 0.7% per year) than in the comparison group (approximately 0.4% per year).



Figure 48 Proportion of participants with a DVA Treatment Card in each year from 2001 to 2012

5.24.7 Key findings

Health service and pharmaceutical use information was drawn from self-reported data and DVA-held and Medicare health databases. Combined, the self-reported and linked recorded data sets provide a more complete description of health service and pharmaceutical use than that which would be achievable with any one data source alone. DVA disability claims and DVA Treatment Entitlements Card data were obtained from DVA-held data only.

The three datasets revealed only a few statistically significant differences between the Gulf War veterans and the comparison group in regard to their health service utilisation. Based on DVA-funded hospitalisation data, Gulf War veterans were 71% more likely than the comparison group to have been hospitalised at least once during the period January 2007 to August 2012. DVA-hospitalised Gulf War veterans were about a third as likely as hospitalised comparison group participants to have a principal diagnosis of 'neoplasms'. Gulf War veterans lodged 56% more disability claims with DVA in the period 1 January 2001 to 15 August 2012, and the veterans were 24% more likely than the comparison group to have had a disability claim accepted by DVA in that time period. Overall acceptance rates for submitted claims were similar between the two groups. Gulf War veterans were 43% more likely than the comparison group to have made at least one accepted claim under VEA legislation, and 76% more likely to have had a non-service-related claim accepted. Further, Gulf War veterans (11%) were more than twice as likely as the comparison group (5%) to have been issued a Gold Card. Based on PBS and RPBS data, the average number of scripts dispensed to Gulf War veterans, in the 12 months before follow up, was 63% higher than that in the comparison group.

There were some other indications of differences in the pattern of health service utilisation in Gulf War veterans relative to the comparison group, but these differences did not reach statistical significance. They include the findings that, proportionately, DVA hospitalised Gulf War veterans were more likely than hospitalised comparison group participants to have 'mental and behavioural disorders' or 'injury' as the principal diagnosis, and less likely to have 'circulatory disease' as the principal diagnosis. Both the self-report- and DVA-hospitalisation results indicate that Gulf War veterans were likely to be hospitalised for a little longer than comparison group participants.

In regard to the overall pattern of health service use by follow up study participants, the combined self-report, DVA and MBS data showed that between 64% and 85% of all participants had consulted with a GP in last 12 months, and this was the type of health professional most frequently consulted by both study groups. A dentist or dental

professional had been consulted by about 68% and a specialist doctor by about 50%. Allied health professionals most frequently consulted in the previous 12 months were physiotherapists or hydrotherapists, consulted by 22% of participants, followed by psychologists (this category included psychiatrists), chiropractors or audiologists/audiometrists (each approximately 13%) and counsellors (11%). DVA-held and Medicare-MBS data showed that consultations with medical specialists of a priori interest (ie, neurologists, gastroenterologists, psychiatrists, respiratory physicians and dermatologists) were similar between the two study groups and uncommon in the previous ten years, recorded for 4% or less of all participants. Self-report data shows that about 15% of all participants (16% of Gulf War veterans and 14% of the comparison group) had been hospitalised for at least one night in the last year, about 15% attended the emergency department or an outpatient ward, and a third attended a day clinic for minor surgery or diagnostic tests other than X-ray. Amongst DVA hospitalisations, the most frequent primary diagnosis was 'musculoskeletal system and connective tissue', recorded for 47% of hospitalised Gulf War veterans and 42% of hospitalised comparison group participants. followed by 'digestive system' which was recorded for 24% and 22% respectively. About one third of all participants had been dispensed at least one pharmaceutical script in the 12 months prior to follow up. Conversely, two thirds had not filled a script in that year.

In regard to some additional measures of DVA-specific health services, two thirds of 2,176 disability claims made by male study participants for the period 1 January 2001 to 15 August 2012, were made by Gulf War veterans. Almost half of the claims submitted by Gulf War veterans were for illness or disabilities attributed to Gulf War service. Almost 85% of comparison group claims were attributed to peacetime service. Approximately two thirds of all claims were accepted by DVA, and this proportion did not vary between the Gulf War veterans and comparison group. For those claims accepted under VEA or MRCA legislation, more than one half were under the 'Musculoskeletal system and connective tissue system' or the 'Nervous system, Sense organs' SOP categories, 21% were under the 'skin and subcutaneous tissue' SOP, 16% were under the 'injury' SOP, and 13% were under the 'mental disorders' and 'neoplasms' SOPs respectively. Close to 40% of linked participants from both groups had been issued either a Gold Card, a White Card, or both during the period 1 January 2001 to 15 August 2012, but Gulf War veterans were significantly more likely (11% vs 5%) to have been issued a Gold Card.

5.25 Health outcomes at follow up among participants with disorders at baseline

Multisymptom illness (MSI), chronic fatigue, and CIDI-defined 12-month major depression, PTSD and alcohol use disorder were found to be in excess in the Gulf War veterans' group at the time of the baseline study. In addition to investigating the prevalence of these disorders at follow up, and the extent to which these disorders have persisted or recurred since baseline, we also investigated whether the presence of one or more of these disorders at baseline has led to poorer physical or psychological functioning, greater demoralisation, disability or somatisation, poorer quality of life or social functioning, or differential health service utilisation at follow up. Almost one third (N=199, 29%) of the Gulf War veterans and one fifth (N=122, 20%) of the comparison group members who participated at follow up had one or more of MSI, chronic fatigue, or 12-month major depression, PTSD or alcohol use disorder at baseline. The five disorders are referred to as 'baseline disorders' in the remainder of this chapter and a description of these participants is provided in Table 86.

	Gulf War Veterans	Comparison Group	
	N=199	N=122	
	n (%)	n (%)	X ² p-value
Age at deployment			
< 20	25 (12.6)	7 (5.7)	
20-24	52 (26.1)	21 (17.2)	0.030
25-34	90 (45.2)	70 (57.4)	
>=35	32 (16.1)	24 (19.7)	
Service branch			
Navy	176 (88.5)	99 (81.2)	0 161
Army	11 (5.5)	13 (10.7)	0.161
Air Force	12 (6.0)	10 (8.2)	
Rank category			
Officer	31 (15.6)	21 (17.2)	0 195
Other rank-supervisory	98 (49.3)	70 (57.4)	0.165
Other rank - non supervisory	70 (35.2)	31 (25.4)	
Baseline disorders			
Multisymptom illness	158 (79.4)	90 (73.8)	0.273
12-month major depression	54 (27.1)	31 (25.4)	0.734
Chronic fatigue	41 (20.6)	18 (14.8)	0.235
12-month PTSD	29 (14.6)	10 (8.2)	0.113
12-month Alcohol use disorder	24 (12.1)	11 (9.0)	0.463

Table 86 shows that Gulf War veteran participants, with at least one of the baseline disorders, were slightly younger (more likely to be aged < 25 and less likely to be aged 25 or older) than comparison group participants with at least one of the baseline disorders. Otherwise the two groups had a similar distribution across service branch and rank category. Further, in both groups, a larger proportion met criteria for MSI than the other disorders at baseline. Comorbidity of these conditions at baseline was not uncommon, with 30% of Gulf War veterans and 20% of the comparison group having two or more of these five conditions (not tabulated).

Health outcomes at follow up, for participants with baseline disorders compared with participants who did not have any of the baseline disorders, are shown in Table 87. In both study groups, there was a consistent pattern of poorer physical and psychological health status, lesser social support, higher levels of demoralisation, poorer quality of life, lower health satisfaction and greater likelihood of 'days out of role' due to illness at follow up amongst participants with baseline disorders compared to participants without baseline disorders. Somatisation at follow up was not included in these analyses because only one participant met criteria at follow up for CIDI-defined Somatisation.

DVA disability claims and DVA Treatment Card information for participants with and without baseline disorders are presented in Table 88. In both groups, participants with baseline disorders were significantly more likely to have a DVA record than participants without baseline disorders. Gulf War veterans with baseline disorders were more likely to have submitted a claim to DVA, and more likely to have an accepted claim, than veterans without baseline disorders. Gulf War veterans with baseline disorders were twice as likely to attribute their claim wholly or partially to Gulf War service, and 1 ½ times more likely to attribute their claim to peacetime service than veterans without baseline disorders. Comparison group participants with baseline disorders were 2 ½ times more likely than comparison group participants without baseline disorders to attribute their claim to operations other than the Gulf War or peacetime service. Gulf War veterans with baseline disorders were significantly more likely than veterans without baseline disorders to have an accepted claim attributed to the SOPs for 'musculoskeletal system/connective tissue', 'nervous system/sense organs', 'skin and subcutaneous tissue' or 'mental disorders'. For the comparison group, only claims against the 'mental disorders' SOPs were significantly more common among those with a baseline disorder than those without. In both study groups, participants with baseline disorders were more than three times as likely as participants without baseline disorders to have been issued with a DVA Gold Card.

Table 87 Health outcomes at follow up amongst participants with, and without, any of MSI, chronic fatigue, 12-month major depression, PTSD or alcohol use disorder at baseline

	Gulf War veterans						
	No disorder (N=486)	At least one disorder (N=199)		No disorder (N=480)	At least one disorder (N=122)		Comparison between study groups
			adj RR (95% CI)	Mean (sd)	Mean (sd)	adj RR (95% CI)	adj RR (95% CI)
SF12 health status scores: mean (sd)							
Physical Component	49.0 (8.7)	41.0 (11.6)	0.95 (0.95-0.96)	49.4 (8.8)	42.9 (11.2)	0.96 (0.95-0.97)	1.00 (0.98-1.02)
Mental Component	49.1 (10.5)	38.9 (11.8)	0.95 (0.95-0.96)	51.4 (9.4)	42.9 (12.7)	0.95 (0.95-0.96)	1.00 (0.98-1.01)
Demoralisation median score (IQR)	12 (7-23)	28 (17-44)	1.03 (1.02-1.03)	10 (6-10)	21 (11-39)	1.03 (1.02-1.03)	1.00 (0.99-1.01)
MOS Social Support median score (IQR)	3.4 (2.5-3.9)	2.8 (1.9-3.6)	0.79 (0.72-0.87)	3.4 (2.6-3.9)	2.9 (2.0-3.7)	0.82 (0.71-0.94)	1.00 (0.81-1.21)
Overall Quality of life: n (%)							
Very good/good	413 (85.0)	111 (56.1)	1.00	417 (86.9)	78 (63.9)	1.00	1.00
Neither poor nor good	52 (10.7)	61 (30.8)	2.50 (1.84-3.40)	47 (9.8)	26 (21.3)	2.90 (1.99-4.24)	0.79 (0.40-1.55)
Very poor/poor	21 (4.3)	26 (13.1)	2.46 (1.94-3.13)	16 (3.3)	18 (14.8)	1.96 (1.36-2.84)	1.18 (0.68-2.03)
Health satisfaction							
Satisfied/very satisfied	294 (60.5)	53 (26.8)	1.00	325 (67.7)	47 (38.5)	1.00	1.00
Neither satisfied nor dissatisfied	105 (21.6)	51 (25.8)	3.24 (2.43-4.32)	82 (17.1)	29 (23.8)	2.84 (1.99-4.04)	1.09 (0.64-1.85)
Very dissatisfied/fairly dissatisfied	87 (17.9)	94 (47.5)	2.01 (1.43-2.82)	73 (15.21)	46 (37.7)	1.89 (1.24-2.89)	1.00 (0.55-1.83)
Any days out of role in previous 2 weeks (Yes)	60 (12.4)	70 (35.4)	2.21 (1.76-2.77)	57 (11.9)	40 (33.1)	2.25 (1.66-3.05)	0.97 (0.66-1.41)

Table 88 DVA Disability claims data for participants with, and without, any of MSI, chronic fatigue, 12 month major depression, PTSD or alcohol disorder at baseline

Participants attributes	Gulf War veterans			Comparison group			Comparison
	No disorder (N=412)*	At least one disorder (N=171)*		No disorder (N=393)*	At least one disorder (N=97)*		between study groups
	n (%)	n (%)	adj RR (95% CI)	n (%)	n (%)	adj RR (95% CI)	adj RR (95% CI)
Record with DVA	203 (49.3)	123 (71.9)	2.10 (1.57-2.82)	199 (50.6)	64 (66.0)	1.52 (1.02-2.26)	1.26 (0.78-2.03)
At least one DVA disability claim							
All submitted	121 (29.4)	91 (53.2)	2.01 (1.56-2.58)	109 (27.7)	39 (40.2)	1.38 (0.96-1.99)	1.31 (0.85-2.01)
Accepted	114 (27.7)	80 (46.8)	1.80 (1.40-2.31)	102 (26.0)	36 (37.1)	1.35 (0.93-1.96)	1.20 (0.78-1.85)
Attributed service for ≥1 claim							
Other operations	16 (3.9)	8 (4.7)	1.06 (0.59-1.93)	7 (1.8)	7 (7.2)	2.45 (1.41-4.25)	0.45 (0.20-0.99)
Peacetime service only	79 (19.2)	49 (28.7)	1.47 (1.12-1.94)	80 (20.4)	28 (28.9)	1.25 (0.85-1.85)	1.07 (0.67-1.69)
Wholly or partially to Gulf War	47 (11.4)	48 (28.1)	2.01 (1.56-2.60)	N/A	N/A	-	-
SOP category for at least one accept	pted claim [†]						
Musculoskeletal system and connective tissue	57 (13.8)	40 (23.4)	1.62 (1.22-2.15)	47 (12.0)	18 (18.6)	1.23 (0.79-1.91)	1.21 (0.72-2.03)
Nervous System, Sense Organs	54 (13.1)	43 (25.2)	1.70 (1.29-2.22)	47 (12.0)	20 (20.6)	1.45 (0.96-2.21)	1.06 (0.65-1.73)
Skin and subcutaneous tissue	22 (5.3)	18 (10.5)	1.62 (1.13-2.34)	15 (3.8)	6 (6.2)	1.57 (0.77-3.22)	1.06 (0.48-2.36)
Mental disorders	13 (3.2)	14 (8.2)	1.74 (1.14-2.66)	2 (0.5)	8 (8.3)	3.47 (2.35-5.11)	0.46 (0.27-0.81)
Injury	18 (4.4)	7 (4.1)	0.98 (0.52-1.85)	15 (3.8)	6 (6.2)	1.30 (0.65-2.57)	0.64 (0.25-1.62)
Ever held a DVA Treatment Card							
White Card only	121 (29.4)	57 (33.3)	1.16 (0.89-1.53)	135 (34.4)	38 (39.2)	1.11 (0.77-1.61)	0.99 (0.63-1.54)
Gold Card	18 (4.4)	47 (27.5)	3.33 (2.26-4.91)	9 (2.3)	17 (17.5)	3.08 (2.47-3.86)	0.85 (0.56-1.29)

* Only includes those who had given consent to DVA linkage † Only the five broad SOP categories most frequently claimed against are presented.

Table 89 Health service use amongst participants with, and without, any of MSI, chronic fatigue, 12 month major depression, PTSD or alcohol disorder at baseline

				Comparison group			
	No disorder N=420*	At least one disorder N=176*		No disorder N=410*	At least one disorder N=99*		
	n (%)	n (%)	Adj RR (95% CI)	n (%)	n (%)	Adj RR (95% CI)	Adj RR (95% CI)
Self-reported hospitalisation at least once in past 12 months [†]	59 (12.2)	50 (25.6)	1.80 (1.41-2.30)	59 (12.4)	26 (21.7)	1.49 (1.04-2.15)	1.16 (0.75-1.80)
Length of hospital stay							
≤ 5 day	49 (83.1)	29 (60.4)	1.00	47 (79.7)	19 (73.1)	1.00	
> 5 day	10 (17.0)	19 (39.6)	1.62 (1.12-2.36)	12 (20.3)	7 (26.9)	1.15 (0.61-2.16)	1.21 (0.57-2.57)
Consulted a GP							
Past 2 weeks	32 (7.6)	27 (15.3)	1.66 (1.22-2.26)	34 (8.3)	20 (20.2)	1.74 (1.15-2.64)	0.87 (0.52-1.44)
Past 12 months	259 (61.7)	128 (72.7)	1.41 (1.06-1.88)	243 (59.3)	80 (80.8)	2.31 (1.44-3.70)	0.61 (0.35-1.04)
Dispensed prescribed medication							
Past 2 weeks	38 (9.1)	40 (22.7)	1.99 (1.52-2.59)	38 (9.3)	22 (22.2)	1.90 (1.28-2.80)	1.04 (0.65-1.65)
Past 12 months	119 (28.3)	89 (50.6)	1.93 (1.51-2.47)	123 (30.0)	52 (52.5)	2.03 (1.42-2.92)	0.93 (0.61-1.42)

* N=number of participants who gave consent to Medicare and DVA linkage. † Percentage calculated out of total number of participants. (Refer to Table 87 actual numbers).
Table 89 shows that hospitalisation in the 12 months prior to follow up, GP consultations in the previous 2 weeks or 12 months, and having had a prescribed medication dispensed in the previous 2 weeks or 12 months, were all more likely among participants with a baseline disorder compared to those without, and the pattern was similar for the two study groups. Hospitalisations totalling at least six nights were significantly more likely for Gulf War veterans with a baseline disorder compared to veterans without; a similar pattern in the comparison group was not statistically significant.

5.25.1 Key findings

Gulf War veterans were more likely than comparison group participants to have had any one, or more, of MSI, chronic fatigue, 12 month PTSD, 12 month major depression or 12 month alcohol disorder at baseline (29% vs 20%). Participants in both study groups with any one, or more, of these baseline disorders, achieved noticeably poorer results on a number of measures of health and well-being at follow up, compared with participants who did not have any of these baseline disorders. These include measures of physical and psychological health status, social support, demoralisation, quality of life, health satisfaction and 'days out of role' due to illness.

Compared to participants without these baseline disorders, participants with baseline disorders in both study groups also had greater health service utilisation in terms of recent hospitalisations, GP consultations and likelihood of having a pharmaceutical script dispensed. Hospitalisations in the previous 12 months totalling at least 6 nights were more likely for Gulf War veterans with a baseline disorder compared to veterans without.

Compared to Gulf War veterans without baseline disorders, veterans with baseline disorders were also more likely to have made a DVA disability claim, to have an accepted disability claim, to have attributed their claim to Gulf War service or to peacetime service, and to have an accepted claim attributed to the SOPs for 'musculoskeletal system/connective tissue', 'nervous system/sense organs', 'skin and subcutaneous tissue' or 'mental disorders'. The comparison group participants with baseline disorders were more likely than comparison group participants with baseline disorders to attribute their claim to operations other than the Gulf War or peacetime service, and to have an accepted claim attributed to the SOPs for 'mental illness'. In both study groups, participants with baseline disorders were more than three times as likely as participants without baseline disorders to have been issued with a DVA Gold Card.

5.26 Gulf War deployment-related exposures and health outcomes at follow up

The associations between Gulf War-deployment related exposures and health outcomes at follow up are shown in the following Tables.

The association between taking PB during the Gulf War and health outcomes at follow up are shown in Table 90, which indicates that there are some statistically significant associations between use of PB and number of health symptoms, multisymptom illness and IBS at follow up. Those participants who were categorised as having 'high uptake' PB exposure based on their deployment group, had an increased risk of IBS at follow up compared to those who were categorised as 'low uptake' PB exposure based on their deployment group. Using self-reported PB exposure categories, Gulf War veterans who reported taking 'any' number of PB tablets, and those who reported taking 1-80 PB tablets, also had a greater risk of having IBS at follow up, compared to Gulf War veterans who reported that they did not take any PB tablets. Gulf War veterans who reported taking 'any' number of PB tablets, also those who reported taking 81-180 PB tablets, or >180 PB tablets, had a higher health symptom count on average compared to Gulf War veterans who reported no PB tablets. Gulf War veterans who reported that they did not know whether they took PB tablets or not, however, also had a higher health symptom count on average compared to Gulf War veterans who reported no PB tablets. Gulf War veterans who reported taking 81-180 PB tablets were at increased risk of multisymptom illness compared with Gulf War veterans who reported none.

The association between number of vaccinations received as part of the Gulf War deployment and health outcomes at follow up are shown in Table 91. Table 91 indicates that there are some statistically significant associations between self-reported numbers of Gulf War vaccinations and SF-12 defined physical health status, average health symptom count, average neuropathic symptom count, risk of multisymptom illness and risk of chronic fatigue. Compared with Gulf War veterans who reported receiving no vaccinations, those who reported 10 or more vaccinations had a significantly higher average health symptom and neuropathic symptom count, a higher risk of multisymptom illness and a higher risk of chronic fatigue. For every increment of one vaccine reported to be received during the Gulf War, there was on average a 1.03-fold increase in average health symptom count, a 10% increase in risk of multisymptom illness and a 16% increase in risk of chronic fatigue.

The association between anti-malarials taken as part of the Gulf War deployment and health outcomes at follow up are presented in Table 92. There were no clear associations between anti-malarials and health outcomes at follow up. Compared with Gulf War veterans who reported no anti-malarials, those who reported 'any' anti-malarials and those who did not know whether they took anti-malarials or not, both had a slightly higher health symptom count and neuropathic symptom count on average. There were no associations between anti-malarials and any of the other health outcomes shown in Table 92.

The association between exposure to pesticides during the Gulf War deployment and health outcomes at follow up are presented in Table 91. Based on self-reported exposure to pesticides, but not possible exposure based on deployment group, there were statistically significant associations between pesticide exposure and poorer SF12 physical health status, higher average health symptom count, higher risk of multisymptom illness and higher risk of chronic fatigue. Compared to Gulf War veterans who reported no Gulf War-related pesticide exposure, veterans who reported pesticide exposure scored an average of three points lower on the SF12 PCS, approximately 1.3 times higher on their health symptom count, and had approximately double the risk of multisymptom illness and chronic fatigue.

The association between exposure to intense smoke, and SMOIL, during the Gulf War deployment and health outcomes at follow up are presented in Table 94 and Table 95 respectively. There was no association between deployment-based exposure to intense smoke and any of the health outcomes in Table 94, including asthma and chronic bronchitis at follow up. Relative to Gulf War veterans who reported no SMOIL exposure, veterans who reported any, low or high SMOIL exposure had lower SF12 PCS scores and higher health symptom counts. For every increase in reported SMOIL exposure category from 'none' to 'low' to 'high', SF12 PCS score decreased by an average of 2.1 points and there was a 1.2-fold increase in average health symptom count. There was also a marginally significant association between reported low SMOIL exposure and increased risk of IBS, however there was no association between reported high SMOIL exposure and IBS and there was no dose response association.

As presented in Table 96, there were no statistically significant associations between likely exposure to oil in water during the Gulf War deployment, based on deployment group, and SF12 physical health status, average health symptom count and ROME III-defined IBS at follow up.

The associations between exposure to dust during the Gulf War deployment and health outcomes at follow up are presented in Table 97. There was no clear pattern to the

associations between dust and health outcomes at follow up. Self-reported exposure to dust during the Gulf War, but not exposure level based on deployment group, was associated with poorer physical health status at follow up and higher average health symptom count. However, high dust exposure based on deployment group, relative to low dust exposure, was associated with lower risk of symptom-based chronic bronchitis. There was no association between Gulf War-related dust exposure and doctor-confirmed asthma at follow up.

Level of PB exposure	SF12 PCS score		Health symptom count		Neuropathic symptom count		Multisymptom illness (N=203)		Chronic fatigue (N=86)		CFQ case (N=232)		Rome III IBS case (N=90)	
	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj ratio* (95% CI)	Mean (sd)	Adj ratio [†] (95% CI)	n (%)	Adj RR (95% Cl)	n (%)	Adj RR (95% Cl)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)
Deployment- based metric														
Low uptake	46.9 (10.5)	0.0	16.1 (11.1)	1.0	2.1 (2.8)	1.0	92 (26.9)	1.0	42 (12.2)	1.0	113 (32.9)	1.0	34 (10.2)	1.0
High uptake	46.5 (10.1)	-0.54 (-2.2,1.2)	17.8 (12.4)	1.1 (<1.0-1.2)	2.3 (3.1)	0.9 (0.7-1.2)	111 (31.6)	1.2 (0.9-1.6)	44 (12.5)	0.9 (0.6-1.4)	119 (33.8)	1.0 (0.8-1.2)	56 (16.4)	1.7 (1.1-2.7)
Self-report based metric														
None	47.4 (10.5)	0.0	14.0 (11.1)	1.0	1.7 (2.5)	1.0	48 (24.4)	1.0	20 (10.2)	1.0	54 (27.4)	1.0	17 (8.9)	1.0
Any	46.7 (10.0)	-1.0 (-3.0,1.0)	18.1 (12.3)	1.3 (1.1-1.5)	2.3 (3.1)	1.2 (0.9-1.6)	110 (31.4)	1.3 (<1.0-1.9)	45 (14.3)	1.1 (0.7-1.9)	121 (34.6)	1.2 (0.9-1.6)	55 (16.2)	1.9 (1.1-3.3)
1-80 tablets	48.0 (9.0)	0.2 (-2.4, 2.8)	15.2 (11.6)	1.1 (0.9-1.4)	1.6 (2.2)	0.9 (0.6-1.4)	24 (28.9)	1.3 (0.8-2.0)	8 (9.6)	1.0 (0.5-2.1)	25 (30.1)	1.1 (0.7-1.6)	13 (16.5)	2.2 (1.1-4.8)
81-180 tablets	46.6 (9.4)	-1.3 (-4.0, 1.4)	18.5 (12.5)	1.4 (1.1-1.7)	2.4 (3.0)	1.0 (0.6-1.5)	28 (37.8)	1.7 (1.1-2.6)	11 (14.9)	1.4 (0.7-2.8)	26 (35.1)	1.2 (0.8-1.8)	11 (15.1)	1.9 (0.9-4.0)
>180 tablets	46.9 (11.0)	-1.0 (-4.4, 2.4)	17.9 (12.4)	1.3 (1.1-1.6)	2.2 (3.2)	1.1 (0.7-1.8)	21 (32.8)	1.5 (0.9-2.4)	8 (12.5)	1.1 (0.5-2.6)	24 (37.5)	1.3 (0.8-2.0)	8 (12.9)	1.5 (0.6-3.7)
Dose response [§]	0	.42 (-2.19, 1.35)	- 1.08	8 (0.97-1.22)	- *	1.12 (0.89-1.40)	-	1.05 (0.83-1.34)	-	1.03 (0.67-1.61)	-	1.04 (0.82-1.32)	- ().86 (0.56-1.32)
Don't know [‡]	45.7 (10.7)	-2.5 (-4.9, 0.02)	18.2 (10.8)	1.3 (1.1-1.6)	2.7 (3.2)	1.4 (1.1–2.0)	45 (31.3)	1.4 (<1.0-2.1)	21 (14.3)	1.5 (0.8-2.6)	57 (38.8)	1.4 (>1.0-1.9)	18 (12.7)	1.5 (0.8-3.2)

Table 90 Association between use of PB during the Gulf War and health outcomes at follow up in Gulf War veterans

* Calculated using negative binomial regression

† Calculated using zero inflated negative binomial regression due to the approximately 40% of participants with no neuropathic symptoms. Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

‡ Reference category is those who reported 'none'

\$ Dose response per categorical increase in number of PB tablets taken in those who reported taking at least one

Level of vaccination exposure	SF12 PCS score		Health symptom count		Neuropathic symptom count		Multisym (N	ptom illness =203)	Chronic fatigue (N=117)		
	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj ratio* (95% CI)	Mean (sd)	Adj ratio [†] (95% CI)	n (%)	Adj RR (95% Cl)	n (%)	Adj RR (95% CI)	
Deployment-based metric											
Low	46.4 (10.1)	0.0	16.6 (11.1)	1.0	2.3 (3.0)	1.0	47 (30.0)	1.0	22 (13.8)	1.0	
Medium	46.9 (10.4)	0.7 (-2.9, 3.0)	15.6 (10.9)	1.0 (0.8-1.2)	1.9 (2.4)	1.1 (0.7-1.6)	36 (27.3)	1.0 (0.6-1.5)	15 (11.4)	1.1 (0.5-2.4)	
High	46.7 (10.4)	0.5 (-1.4, 2.3)	17.5 (12.2)	1.0 (0.9-1.2)	2.3 (3.1)	1.0 (0.8-1.3)	120 (29.8)	1.0 (0.7-1.3)	49 (12.1)	0.8 (0.5-1.3)	
Self-report based metric											
None	45.7 (11.1)	0.0	16.9 (12.0)	1.0	2.1 (3.0)	1.0	31 (27.4)	1.0	15 (13.3)	1.0	
Any	47.7 (9.8)	1.7 (-0.6, 4.0)	15.8 (11.4)	0.9 (0.8-1.1)	2.0 (2.6)	1.0 (0.8-1.4)	117 (27.6)	1.1 (0.8-1.5)	49 (11.5)	0.9 (0.5-1.5)	
1-4	48.4 (9.6)	2.3 (-0.2, 4.8)	14.4 (10.4)	0.9 (0.7-1.0)	1.6 (2.2)	1.0 (0.7-1.4)	35 (20.6)	0.8 (0.5-1.2)	16 (9.4)	0.7 (0.4-1.4)	
5-9	48.0 (9.8)	1.8 (-0.6, 4.3)	15.8 (11.3)	0.9 (0.8-1.1)	1.9 (2.6)	1.0 (0.7-1.4)	64 (29.1)	1.1 (0.8-1.7)	22 (10.0)	0.8 (0.4-1.4)	
10 or more	43.0 (9.8)	-3.0 (-7.1, 1.0)	23.3 (14.4)	1.4 (1.1-1.7)	1.9 (2.6)	1.8 (1.1-2.9)	18 (52.9)	2.1 (1.3-3.3)	11 (32.4)	2.5 (1.2-5.0)	
Dose response [§]	-	-0.39 (-0.80, 0.01)	-	1.03 (1.01-1.06)	-	not computed	-	1.10 (1.03-1.16)	-	1.16 (1.05-1.28)	
Don't know [‡]	44.5 (10.7)	-1.3 (-4.3, 1.7)	19.9 (11.9)	1.1 (0.9-1.3)	3.0 (3.7)	1.3 (0.9-1.9)	54 (35.1)	1.3 (0.9-2.0)	22 (14.2)	1.0 (0.5-1.9)	
No clustering	47.0 (10.2)	0.0	16.3 (11.5)	1.0	2.0 (2.7)	1.0	135 (27.9)	1.0	57 (11.8)	1.0	
Any clustering	47.9 (9.8)	0.5 (-1.9, 2.9)	16.1 (12.1)	1.01 (0.8-1.2)	2.0 (3.0)	1.1 (0.7-1.5)	20 (27.4)	1.0 (0.7-1.5)	11 (15.1)	1.4 (0.8-2.6)	

Table 91 Association between vaccinations for the Gulf War deployment and health outcomes at follow up in Gulf War veterans

* Calculated using negative binomial regression

† Calculated using regative binomial regression due to the approximately 40% of participants with no neuropathic symptoms. Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

‡ Reference category is those who reported 'none'

§ Dose response per unit increase in number of vaccinations in those who received at least one

Level of anti- malarial exposure	SF12 PCS score		Health symptom count		Neuropathic symptom count		Multisymptom illness (N=203)		Chronic fatigue (N=117)	
	Mean (sd) Adj diff (95% Cl)		Mean (sd)	Adj ratio* (95% CI)	Mean (sd)	Adj ratio [†] (95% Cl)	n (%)	Adj RR (95% Cl)	n (%)	Adj RR (95% Cl)
Self-report based metric										
None	48.2 (9.7)	0.0	14.6 (11.0)	1.0	1.6 (2.3)	1.0	42 (25.9)	1.0	13 (8.0)	1.0
Any	46.1 (10.9)	-1.6 (-3.6, 0.5)	17.7 (12.5)	1.2 (>1.0-1.3)	2.4 (3.2)	1.5 (1.1-2.0)	88 (31.8)	1.2 (0.9-1.6)	43 (15.5)	1.8 (<1.0-3.3)
Don't know [‡]	46.3 (10.0)	-1.7 (-3.8, 0.4)	17.5 (11.2)	1.2 (>1.0-1.4)	2.4 (3.0)	1.5 (1.1-2.0)	72 (28.8)	1.1 (0.8-1.5)	30 (12.0)	1.4 (0.7-2.6)

Table 92 Association between anti-malarial tablets taken during	the Gulf War deployment and healt	n outcomes at follow up in Gulf War veterans

* Calculated using negative binomial regression

† Calculated using regative binomial regression due to the approximately 40% of participants with no neuropathic symptoms. Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

‡ Reference category is those who reported 'none'

Table 93 Association between exposure to pesticides during the Gulf War and health outcomes at follow up in Gulf War veterans

Level of exposure to pesticides	SF12 PCS score		Health symptom count		Neuropathic symptom count		Multisymptom illness (N=203)		Chronic fatigue (N=117)	
	Mean (sd)	Adj diff (95% Cl)	Mean (sd)	Adj ratio* (95% Cl)	Mean (sd)	Adj ratio [†] (95% Cl)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)
Deployment-based										
metric										
Unlikely	46.8 (10.3)	0.0	16.8 (11.7)	1.0	2.2 (2.9)	1.0	193 (29.1)	1.0	80 (12.0)	1.0
Possible	44.3 (10.9)	-0.5 (-5.2, 4.3)	19.5 (13.6)	1.0 (0.7-1.4)	3.1 (4.0)	1.0 (0.6-1.8)	10 (33.3)	0.7 (0.4-1.4)	6 (20.7)	1.8 (0.7-4.5)
Self-report based										
metric										
No	47 7 (9.8)	0.0	15.5	1.0	2.0 (2.8)	1.0	120 (23.7)	1.0	47 (9.3)	1.0
Yes	43.9 (11.0)	-3.1 (-5.0, -1.2)	20.8	1.3 (1.1-1.5)	2.9 (3.4)	1.1 (0.9-1.4)	79 (44.1)	1.8 (1.4-2.3)	39 (21.7)	2.3 (1.6-3.5)

* Calculated using negative binomial regression

† Calculated using zero inflated negative binomial regression due to the approximately 40% of participants with no neuropathic symptoms. Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

Level of smoke exposure	SF12 PCS score		Health symptom count		Rome III IBS case (N=90)		Self-reported doctor confirmed Asthma (N=87)		Symptom-based-Chronic bronchitis (N=144)	
	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj ratio* (95% CI)	n (%)	Adj RR (95% CI)	n (%) Adj RR† (95% Cl)		n (%)	Adj RR† (95% CI)
Deployment-based metric										
Low	46.6 (10.2)	0.0	17.0 (11.9)	1.0	85 (13.8)	1.0	81 (12.7)	1.0	133 (20.9)	1.0
High	47.2 (11.4)	0.6 (-2.6, 3.7)	16.1 (10.1)	0.9 (0.8-1.1)	5 (8.9)	0.6 (0.3-1.5)	5 (9.3)	0.7 (0.3-1.5)	11 (19.6)	1.0 (0.6-1.8)

Table 94 Association between intense smoke exposure during the Gulf War and health outcomes at follow up in Gulf War veterans

* Calculated using negative binomial regression

† Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, atopy at baseline and current smoking status (never; former; current smoker)

Table 95 Association between SMOIL exposure during the Gulf War and health outcomes at follow up in Gulf War veterans

Level of SMOIL exposure	SF12 PCS score		Health symptom count		Rome III IBS case (N=90)		Self-reported doctor confirmed Asthma (N=87)		Symptom-based-Chronic bronchitis (N=144)	
	Mean (sd)Adj diff (95% Cl)Mean (sd)Adj ratio* (95% Cl)Adj RR (95% Cl)		n (%)	Adj RR† (95% Cl)	n (%)	Adj RR† (95% Cl)				
Self-report based										
metric										
None	48.3 (9.5)	0.0	14.9 (10.3)	1.0	34 (10.7)	1.0	35 (10.7)	1.0	60 (18.3)	1.0
Any	45.3 (10.8)	-2.9 (-4.4, -1.4)	18.8 (12.8)	1.2 (1.1-1.4)	55 (15.7)	1.4 (<1.0-2.2)	50 (14.0)	1.3 (0.8-1.9)	82 (22.9)	1.2 (0.8-1.6)
Low	45.3 (10.8)	-2.8 (-4.4, -1.2)	18.4 (12.6)	1.2 (1.1-1.3)	49 (16.8)	1.5 (>1.0-2.3)	39 (13.2)	1.2 (0.7-1.8)	65 (22.0)	1.1 (0.8-1.6)
High	45.3 (10.8)	-3.4 (-6.4, -0.5)	20.5 (13.4)	1.4 (1.1-1.6)	6 (10.2)	0.9 (0.4-2.1)	11 (18.0)	1.7 (0.9-3.1)	17 (27.4)	1.6 (<1.0-2.6)
Dose response [§]	-	-2.14 (-3.33, -0.94)	-	1.18 (1.10-1.28)	-	1.17 (0.89-1.55)	-	1.26 (0.93-1.71)	-	1.22 (0.96-1.55)

* Calculated using negative binomial regression

† Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, atopy at baseline and current smoking status (never; former; current smoker)

§ Dose response per categorical increase in SMOIL where participants are categorised as either "none', "low" or "high"

Table 96 Association between exposure to oil in water during the Gulf War and health outcomes at follow up in Gulf War veterans

Level of exposure to oil in water						
	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj ratio* (95% CI)	n (%)	Adj RR (95% CI)
Deployment-based metric						
Unlikely	46.8 (10.4)	0.0	16.7 (11.5)	1.0	65 (12.4)	1.0
Possible	46.1 (10.1)	-0.9 (-2.8, 1.0)	17.8 (12.8)	1.0 (0.9-1.2)	25 (16.8)	1.3 (0.8-2.1)

* Calculated using negative binomial regression

Level of dust exposure	SF12	PCS score	Health sy	ymptom count*	Self-re confirme	ported doctor d Asthma (N=87)	Symptom-based-Chronic bronchitis (N=144)		
-	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj diff (95% CI)	n (%)	Adj RR^{\dagger} (95% CI)	n (%)	Adj RR [†] (95% CI)	
Deployment-based									
metric									
Low	46.7 (10.2)	0.0	16.6 (10.8)	1.0	24 (13.1)	1.0	52 (63.4)	1.0	
High	46.7 (10.3)	-0.1 (-1.9, 1.7)	17.1 (12.1)	1.0 (0.9-1.2)	62 (12.2)	1.0 (0.6-1.5)	92 (45.5)	0.7 (0.6-0.9)	
Self-report based									
metric									
Absent	48.0 (9.6)	0.0	15.4 (10.5)	1.0	46 (12.5)	1.0	68 (46.3)	1.0	
Present	45.1 (11.0)	-2.9 (-4.4, -1.3)	18.7 (12.9)	1.2 (1.1-1.4)	39 (12.4)	1.1 (0.7-1.6)	76 (56.3)	1.3 (<1.0-1.6)	

Table 97 Association between dust exposure during the Gulf War and health outcomes at follow up in Gulf War veterans

* Calculated using negative binomial regression † Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, atopy at baseline and current smoking status (never; former; current smoker)

Table 98 shows that there was no statistically significant association between possible exposure to gastroenteritis outbreaks during the Gulf War, based on deployment group, and ROME III-defined IBS at follow up.

Table 98 Association between possible exposure to gastroenterit	is outbreaks during the Gulf War
and health outcomes at follow up in Gulf War veterans	

Level of exposure to gastroenteritis outbreak	Rome III IBS case (N=90)						
	n (%)	Adj RR (95% CI)					
Deployment-based							
metric							
Unlikely	28 (10.9)	1.0					
Possible	62 (14.8)	1.3 (0.8-2.0)					

Table 99 shows the associations between Gulf War deployment era, and MSEQ score, with health outcomes at follow up. Compared with those Gulf War veterans whose deployment ended prior to the combat phase of the Gulf War, veterans whose deployment included the combat phase had a higher risk of multisymptom illness, alcohol disorder as measured by AUDIT caseness, 12 month major depression and a higher average health symptom count (for the latter two health outcomes the differences only just met statistical significance). Gulf War veterans whose deployment commenced after the combat phase were at greater risk of 12 month alcohol disorder compared to Gulf War veterans whose deployment ended prior to the combat phase.

Increasing number of reported Gulf War-related stressors, as indicated by increasing MSEQ score, was strongly associated with decreased SF12 mental health status score, increased average health symptom and neuropathic symptom count, increased depressive symptom severity score, and increased risk of multisymptom illness, chronic fatigue, 12 month major depression, 12 month PTSD, alcohol disorder as measured by AUDIT caseness (the association with CIDI-defined alcohol disorder was only marginal), and psychological distress as measured by GHQ-12 caseness. The greatest risk was amongst those who reported 12 or more Gulf War-related stressors. Those Gulf War veterans were at six times greater risk of multisymptom illness, five times greater risk of 12 month PTSD, three times greater risk of 12 month major depression and irritable bowel syndrome, and double the risk of chronic fatigue, for example, compared with those veterans who reported four or fewer Gulf War-related stressors. Every increase in MSEQ score of one Gulf War-related stressor was associated with increased morbidity on a number of measured outcomes including a 13% increase in 12 month PTSD, a 9% increase in multisymptom illness, a 7% increase in chronic fatigue and a 6% increase in 12 month major depression.

Gulf War deployment exposure	SF12 MCS score		Health symptom count		Neuropathic symptom count		Multisymptom illness (N=203)		Chronic fatigue (N=86)		Irritable Bowel Syndrome (N=90)	
	Mean (sd)	Adj diff (95% CI)	Mean (sd)	Adj ratio* (95% CI)	Mean (sd)	Adj ratio [†] (95% CI)	n (%)	Adj RR (95% Cl)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)
Deployment era						,		,		,		
before combat	46.6 (11.1)	0.0	15.5 (11.0)	1.0	2.1 (2.9)	1.0	44 (22.5)	1.0	27 (13.7)	1.0	17 (9.0)	1.00
during combat	45.7 (12.3)	-0.5 (-2.5, 1.5)	17.6 (12.1)	1.1 (>1.0-1.3)	2.3 (3.0)	0.9 (0.7 – 1.1)	133 (32.0)	1.4 (1.1-1.9)	48 (11.5)	0.8 (0.5-1.3)	61 (15.0)	1.65 (0.99-2.73)
after combat	46.9 (11.4)	-0.0 (-3.0, 2.9)	17.1 (11.8)	1.0 (0.9-1.2)	2.1 (3.0)	0.8 (0.5 – 1.3)	26 (32.1)	1.3 (0.8-2.0)	11 (13.6)	0.9 (0.5-1.8)	12 (15.2)	1.58 (0.82-3.06)
MSEQ score												
0-4	51.2 (9.3)	0.0	10.3 (8.4)	1.0	1.1 (1.8)	1.0	14 (9.0)	1.0	13 (8.4)	1.0	10 (6.5)	1.00
5-8	47.5 (11.0)	-3.8 (-6.0, -1.7)	14.9 (9.7)	1.5 (1.3-1.7)	1.7 (2.7)	1.2 (0.9 – 1.7)	43 (20.9)	2.4 (1.3-4.2)	19 (9.2)	1.0 (0.5-2.0)	24 (12.1)	1.88 (0.91-3.87)
9-12	44.6 (12.3)	-6.9 (-9.3, -4.5)	19.5 (12.4)	1.9 (1.6-2.2)	2.9 (3.4)	1.7 (1.2 – 2.4)	62 (35.6)	4.0 (2.3-6.8)	21 (12.0)	1.3 (0.7-2.6)	29 (17.2)	2.65 (1.31-5.37)
>12	40.9 (12.4)	-10.3 (-12.9, -7.8)	23.3 (12.3)	2.3 (2.0-2.7)	3.1 (3.3)	1.9 (1.4 – 2.8)	84 (53.5)	6.1 (3.6-10.4)	33 (20.9)	2.3 (1.2-4.3)	27 (17.7)	2.86 (1.42-5.77)
Dose response [‡]	-	-0.72 (08, -0.56)	-	1.06 (1.05-1.07)	- 1.	.04 (1.02 – 1.07)	- 1.0	9 (1.08-1.11)	- 1.	07 (1.04-1.10)	-	1.05 (1.03-1.09)

Gulf War deployment exposure	12 month Major depression (N=63)		PHQ-9 depressive symptom score		12 month PTSD (N=47)		12 month Alcohol disorder (N=40)		AUDIT case (N=199)		GHQ-12 case (N=264)	
	n (%)	Adj RR (95% CI)	Median (IQR)	Adj diff (95% CI)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)	n (%)	Adj RR (95% CI)
Deployment era												
before combat	11 (6.1)	1.0	3 (1-6)	0.0	10 (5.5)	1.0	5 (2.8)	1.0	42 (21.5)	1.0	81 (41.1)	1.0
during combat	46 (11.9)	1.9 (>1.0-3.6)	4 (0-8)	1 (-0.1-2.1)	32 (8.3)	1.4 (0.7-2.8)	27 (7.0)	2.4 (0.9-6.4)	134 (32.4)	1.5 (1.1-2.0)	155 (37.4)	0.9 (0.7-1.1)
after combat	6 (7.5)	1.3 (0.5-3.8)	4 (1-7)	1 (-0.7, 2.7)	5 (6.3)	0.7 (0.2-2.3)	8 (10.0)	3.5 (1.1-10.9)	23 (28.1)	1.4 (0.9-2.2)	28 (34.2)	0.8 (0.6-1.2)
MSEQ score												
0-4	7 (4.8)	1.0	1 (0-4)	0.0	0	-	5 (3.5)	1.0	33 (21.3)	1.0	36 (23.2)	1.0
5-8	17 (8.7)	1.9 (0.8-4.4)	3 (0-6)	1 (-0.3-2.3)	11 (5.6)	1.0 [§]	10 (5.1)	1.4 (0.5-4.1)	50 (24.3)	1.1 (0.7-1.6)	73 (35.3)	1.5 (1.1-2.2)
9-12	16 (10.1)	2.2 (0.9-5.2)	4 (2-8)	2 (0.6-3.4)	12 (7.6)	2.2 (>1.0-4.9)	11 (7.0)	1.9 (0.7-5.5)	58 (33.5)	1.5 (1.1-2.2)	75 (42.9)	1.9 (1.3-2.6)
>12	23 (15.6)	3.2 (1.4-7.4)	7 (3-12)	5 (3.6-6.4)	24 (16.3)	4.6 (2.3-9.1)	14 (9.5)	2.5 (0.9-6.7)	57 (36.5)	1.6 (1.1-2.4)	80 (51.3)	2.2 (1.6-3.1)
Dose response [†]	-	1.06 (1.02-1.09)	-	0.36 (0.27-0.46)	-	1.13 (1.10-1.17)	-	1.05 (>1.00-1.10)		1.04 (1.02-1.06)		1.04 (1.03-1.06)

* Calculated using negative binomial regression

† Calculated using zero inflated negative binomial regression due to the approximately 40% of participants with no neuropathic symptoms. Adjusted for age (<20; 20-24; 25-34; >=35 years), service branch (Navy; Army; Air Force) and rank (CO, NCO, enlisted ranks) each estimated as at August 1990, and alcohol (AUDIT score > 10) and self-reported doctor-diagnosed diabetes

The dose response slope is the expected proportionate increase in the adj RR (or adj difff) per unit increase in the MSEQ score § Because there are no PTSD cases with an MSEQ score of 0-4, the reference category for this regression was MSEQ score 0-8

5.26.1 Key findings

There were a number of statistically significant associations between Gulf War deployment exposures and health outcomes at follow up. Typically, significant associations were found for self-report based-metrics of exposure level rather than metrics based on deployment group.

The use of pyridostigmine bromide during the Gulf War was associated with an increased number of health symptoms, multisymptom illness and IBS at follow up. Gulf War veterans who were categorised as having 'high uptake' of PB exposure based on their deployment group, compared with 'low uptake', and those who reported taking 'any' number of PB tablets, or 1-80 PB tablets, compared with none, had a greater risk of having IBS at follow up. Gulf War veterans who reported taking 'any' number, 81-180 PB tablets, or >180 PB tablets, had a higher health symptom count on average compared to veterans who reported no PB tablets. Gulf War veterans who reported that they did not know whether they took PB tablets or not, however, also had a higher health symptom count on average compared to veterans who reported no PB tablets. Gulf War veterans who reported taking 81-180 PB tablets were at increased risk of multisymptom illness compared with veterans who reported no PB tablets.

Compared with Gulf War veterans who reported receiving no vaccinations, those who reported 10 or more vaccinations as part of the Gulf War deployment had a significantly higher average health symptom and neuropathic symptom count, and a higher risk of multisymptom illness and chronic fatigue at follow up. For every increment of one vaccine reported to be received during the Gulf War, there was a 1.03-fold increase in average health symptom count, a 10% increase in multisymptom illness risk and a 16% increase chronic fatigue risk.

Compared to Gulf War veterans who reported no Gulf War-related pesticide exposure, veterans who reported pesticide exposure scored an average of three points lower on the SF12 PCS, approximately 1.3 times higher on their health symptom count, and had approximately double the risk of multisymptom illness and chronic fatigue.

Relative to Gulf War veterans who reported no SMOIL exposure, veterans who reported any, low or high SMOIL exposure had lower SF12 PCS scores and higher health symptom counts. For every increase in reported SMOIL exposure category from 'none' to 'low' to 'high', SF12 PCS score decreased by an average of 2.1 points and there was a 1.2-fold increase in average health symptom count.

There was no clear pattern to the associations between dust and health outcomes at follow up. Self-reported exposure to dust during the Gulf War was associated with poorer physical health status at follow up and higher average health symptom count. However, high dust exposure based on deployment group, relative to low dust exposure, was associated with lower risk of symptom-based chronic bronchitis. There was no association between Gulf War-related dust exposure and doctor-confirmed asthma at follow up.

Compared with those Gulf War veterans whose deployment ended prior to the combat phase of the Gulf War, veterans whose deployment included the combat phase had a higher average health symptom count, depressive symptom severity, multisymptom illness risk and major depression risk. Gulf War veterans whose deployment commenced after the combat phase were at greater risk of alcohol disorder compared to veterans whose deployment ended prior to the combat phase.

Increasing number of reported Gulf War-related stressors, as indicated by increasing MSEQ score, was associated with decreased mental health status score, and increased average health symptom and neuropathic symptom count, depressive symptom severity, and risk of multisymptom illness, chronic fatigue, major depression, PTSD, AUDIT alcohol disorder and psychological distress at follow up.

There were no clear patterns to the associations observed between anti-malarials and health outcomes at follow up. There were no statistically significant associations between deployment-based metrics for likely exposure to oil in water, intense smoke, or possible exposure to gastroenteritis outbreaks during the Gulf War deployment, and health outcomes at follow up.

6 Discussion

This Australian Gulf War Veterans' Follow Up Health Study was primarily designed to examine the physical, psychological and social health sequelae of deployment to the 1991 Gulf War, amongst Australian veterans of that conflict more than 20 years after deployment. It also aimed to further develop the methods for assessing exposures during the Gulf War for inclusion in analyses for the follow up study. The findings build upon the results of the baseline Australian Gulf War Veterans' Health Study conducted in the period 2000-2002, approximately 10 years after deployment. At that time a cohort was established of Australian veterans of the Gulf War, and a frequency matched comparison group of ADF personnel who were in operational units at the time of the Gulf War but who did not deploy to that conflict. It was intended that the cohort be followed prospectively to measure mortality and cancer incidence, and to monitor various other health and related outcomes and their relationship with Gulf War deployment-related exposures.

Overview of health outcomes at follow up

More than 20 years after the Gulf War, the Australian Gulf War Veterans' Follow Up Health Study results demonstrate that Australian veterans of the Gulf War have poorer physical health, psychological health and quality of life, greater use of DVA-health services and greater use of pharmaceuticals relative to the comparison group of ADF personnel who did not deploy to the Gulf War. The two study groups, however, are similar in regard to their overall life satisfaction and health satisfaction, their levels of resilience, social support and community participation, and their likelihood of accessing GPs, medical specialists and other health professionals. While there were no statistically significant excesses in the mortality and cancer incidence rates of the Gulf War veterans, there were some causes of death and types of cancer for which numbers are small, but which are suggestive of an excess and will need close monitoring.

At follow up, Gulf War veterans were at statistically significantly increased risk of numerous adverse health outcomes, relative to the comparison group. Risk of multisymptom illness at follow up, based on past-month symptoms, was 60% higher in Gulf War veterans, risk of irritable bowel syndrome was 64% higher and risk of chronic fatigue was 41% higher. Gulf War veterans were also at increased risk of 12 month PTSD by 137%, 12 month alcohol disorder by 93% and GHQ-12 caseness for psychological distress by 19%. Of these outcomes, multisymptom illness was the most prevalent, observed in 26-29% of Gulf War veterans and 16-18% of the comparison group. Gulf War veterans reported six of 40 doctor-

diagnosed medical conditions significantly more frequently than the comparison group, including PTSD, sinus problems, dermatitis, eczema, pneumonia and impotence. At follow up Gulf War veterans also reported 47 of 63 general health symptoms, and five of 17 neuropathic symptoms, significantly more frequently than the comparison group, also more difficulty with sleeping patterns, greater likelihood of severe daytime sleepiness, greater likelihood of having numerous body areas of pain or tenderness, increased risk of injury which potentially involved concussion, more respiratory symptoms including wheeze, cough and sputum, depression symptoms of greater severity, higher levels of demoralisation, higher risk of self-reported difficulty fathering a pregnancy, a slightly increased risk of interaction with the judicial system and increased risk of recently feeling that life was not worth living. In regard to quality of life at follow up, Gulf War veterans rated their physical, psychological and social quality of life statistically significantly more poorly than the comparison group.

There were also other measures of adverse health outcomes at follow up where the differences between Gulf War veterans and the comparison group did not achieve statistical significance, however the pattern was such that the Gulf War veterans typically scored more poorly. These results include increased risk of 12 month depression, symptom-based chronic bronchitis, in-patient hospitalisation for recent injury, and self-reported kidney and bladder disease and eye or vision problems.

The excess of adverse health outcomes in Gulf War veterans relative to the comparison group was also reflected in their significantly increased rate of lodging disability claims with DVA and increased likelihood of having had at least one claim accepted, their increased rate of DVA hospitalisation, their increased likelihood of having been issued a Gold Card and the increased number of pharmaceutical scripts filled in the past 12 month. There was no observable difference, however, in the two study groups' likelihood of having accessed GPs, medical specialists such as neurologists, gastroenterologists, respiratory physicians and psychiatrists and allied health professionals such as physiotherapists, chiropractors or naturopaths.

For a few health outcomes, there was no apparent difference between the two study groups. These include musculoskeletal disorders, structural gastrointestinal disorders such as ulcers, Crohn's Disease and Colitis, also reflux-related diseases and gall bladder disease, number of injuries in the previous 12 months, psychological disorders other than PTSD, alcohol disorder and depression, likelihood of fathering a full-term and normal weight baby, risk taking propensity, and some other self-reported doctor-diagnosed medical conditions including hearing loss, sleep apnoea, heart attack or myocardial infarction, carpal tunnel

syndrome and diabetes. There were also no differences between the two groups in their likelihood of having experienced a traumatic event since baseline, or to have experienced financial distress, homelessness or incarceration. The Gulf War veterans and the comparison group were also similar on measures of resilience, overall social support, membership and activity levels in voluntary groups, involvement in ex-service organisations and commemoration of significant military-related occasions.

Overall patterns of association between Gulf War deployment characteristics and exposures, and health outcomes at follow up

Several Gulf War deployment characteristics and exposures were associated with a number of adverse health outcomes in Gulf War veterans at follow up. Lower rank at the time of the Gulf War deployment was significantly associated with poorer perceived physical health status, and increased risk of multisymptom illness, neuropathic symptom reporting, irritable bowel syndrome, and 12 month alcohol disorder. Self-reported taking of pyridostigmine bromide (PB) tablets was associated with increased symptom reporting and risk of multisymptom illness, and irritable bowel syndrome at follow up. Self-reported number of vaccinations was associated in a dose response relationship with increased symptom reporting and risk of multisymptom illness, and chronic fatigue; with the greatest risk amongst Gulf War veterans who reported ten or more vaccinations. Self-reported pesticide exposure was associated with poorer physical health status, increased symptom reporting and risk of multisymptom illness, and chronic fatigue. Self-reported SMOIL exposure was associated in a dose response relationship with poorer physical health status and increased symptom reporting. Deployment which included the combat phase of the Gulf War was associated with increased symptom reporting and risk of multisymptom illness, increased depressive symptom severity and increased risk of major depression. Finally, increasing number of self-reported deployment-related stressors, was associated in a dose response relationship with poorer perceived mental health status, increased health symptom and neuropathic symptom reporting, increased risk of multisymptom illness, chronic fatigue, irritable bowel syndrome, major depression, PTSD, AUDIT alcohol caseness and GHQ12 psychological distress at follow up.

There were no clear patterns of association between anti-malarials, dust storms, oil in water, intense smoke, or possible exposure to gastroenteritis outbreaks during the Gulf War, and health outcomes at follow up.

There are a number of ways in which the above-listed exposures overlap with each other, therefore limiting the certainty with which any one exposure can conclusively be linked to any one health outcome. Those taking PB tablets, for example, were primarily deployed as part of Damask II which included the combat phase of the Gulf War and the torching of the oil wells resulting in SMOIL. Clearance divers and HMA Ships *Brisbane* and *Sydney* who were categorised as 'high uptake' for PB, were also categorised as 'high' for vaccination exposure and dust. Clearance divers were also categorised as 'high' for intense smoke, oil in water and possible outbreaks of gastroenteritis. Gulf War veterans who reported the most deployment-related stressors were most likely to have served under junior ranks at the time of the Gulf War and during the combat phase. What is apparent, however, is that there is clearly an excess of adverse health outcomes in the Gulf War veteran group, and there are plausible connections with the various exposures described above.

Health outcomes at follow up in more detail

Symptoms

At follow up the Gulf War veterans endorsed an average of 17 of 63 general health symptoms whereas the comparison group averaged 12 symptoms. Gulf War veterans reported 62 of 63 general health symptoms more frequently than the comparison group, and for 47 of those the increase was statistically significant. The greatest increases in risk were for forgetfulness, avoiding doing things, loss of concentration, feeling distant or cut off, rash or skin irritation, distressing dreams, night sweats, stomach cramps, increased sensitivity to light, feeling disoriented and skin ulcers, where the lower values of the 95% CIs indicated an increased risk of at least 25%. Interestingly, many of the above-listed symptoms could be broadly categorised as neuropsychological. The most prevalent symptoms in both groups were typically neuropsychological or musculoskeletal, including feeling unrefreshed after sleep, fatigue, sleeping difficulties, muscle aches or pains, headaches, low back pain and irritability or outbursts of anger, stiffness in several joints, and ringing ears, all reported by more than 50% of the Gulf War veterans.

These findings are consistent with those at baseline, when Gulf War veterans reported all 63 general health symptoms more frequently than the comparison group, and the increase was significant for 56 of those. The greatest increases in risk at baseline were for neuropsychological-type symptoms. Eight of the ten symptoms most prevalent for Gulf War veterans at baseline were amongst the ten symptoms most prevalent at follow up, and these were typically neuropsychological or musculoskeletal. Symptoms which were not significantly in excess at baseline were also not significantly in excess at follow up; they were low back pain, persistent cough, toothache, tender/swollen lymph glands, vomiting, unintended weight loss and seizures.

Since baseline the mean number of past-month symptoms increased by approximately three in the Gulf War veteran group and 1.5 in the comparison group. In the Gulf War veteran group, about half of the symptoms were significantly more prevalent at follow up compared to baseline, whilst in the comparison group this was true for about one third of the symptoms. Amongst the 20 symptoms most prevalent at follow up, a half were significantly more persistent and more incident at follow up in the Gulf War veteran group, but none were significantly more persistent or incident in the comparison group.

Whilst the Gulf War veterans continue to report health symptoms with greater frequency than the comparison group at follow up, the pattern of co-occurrence of symptoms reported at follow up by the two groups was similar. Analogous to the result found at baseline, this suggests that the pattern (although not frequency) of self-reported symptoms among Gulf War veterans is not unique.

Somatic psychological disorders can be associated with increased physical symptom reporting with no organic basis. However, CIDI-defined somatic disorders were detected in less than 2% of all participants at follow up, somatization was detected in only one participant and a somatic symptom attribution style was predominant in only 7% of all participants. Therefore somatic psychological disorders are not considered an explanation for excess symptom reporting in the Gulf War veteran group.

Multisymptom illness

The more frequent reporting of symptoms by Gulf War veterans, relative to the comparison group, does not necessarily equate to increased multisymptom illness in Gulf War veterans. To meet criteria for multisymptom illness, participants were required to endorse one or more symptoms in the past month, rated as at least moderate in severity, from at least three of four categories (fatigue, psycho-physiological, cognitive, and arthro-neuromuscular), where the latter three categories comprised the three factors identified in the exploratory factor analysis of symptoms in the baseline study.¹⁹ An alternative set of criteria for multisymptom illness excluded participants with serious medical or psychiatric conditions that might explain their symptom reporting. Regardless of the criteria used, Gulf War veterans were 60% more likely than the comparison group to have multisymptom illness at follow up.

The prevalence of multisymptom illness in 26-29% of Australian Gulf War veterans, is consistent with US studies reporting that as many as one quarter of Gulf War veterans are suffering from an array of symptoms that, taken together have been called multisymptom illness, Gulf War illness or Gulf War syndrome.¹²⁹ Blanchard *et al* (2006)³⁶ reported chronic multisymptom illness, present for at least six months, in 29% of US Gulf War veterans ten

years after deployment, and Unwin *et al* (1999)⁸ reported multisymptom syndrome based on severe symptoms only, in 25% of a British Gulf cohort. Unlike the Australian Gulf War veteran group which comprised predominantly Navy personnel, the US and British Gulf War veterans were predominantly Army.

In the ten year period since the baseline study, multisymptom illness in Australian Gulf War veterans has been very slightly more persistent, less remittent and more incident, than in the comparison group. However, the overall excess in risk of multisymptom illness of 60% in Gulf War veterans at follow up, is slightly smaller than the excess risk of 80% observed at baseline.

The finding of a persisting excess of multisymptom illness in the Australian Gulf War veteran group is consistent with the US Institute of Medicine's 2010 judgement that the weight of the scientific studies have provided "*sufficient evidence of an association*" between deployment to the Gulf War and multisymptom illness.²¹

Fatigue and chronic fatigue

Twenty years after the Gulf War, extreme tiredness or fatigue following normal activities, prolonged fatigue of at least one month and chronic fatigue of at least six months are present in 33%, 17% and 12% of Gulf War veterans respectively. Gulf War veterans are at significantly increased risk of each of the three fatigue-related outcomes above by about 40%. This represents a narrowing of the magnitude of the excesses in Gulf War veterans which were observed at baseline (70%, 80% and 90% for the three outcomes respectively). In both groups, prevalence of these fatigue outcomes roughly doubled from baseline to follow up, and there were no significant differences in persistence or incidence. CFQ fatigue caseness at follow up was found in 33% of Gulf War veterans and this represented a significantly increased risk of 23%, however the two groups reported similar severity of fatigue symptoms.

Our measure of chronic fatigue at follow up should not be mistaken for chronic fatigue syndrome; the latter requiring a medical examination, laboratory testing and medical history. At baseline, less than 1% of Australian Gulf War veterans met criteria for chronic fatigue syndrome, however this outcome could not be measured at follow up because medical examinations and laboratory testing were not conducted. Comparison of our follow up study fatigue-related findings with recent international Gulf War veteran literature is limited, both because there are few follow up studies of Gulf War veterans and because definitions used for fatigue-related outcomes vary. Based on data collected approximately 14 years after deployment, Kang *et al* (2009) reported that 9% of US Gulf War veterans had "chronic

fatigue syndrome-like" illness in the previous 12 months.¹³⁰ Similar to our study, this outcome had almost doubled in prevalence since an assessment ten years earlier. Approximately ten years after deployment, Hotopf *et al* (2003) observed that 43% of British Gulf War veterans met CFQ criteria for fatigue. In that study, the prevalence in the group had actually decreased by 5% since an assessment four years earlier.

Consistent with our Australian study, and regardless of the method of assessment, the above and other studies typically show an excess of fatigue-related outcomes in Gulf War veterans relative to comparators.^{9,32,131-133} Whilst our follow up health study did not measure chronic fatigue syndrome *per se*, it provides further support for the US Institute of Medicine's 2010 judgement that the weight of the scientific studies provide "*sufficient evidence of an association*" between deployment to the Gulf War and chronic fatigue syndrome.²¹

Irritable bowel syndrome and other gastrointestinal disorders

Thirteen percent of Gulf War veterans and 8% of the comparison group reported the recurrent or prolonged clusters of symptoms that meet Rome III diagnostic criteria for irritable bowel syndrome (IBS), representing an increased risk of 64%. The excess risk was maintained when additional analysis excluded participants who reported that they had Colitis or Crohn's disease, which might explain IBS symptoms.

Interestingly, less than 1% of all participants reported that a medical doctor had diagnosed them with, or treated them for IBS. This could indicate that study participants are not reporting symptoms of IBS to doctors, or that doctors are not identifying IBS as the condition underlying the reported symptoms. However, the same theory could be applied to the self-report of Colitis or Crohn's disease, which could be under-estimated in the follow up study and which could explain more IBS symptoms than we have estimated. A comprehensive medical examination and medical history would, of course, provide a more robust estimate of the true IBS prevalence in the study groups, however the Rome III criteria are considered valid and reliable.^{59,60}

At baseline, the odds of self-reported doctor diagnosed, or treated, IBS in Gulf War veterans (3%) was more than double that in the comparison group (1%). To improve the reliability of the self-reported data, participants were interviewed by a medical doctor and only reports of IBS which were rated as "possible or probable" were included. Rome III criteria for IBS, however, were not applied at baseline and therefore change over time could not be investigated. In fact, Rome III criteria for IBS have rarely been applied in Gulf War veteran health studies. In its 2009 review of the extensive Gulf War health literature, the IOM identified only one published study using Rome criteria to estimate prevalence of functional

gastrointestinal disorders.²¹ In a sample of only 247 Gulf War veterans registered at Veterans Affairs Medical Centers, Tuteja *et al* (2008)¹³⁴ reported that 0.4% met Rome III IBS criteria pre-deployment, 17% met criteria during deployment and 40% met criteria post deployment. These findings, however, are severely limited, not only by the small sample size and selection from medical centres, but also by the fact that participants were surveyed only once and required to retrospectively recall their bowel habits for the pre- and during-deployment measures.

Information about gastrointestinal disorders other than IBS at follow up, were collected by self-reported doctor-diagnosis or treatment only. Prevalences were low, for example, 5% of Gulf War veterans reported stomach or duodenal ulcers, 2% reported reflux related diseases, hernia or oesophagitis, less than 1% reported diverticular disease and less than ½% reported coeliac disease. The prevalences of these disorders were not significantly different between the two study groups, although peptic ulceration was the most suggestive of an excess in Gulf War veterans. Past month symptoms of gastrointestinal type, however, including indigestion, diarrhoea and stomach cramps were significantly more prevalent in the Gulf War veteran group.

The US IOM reviewed a number of Gulf War studies that reported excess gastrointestinal complaints in veterans.²¹ For example, ten years after deployment, Eisen *et al* (2005)¹³⁵ reported increased odds of dyspepsia of 87%, and increased odds of gastritis of 57% in US Gulf War veterans. Gray *et al* (2002) reported the odds of self-reported physician-diagnosed IBS in Gulf War deployed Seabees (a US Navy Construction battalion) to be more than three times the odds in non-deployed Seabees. Two physiological studies of symptomatic Gulf War veterans demonstrated chronic inflammation consistent with postinfectious IBS.^{136,137} Numerous studies reported excess gastrointestinal symptoms, such as gas and cramps,^{34,138}, bloating,³⁴ and diarrhoea.^{33,34,37,138}

The IOM²¹ reports that the most compelling evidence for an association between Gulf War deployment-related exposures and IBS, is that in relation to exposure to enteric pathogens during deployment leading to the development of postinfectious IBS.^{136,139} Our exposure analyses showed an elevated risk (but not significantly so) of IBS in Gulf War veterans rated as having "possible exposure" to gastroenteritis outbreaks. This exposure rating, however, was based on deployment with a Ship or group for which Medical records reported outbreaks of gastroenteritis. The magnitude or severity of the outbreaks, however, could not reliably be estimated, nor could any individual's level of exposure.

Overall, our findings are consistent with the IOM's 2010 judgement that the weight of the scientific studies provide "*sufficient evidence of an association*" between deployment to the Gulf War and functional gastrointestinal disorders such as irritable bowel syndrome, but *"inadequate/insufficient evidence of an association*" between deployment to the Gulf War and structural gastrointestinal disorders such as ulcers and Crohn's Disease or colitis.²¹

Musculoskeletal disorders

The follow up study showed no significant excess of self-reported doctor diagnosed, or treated, musculoskeletal disorders in Australian Gulf War veterans relative to the comparison group, including osteoarthritis, rheumatoid arthritis, other inflammatory arthritis, gout or osteoporosis. The most prevalent disorder was osteoarthritis, reported by one in seven participants, and this most frequently manifested in the knee relative to the other body sites. Osteoarthritis of the hip was significantly less prevalent in the Gulf War veterans (9%) than in the comparison group (19%).

At baseline, 5% of participants in both study groups self-reported doctor diagnosed or treated, "arthritis or rheumatism". Other studies at around that time, also relying on self-reported prevalence of arthritis, showed significant excesses in Gulf War veterans.^{140,141} Additional studies reporting musculoskeletal diseases have primarily relied on hospitalisation studies using discharge diagnosis data.^{124,142,143} The results of these studies were mixed and were limited by the restriction to musculoskeletal diseases resulting in hospitalisation (arthritis, for example, would not typically require hospitalisation), and a lack of outpatient data.

The follow up study results provide further support for the IOM's 2010 judgement that the weight of the scientific studies provide *"inadequate/insufficient evidence of an association"* between deployment to the Gulf War and musculoskeletal disorders.²¹

Pain

Debilitating pain in the previous six months was highly prevalent in both study groups, with approximately one in five Gulf War veterans and one in six comparison group participants reporting pain graded as high in disability and moderately or severely limiting. Approximately two in five participants reported that pain had kept them from their usual activities for one or more days in the previous six months. There were no significant differences, however, in the overall pain grade ratings. Gulf War veterans were more likely than the comparison group to report multiple body-sites of pain, and several pain-related past month symptoms were endorsed more frequently by Gulf War veterans; including headaches, pain without swelling or redness in several joints, itchy or painful eyes and

stomach cramps. The most frequently reported pain-related health symptoms in the past month, for both study groups, were general muscle aches or pains, headaches and low back pain; each reported by more than half of all participants.

A severe manifestation of chronic widespread pain is fibromyalgia, characterised by widespread muscle and skeletal pain in combination with point tenderness at numerous soft tissue sites.¹⁴⁴ Diagnosis is dependent on clinical examination and therefore fibromyalgia was not assessed in the follow up study other than by self-reported doctor-diagnosis. It was reported by only two participants in each study group.

International Gulf War veteran studies reporting pain-related outcomes have employed various methods and definitions. Stimpson *et al* (2006) reported a significant excess in chronic widespread pain in Gulf War veterans (17%) relative to era comparators (8.5%) based on self-reported data on paper pain manikins.¹⁴⁵ Forman-Hoffman *et al* (2007) found that the odds of Gulf War veterans reporting symptoms of chronic widespread pain was twice that of non-deployed comparators, based on participants reporting fibromyalgia or fibrositis, or overall body pain every day for at least three months, and body pain in the 24 hours before interview.¹⁴⁶ In general, many Gulf War veteran studies report increased pain symptoms in veterans.¹⁴⁷

Our finding of increased number of pain sites and increased pain related symptoms in Australian Gulf War veterans, but not increased pain grade, provides limited support to the IOM's 2010 judgement that the weight of the scientific studies provides *"limited but suggestive evidence of an association*" between deployment to the Gulf War and chronic widespread pain.²¹ However these follow up study findings do not assist with the parallel IOM 2010 judgement that there is *"limited but suggestive evidence of an association*" between deployment to the Gulf War and chronic widespread pain.²¹ However these follow up study findings do not assist with the parallel IOM 2010 judgement that there is *"limited but suggestive evidence of an association*"

Reproductive outcomes

It is of major concern to Gulf War veterans, that their deployment may have adversely impacted upon their reproductive and sexual functioning in the post-deployment period. Our follow up study found that Gulf War veterans were significantly more likely than the comparison group to report difficulty fathering a pregnancy since January 1992 (13% vs 8%). Of those who reported difficulty fathering a pregnancy, Gulf War veterans were significantly less likely than the comparison group to report that a cause for their infertility had been found (24% vs 41%) but equally likely to have sought or undertaken infertility treatment, and equally likely to have fathered a pregnancy.

About one half of all participants fathered a pregnancy in the period since 1992, and the average number of pregnancies per participant was about two. Approximately 80% of pregnancies were reported to have resulted in a live birth, approximately 15% resulted in a miscarriage, less than 1% resulted in a still birth and 4% were terminated. About 87% of babies were full-term and normal birth weight. There was no difference between the two groups on these reproductive health measures.

Since the baseline study a larger proportion of Gulf War veterans than comparison group participants reported doctor-diagnosed or treated impotence (8.5% vs 4.5%). Also, in the month prior to the follow up study, Gulf War veterans were more likely than the comparison group to report problems with sexual functioning (32% vs 24%) and loss of interest in sex (43% vs 32%).

In summary, Gulf War veterans were more likely than comparison group participants to report difficulty with fertility and sexual functioning, but it is encouraging to see that the two groups were equally likely to father a pregnancy which resulted in the live birth of a full-term baby with normal birth weight. This was similar to the pattern of findings observed at baseline. The baseline study also included an investigation of reported birth defects in children, however the quality of the data made it difficult to distinguish between minor and major birth defects, we were unable to control for various genetic, health and psychosocial factors in both parents which might affect reproductive outcomes, and medical verification of the birth defects could not be undertaken. For these reasons birth defects were not investigated in the follow up study.

The findings of the Australian Gulf War Veterans' Follow Up Health Study, and studies of international Gulf War veterans, are consistent with the IOM's 2010 judgement that there is *"inadequate/insufficient evidence of an association"* between deployment to the Gulf War and fertility, and pregnancy outcomes such as miscarriage, still birth, preterm birth, and low birth weight, but *"limited/suggestive evidence of an increased prevalence of self-reported sexual functioning difficulties among Gulf War veterans"*.

Sleeping pattern and daytime sleepiness

Gulf War veterans were significantly more likely, than the comparison group, to report difficulty falling asleep, staying asleep and, to some extent, staying awake. For example, 27% of Gulf War veterans versus 16% of the comparison group reported moderate to severe or very severe difficulty falling asleep; the difference for moderate to severe or very severe difficulty staying asleep was 37% vs 29% and the difference for moderate to severe or very severe difficulty waking up early was 29% vs 20%. Overall levels of daytime sleepiness

were similar between the two groups. However, twice as many Gulf War veterans as comparison group participants (5% vs 2.4%) achieved a daytime sleepiness score greater than 16, which Johns (1991)⁵⁰ observed only in patients with narcolepsy, idiopathic hypersomnia or moderately severe obstructive sleep apnoea. Approximately 10% of participants in both groups reported doctor diagnosed, or treated, sleep apnoea, and this was roughly triple the prevalence reported at baseline. Other than sleep apnoea, sleeping pattern and daytime sleepiness were not investigated at baseline and so changes in these over time could not be assessed.

There are no recent studies of the prevalence of sleep disturbance in Gulf War veterans. We identified one recent study of cholinergic autonomic deficits in symptomatic Gulf War veterans where sleep dysfunction was identified as an autonomic symptom.¹⁴⁸ Data collected by Proctor *et al* (1998) two years after the Gulf War deployment, showed 'unsatisfactory sleep' to be among the three most prevalent symptoms in Gulf War veterans from Fort Devons in the US.¹⁴⁹ Also, the odds of 'inability to fall asleep' was about 3½ times higher in Gulf War veterans (30%) relative to comparators (11%).¹⁴⁹ Approximately nine years after the Gulf War, Ismail *et al* (2002)¹⁵⁰ investigated DSM-IV sleep disorder but only in a very small sample of Gulf War veterans who had previously reported impaired physical function (n=133). DSM-IV sleep disorder was present in 18% and 14% respectively, which suggested that sleep disorder was not unique to impaired veterans of the Gulf War.

The IOM have not investigated sleep disturbance as an outcome of Gulf War deployment. Our findings support a strong association between Gulf War deployment and difficulty falling asleep, staying asleep and, to a lesser extent, staying awake. There is also an indication that Gulf War deployment is associated with severe daytime sleepiness.

Respiratory health

Respiratory symptoms in relation to wheeze, cough and sputum were all reported significantly more frequently by Gulf War veterans than the comparison group. The greatest excess was for morning cough, where risk in the Gulf War veteran group was elevated by 67%, followed by 44% for wheeze, 38% for morning sputum in winter and about 36% for day or night time cough including being woken by cough. The differences between the two groups on self-reported doctor-confirmed respiratory medical conditions were not significant, however the pattern was such that asthma, chronic bronchitis and emphysema or COPD were all reported more frequently by Gulf War veterans. The findings above are consistent with those observed at baseline, except for self-reported doctor-confirmed chronic bronchitis

which was significantly in excess at baseline. PBS and RPBS data did not show a significant difference between the two groups in regard to respiratory medication use in the 12 months prior to follow up, although it is acknowledged that many asthma medications can be bought over the counter.

The overall levels of self-reported doctor-confirmed asthma are slightly higher in the study participants (13% for Gulf War veterans and 11% for comparison group) relative to the 9% estimated for the Australian male population from 2007-2008 National Health Survey data.¹⁵¹ However this difference was not tested statistically, and may not be evident once confounders such as age, smoking and socio-economic indices are taken in to consideration.

Consistent with our findings at follow up, international Gulf War veteran studies have often shown excesses of self-reported respiratory symptoms, and self-reported diagnoses of respiratory conditions, in Gulf War veterans relative to comparators. For example, the Iowa Persian Gulf Study Group reported the prevalence rate for symptoms of both asthma and bronchitis to be 2.3% higher in Gulf War veterans relative to non-Gulf War comparators,⁷ and Unwin *et al* (1999) found the odds of self-reported diagnoses of bronchitis to be between 40-70% higher in British Gulf War veterans relative to Bosnia and era comparators.⁸ Our finding at follow up of no difference between groups for recent respiratory medication use, is also consistent with other studies which have shown no differences on objective markers of respiratory health including spirometry,^{152,153} diagnoses category upon hospitalisation¹²⁴ or respiratory disease mortality rates.¹⁵⁴

Overall, our findings are consistent with the IOM's 2010 judgement that there is *"inadequate/insufficient evidence of an association"* between deployment to the Gulf War and respiratory disease.²¹

Neuropathic symptoms

Participants in both study groups averaged only two of the 17 symptoms measured. Gulf War veterans were significantly more likely than the comparison group, however, to report at least one neuropathic symptom (60% vs 52%), or at least four neuropathic symptoms (24% vs 18%), one or more symptom of muscle weakness (44% vs 36%) and one or more symptom of sensory disturbance (45% vs 39%). Individual symptoms which were reported significantly more frequently by Gulf War veterans were 'difficulty lifting objects above the head', 'difficulty getting up from sitting in a chair', 'problems with feet tripping or feet slapping when walking', 'difficulty feeling pain cuts or injuries' and 'unusual sensitivity or tenderness of your skin when rubbed by clothes or bedclothes'.

In Gulf War veterans, increasing number of neuropathic symptoms reported at follow up was associated with lower rank category during the Gulf War, and with 10 or more self-reported vaccinations and any self-reported anti-malarial tablets.

Neurological diseases including epilepsy, multiple sclerosis and Motor Neurone Disease were each reported as doctor-diagnosed or treated since January 2001 by only four or fewer participants in total. These results were almost unchanged from the baseline results.

Relative to the baseline study, the gap between groups in the proportions of participants with neuropathic symptoms has narrowed. At baseline, Gulf War veterans were significantly more likely to report 16 of the 17 symptoms measured, whereas this difference was significant for only five of 17 symptoms at follow up.

The baseline study included a face-to-face neurological examination from which a neuropathy impairment score and other neuropathic health outcomes were derived, such as likely neuropathic disorder, myopathy or central nervous system disorder. The neurological examination was not conducted at follow up however, and so the prevalence at follow up of these neuropathic health outcomes and change over time could not be investigated.

Due to the lack of a neurological examination, our findings cannot be used to evaluate the IOM's 2010 conclusions that there is "*limited/suggestive evidence of no association between deployment to the Gulf War and peripheral neuropathy*." This study provides some limited support to the IOM finding that there is "inadequate/ insufficient *evidence to determine whether an association exists between deployment to the Gulf War and multiple sclerosis*".

Self-assessed physical health status

Given the above-listed excesses in adverse health outcomes in Australian Gulf War veterans, it is not surprising that the self-reported physical health status of the Gulf War veterans was poorer than that of the comparison group. The differences between the two groups were greatest for the participants who were oldest and lowest ranked at the time of the Gulf War. In both study groups, self-perceived physical health status declined in the ten year period from baseline to follow up. This pattern is consistent with population studies that show health status to decline with age.¹²⁷ Whilst there was no significant difference between the two groups in regard to the magnitude of the decline in self-reported physical health status over time, the gap between the two groups at follow up (SF12-PCS mean diff -1.5) was very slightly wider than that at baseline (SF12-PCS mean diff -0.7).

Posttraumatic stress disorder

Using three different measures, the risks of PTSD at follow up in Australian veterans of the Gulf War were between 1½ and three times greater than the risks in the comparison group. Approximately 8% of Gulf War veterans met criteria for PTSD relative to about 3 to 5% of the comparison group. In the decade or so since baseline the risk of PTSD has almost doubled in the Gulf War veteran group, whilst in the comparison group it has risen only slightly. Since the baseline study, PTSD in Gulf War veterans has been more persistent, less likely to remit and new cases have been more likely to occur relative to the comparison group. The gap between the two groups in PTSD-related morbidity has, therefore, widened since baseline.

Increasing number of reported Gulf War-related stressors on the MSEQ was strongly associated with increased risk of 12 month PTSD. The greatest risk was amongst those Gulf War veterans who reported 12 or more Gulf War-related stressors; they were at five times greater risk of 12 month PTSD than Gulf War veterans who reported four or fewer Gulf War-related stressors. Every increase in MSEQ score of one Gulf War-related stressor was associated with a 13% increase in 12 month PTSD. Army Gulf War veterans were also at greater risk of 12 month PTSD than Navy or Air Force Gulf War veterans, however this finding needs to be interpreted with some caution due to small numbers. Our previous assessment of MSEQ responses showed that Australian Gulf War veterans reported few direct-combat encounters such as killing someone, handling dead bodies or coming under attack, but many other stressful experiences including fear of death or entrapment and the perceived threat of nuclear, biological or chemical (NBC) agent or other military attack.¹⁵ Just as direct combat encounters have been shown to have long-term adverse effects on Gulf War veterans' mental health,¹⁵⁵ experiencing increasing numbers of other types of Gulf War-related stressors appears to be predictive of PTSD in Australian Gulf War veterans more than 20 years after deployment. Further analysis is required to explore, in more depth, whether particular groups or types of MSEQ items are driving the association between higher score and subsequent increased PTSD symptoms.

We only identified two other studies that had measured PTSD longitudinally in a representative sample of Gulf War veterans. Similar to our study, but at approximately 14 years after deployment, Kang *et al* (2009) demonstrated a three-fold excess in the risk of PCL-derived PTSD in US Gulf War veterans relative to era comparators.¹⁵⁶ Using the same dataset, Li *et al* (2011) showed that the prevalence of PTSD had increased in the Gulf War veteran group since baseline ten years earlier, but remained stable among comparators, and that PTSD had been more persistent and incident in the Gulf War veteran group.¹⁵⁷

Many older studies have consistently demonstrated increased risk of PTSD in Gulf War veterans. For example, approximately ten years after the Gulf War deployment, Fiedler *et al* (2006) reported CIDI Short Form 12 month PTSD to be evident in 3.4% of Gulf War veterans compared to 0.7% in non-deployed controls. Goss Gilroy (1998) reported the odds of PCL-derived PTSD in Canadian veterans of the Gulf War to be 2.7 times the odds in non-deployed veterans. Brailey *et al* (1998) assessed Gulf War veterans at 9 months post-deployment and again 16 months later, and showed PTSD rates to be increasing over time and correlated with war-zone stress and high-risk activities.¹⁵⁸

Based on the weight of the evidence up to the end of 2008, the IOM concluded that there was *"sufficient evidence of a causal association between traumatic war exposures experienced during deployment to the Gulf War and PTSD*". Our findings are completely in agreement. In fact, the magnitude of the excess in risk for PTSD in Australian Gulf War veterans is larger than the excess risk observed for other health outcomes included in this follow up study. In conclusion, 20 years after the Gulf War PTSD rates remain at elevated levels and the prevalence of PTSD in the Gulf War veteran group appears to be increasing, rather than decreasing.

Alcohol disorder

The percentage of participants estimated to have alcohol disorder at follow up was highly variable across the three measures used. Six percent of Gulf War veterans met CIDI criteria for 12 month alcohol disorder, 29% met AUDIT criteria for alcohol disorder in the past 12 months, but only 3% reported doctor-diagnosed alcohol disorder treated in the previous 12 months. The risk of alcohol disorder at follow up was estimated to be 1¼ to two times higher in the Gulf War veteran group relative to the comparison group, and this was significant for the CIDI and AUDIT results, but not for self-reported doctor diagnosis and treatment. Very few participants met criteria for 12 month substance disorders other than alcohol, and therefore no conclusions about other substance disorders could be made.

The AUDIT is a self-report screening instrument for harmful or hazardous levels of drinking or drinking-related behaviour, rather than an actual diagnosis, and so prevalence might be expected to be higher for this measure rather than for the more comprehensive CIDI DSM-IV diagnosis of alcohol disorders. The very low prevalence of doctor diagnosed and treated alcohol disorder suggests the possibilities that participants are under-reporting diagnoses of alcohol disorder, or not reporting alcohol symptoms to medical doctors in the first place, or that medical doctors are not identifying alcohol disorder as the condition underlying the reported symptoms.

Based on the CIDI data, risk of 12 month alcohol disorder in Gulf War veterans had approximately doubled in the ten year interim since baseline, and this was a statistically significant increase. The risk of alcohol disorder in the comparison group had also increased but not significantly so. Whilst, proportionately, 12 month alcohol disorder in Gulf War veterans has been slightly more persistent, slightly less likely to remit and new cases have been slightly more likely to occur relative to the comparison group, these differences were also not statistically significant. Nonetheless, the gap between the two groups in alcoholrelated morbidity is gradually widening over time.

At 14 years post-deployment, Kang *et al* (2009) demonstrated a 24% excess in the risk of probable 6 month alcohol abuse (based on the PHQ alcohol module)¹⁵⁹ in US Gulf War veterans relative to era comparators.¹⁵⁶ At ten years post-deployment, Fiedler et al (2006) reported CIDI Short Form 12 month alcohol dependence to be evident in about 5% of Gulf War veterans compared to 3.3% in non-deployed controls, but this difference was not significant.

This Australian follow up health study and other studies provide further support for the US Institute of Medicine's 2010 judgement that the weight of the scientific studies provide "sufficient evidence of an association between deployment to the Gulf War and substance abuse particularly alcohol abuse... [and] these disorders persist for at least 10 years after deployment".²¹ In our results, it is of concern that the prevalence of alcohol-related morbidity is increasing in both study groups, and the gap between the Gulf War veterans and comparison group is gradually widening. On a more positive note, our study did not provide evidence of high levels of substance abuse other than alcohol in the two study groups.

Major depression

More than 20 years after the Gulf War, the rate of CIDI-defined 12 month major depression was similar in the two study groups, observed in almost 10% of Australian Gulf War veterans and almost 8% of the comparison group. Importantly, this indicated that the vast majority of study participants did not have major depression. At the time of the baseline study, the Gulf War veterans were found to be significantly more likely than the comparison group to have CIDI-defined 12 month major depression (adj OR 1.7, 95%CI 1.2-2.3)¹⁶ however at follow up the prevalence gap between the two groups was no longer statistically significant.

There were, however, other indicators of increased depressive morbidity amongst Gulf War veterans relative to the comparison group. Gulf War veterans were more likely than the comparison group to have been dispensed an anti-depressive medication under the PBS or RPBS in the 12 months prior to the follow up study. Gulf War veterans were also more likely

than the comparison group to report depression symptoms at follow up which were mild or moderate in severity, and less likely to report symptoms of minimal severity.

Longitudinally, there was a pattern of major depression being slightly more persistent, slightly less likely to remit and slightly more incident in Gulf War veterans relative to comparison group participants, however these differences were not statistically significant. The proportion of remitted cases of depression between baseline and follow up (66% in the Gulf War veteran group and 75% in the comparison group) is worthy of note. This may, in part, be a function of the cyclical nature of recurrent depression, although the 12-month assessment timeframe suggests that this remission was relatively stable. There were not sufficient numbers to analyse predictors of remission. Future research with larger numbers, achievable perhaps by pooling datasets internationally, may shed light on predictors of remitted and persistent depression, as well as risk factors for new onset depression.

In a similar pattern to that which we observed 10 years ago,¹⁶⁰ the prevalence of 12 month major depression in Gulf War veterans at follow up was associated with higher numbers of Gulf War-related psychological stressors. As per the discussion above of the similar pattern of association found between MSEQ scores and PTSD, further analysis could reveal whether particular groups or types of MSEQ items are driving the association between higher score and subsequent increased depressive morbidity.

In an, as yet, unpublished systematic review and meta-analysis of 1990-2012 studies of depression in Gulf War veterans, we found that Gulf War veterans had over twice the odds of experiencing depression compared to non-deployed military personnel (OR 2.3, 95%CI 1.9-2.8). Our Australian Gulf War Veterans' Follow Up Health Study findings at 20 years post-Gulf War, however, indicate that the prevalence gap in major depression between Australian Gulf War veterans and the comparison group appears to be closing, although depressive symptoms may still be more severe in Gulf War veterans. Our findings provide some further support for the IOM's 2010 conclusion that there is "*sufficient evidence of an association*" between Gulf War deployment and depressive disorder *per se*.

Other psychological health indicators

Australian Gulf War veterans reported significantly poorer mental health status on the SF12 at follow up, and they were at 19% greater risk of general psychological distress (as measured by the GHQ-12) relative to the comparison group. This outcome was weakly associated with younger age at deployment, but strongly associated with increasing number of self-reported Gulf War-related stressors; the latter finding independent of age. Gulf War veterans also had higher levels of demoralisation, and this was demonstrated across a

number of dimensions representing feelings of loss of meaning, dysphoria and disenheartenment. Further, risk of feeling that life was not worth living was elevated by 40% and risk of making a suicide plan was elevated by 144% in Gulf War veterans. While these findings are disturbing, they are also not particularly surprising considering the association between demoralisation and mental health problems, particularly depression,⁶¹ and between suicidality and demoralisation, ¹⁶¹mental health problems, particularly PTSD,¹⁶² trauma exposure¹⁶³ and also military service in general.¹⁶⁴ However, actual suicide rates among Gulf War veterans were not elevated.

There were some more positive findings in relation to Gulf War veteran psychological health at follow up. CIDI-defined 12 month disorders other than PTSD, alcohol and major depression (all discussed above), were infrequent in both study groups and there was no evidence of any excess risk in Gulf War veterans. The most prevalent of these other CIDIdefined 12 month disorders at follow up was specific phobia (5% of all participants), followed by social phobia (3.6%), bipolar disorder (3.3%) and obsessive compulsive disorder (3%). However, Gulf War veterans were significantly more likely than the comparison group to have at least one CIDI-defined 12 month disorder (25% vs 17%) when all CIDI-defined 12 month disorders were included, including PTSD, alcohol and major depression. There was also no excess risk in the Gulf War veteran group of meeting screening criteria for full administration of any of the Psychosis, Intermittent Explosive Disorder or Eating Disorders modules of the CIDI. Gulf War veteran and comparison group participants were also similar in regard to their likelihood of being average-, above average- or severe risk takers. Relative to the comparison group, Gulf War veterans scored slightly lower on risk-taking propensity factors labelled self-control and self-confidence, and slightly higher on the factor labelled invincibility. The latter difference might, to a small extent, explain the small excess observed in Gulf War veterans in relation to falls leading to injury and injuries possibly involving concussion.

Importantly, although perhaps surprisingly, the two study groups were equally resilient. This is a positive finding for the Gulf War veterans, being a measure of their ability to thrive despite adversity.

Injuries

A little more than one third of participants, in both study groups, reported at least one injury in the past 12 months which was bad enough to interfere with their daily activities. The most prevalent event type leading to injury was falls of less than a metre (22% Gulf War veterans and 15% comparison group). The two study groups did not differ in regard to the activity types to which their injuries were attributed. 'Sports' was the activity-type most frequently reported, with one third of recent injuries attributed to this. 'Leisure', 'working for an income outside of the ADF' and 'other work' were also frequently reported with more than 20% of injuries attributed to these.

Injury resulting in attendance at hospital as an inpatient, which could possibly be an indicator for the most severe injuries, was reported by slightly more Gulf War veterans (14%) than comparison group participants (9%), however this difference did not meet statistical significance (p=0.187). The two groups were equally likely to attend other types of health services, or to have required time off from work/study, as a result of their injury. Injuries in the previous 12 months which were sustained when respondents were under the influence of alcohol or other substances, were very infrequently reported.

Respondents were asked to report whether any injuries received in the past three years involved being dazed, confused or seeing stars; not remembering the injury; or losing consciousness (knocked out), as possible indicators of concussion. The Gulf War veterans were slightly, but statistically significantly, more likely than the comparison group to report at least one of the three concussion-related consequences of injury (11% vs. 7%; p=0.013).

O'Donnell et al (2009) showed that prior trauma or prior psychiatric illness may represent risk pathways to injury. The findings in this follow up study, of increased psychological morbidity in Gulf War veterans in combination with the Gulf War veterans scoring slightly higher on the risk-taking factor labelled *invincibility*, may explain the slight excesses in recent fall-related injuries, injuries requiring hospitalisation and injuries possibly involving concussion in the Gulf War veteran group.

Life events

Questions about traumatic life events, financial strain, homelessness and convictions or incarcerations were included in this follow up study because these outcomes could be associated with chronic health problems, social dysfunction or maladaptive behaviours related to war deployment. In combination with the spectrum of physical and psychological outcomes measured in this follow up study, the above measures facilitate a more comprehensive investigation of the full impact of Gulf War deployment on the lives of Gulf War veterans.

More than half of the participants in both study groups had experienced at least one potentially traumatic event. The pattern of exposure to potentially traumatic events was similar for the two groups, and so life experiences of this nature do not appear to be an explanation for the excess of PTSD, alcohol disorder or other adverse psychological health

indicators in the Australian Gulf War veterans. Conversely, the excess of psychological morbidity in Gulf War veterans does not appear to be resulting in increased exposure to traumatic events.

Similarly, Gulf War veterans were not more likely than the comparison group to have experienced financial difficulty which had led to events such as the inability to pay utilities, car registration or insurance on time, or the need to seek financial assistance from friends or family or welfare organisations. Events such as these were, however, reported by 17% of all participants. Very small numbers of participants reported homelessness or incarcerations and there was no difference between the study groups on these measures. Gulf War veterans were very slightly more likely than the comparison group to have received a criminal conviction in the period since August 1990. This finding could be an early sign of severe social dysfunction or maladaptive behaviours related to Gulf War deployment and possibly connected to chronic morbidity. It is known, for example, that anxiety disorders, affective disorders and alcohol disorders, all observed to be in excess in Gulf War veterans at follow up, are associated with increased risk of incarceration in the Australian population⁹¹. This alone is sufficient reason to assertively target mental health prevention, intervention and treatment programs to minimise these types of adverse social outcomes.

Life satisfaction and quality of life

There were no statistically significant differences between the Gulf War veterans and comparison groups at follow up on measures of Life Satisfaction, Overall Quality of Life and Health Satisfaction. However there was a consistent pattern of Gulf War veterans tending to rate themselves a little lower on these measures. For example, when asked about how they felt about their life as a whole including what they expected to happen in future, Gulf War veterans were a little less likely than the comparison group to report that they felt delighted or pleased, and a little more likely to report feeling unhappy, mostly dissatisfied, mixed or mostly satisfied. Gulf War veterans were also a little less likely than the comparison group to rate their Quality of Life as very good and more likely to rate their quality of life as very poor, poor, neither poor nor good or good. Further, Gulf War veterans were a little less likely than the comparison group to report being satisfied or very satisfied with their health and more likely to report being dissatisfied or neither dissatisfied nor satisfied. Some of these differences met statistical significance before, but not after, adjustment for age, service and rank, indicating that it might be those factors underlying these differences between the two study groups and not Gulf War deployment. Considering that life satisfaction, health satisfaction and overall quality of life are undoubtedly associated with physical and psychological health⁹³ the fact that Gulf War veterans are similar to the comparison group on

these measures is an indication of their positive outlook on life despite adversity, consistent with the findings in relation to their resilience.

Other measures of quality of life, however, were significantly poorer in the Gulf War veteran group, and these are no doubt reflective of the adverse health outcomes which are in excess. Gulf War veterans reported significantly poorer quality of life on the Physical Health domain of the WHOQOL-Bref which comprised items such as ability to perform activities of daily living and mobility. Gulf War veterans also reported significantly poorer quality of life on the Psychological domain comprising items such as self-esteem, concentration, negative mood and body image, and significantly poorer quality of life on the Social Relationships domain comprising items such as personal relationships and social support. Gulf War veterans did not, however, report poorer quality of life on the Environment domain. This latter domain, comprising items such as financial resources, transport, safety and access to information, would seem less likely to be influenced by the adverse health outcomes which are in excess in the Gulf War veteran group, than the other domains.

Life satisfaction and quality of life were not measured at baseline and so change over time in these outcomes could not be investigated.

Social health

Social health has been described as the dimension of a person's wellbeing in regard to how that person gets along with other people, how other people react to him/her and how that person interacts with social institutions and societal codes or mores.¹⁶⁵ Social health is of relevance to this Gulf War Veterans' Follow Up Health Study for a number of reasons; i. people who are well integrated in to their communities tend to live longer, achieve greater personal growth, and have greater capacity to recover from disease and stressful events; ii. people with disease or disability need social support to remain in the community and live productive lives in society; and iii. disease or disability may also precipitate fractures in social health through the limitations imposed on usual role functioning, occupation and community participation.

Social support is an aspect of social health, generally defined in terms of the availability of people whom the individual trusts, or whom he can rely on, and who makes him feel cared for and valued.¹⁶⁶ Although the Australian Gulf War veterans reported poorer quality of life in regard to Social Relationships at follow up (as described above), they did not differ from the comparison group in regard to a number of aspects of functional social support (e.g. perception of being supported) and structural social support (e.g. size of social network). In regard to functional support, the Gulf War veterans were similar to the comparison group on

each of the scales of the MOS Social Support Survey including overall support, Tangible support (e.g. having someone to assist you when needed), Affectionate support (e.g. having someone who loves you or shows affection), Positive Social Interaction (e.g. having someone to do enjoyable things with) and Emotional/Informational support (e.g. having someone to confide on, or count on, who understands you). Functional social support, more so than structural support, is considered a protective factor against stress and the development of psychological health problems.

The Gulf War veterans were also very similar to the comparison group on measures of structural social support. Gulf War veterans reported very slightly fewer close friends and relatives who they could comfortably talk to, by an average of only one, but the same level of membership (35-38% of participants) and activity in voluntary groups or organisations such as parent groups, clubs or lodges and church groups.

The two study groups were also fairly equally likely to be involved in ex-service groups and to commemorate significant military occasions like ANZAC day. A slight increase observed in Gulf War veterans' involvement in ex-service groups is likely to be too small to be a meaningful difference. Less than a third of all participants reported being involved in ex-service groups, even though more than 80% of participants are now ex-servicemen, having been discharged.

On the whole, the social health of Gulf War veterans at follow up is similar to that in the comparison group, based on our measures of functional and structural social support, community participation and involvement in military related organisations and commemorations. Considering the excess of physical and psychological morbidities in Gulf War veterans observed in this follow up study, it is a positive finding that they are functioning as well socially as their comparators. Ongoing chronicity of these adverse health outcomes however, is likely to lead to a gradual decline in the social health of Gulf War veterans over time.

Health services utilisation and DVA healthcare support

Information about participants' health service utilisation, including consultations with health professionals, hospitalisations and pharmaceutical use, was sourced from a combination of self-reported data and recorded data available in the DVA-held health datasets and Medicare Australia Medical Benefits Schedule (MBS) and Pharmaceutical Benefits Schedule (PBS) databases. DVA disability claims and DVA Treatment Entitlements Card data was obtained from DVA-held data only. It was not intended that these data sources be compared,
rather, used in combination to provide a more complete description of health service and pharmaceutical use than that which would be achievable with any one data source alone.

It was mostly in the area of DVA provided healthcare support that statistically significant differences between the Gulf War veterans and the comparison group were observed. Gulf War veterans lodged two thirds of all disability claims observed in the period 1 January 2001 to 15 August 2012. The proportion of total claims accepted, however, was not higher for the Gulf War veteran group, with approximately two thirds of all claims accepted in both groups. Gulf War veterans were 24% more likely than the comparison group, however, to have made at least one disability claim which was accepted. About one half of the claims submitted by the Gulf War veterans were for illness or disabilities attributed to Gulf War service, whereas almost 85% of comparison group claims were attributed to peacetime service. Gulf War veterans were 43% more likely than the comparison group to have made at least one accepted claim under VEA legislation, and 76% more likely to have had a non-servicerelated claim accepted. DVA-funded hospitalisation was 71% more likely in the Gulf War group relative to the comparison group for the period January 2007 to August 2012. DVAhospitalised Gulf War veterans were about 1/3rd as likely as hospitalised comparison group participants to have a principal diagnosis of 'neoplasms'. Further, Gulf War veterans (11%) were more than twice as likely as the comparison group (5%) to have been issued a Gold Card. Based on PBS and RPBS data, the average number of scripts dispensed to Gulf War veterans, in the 12 months before follow up, was 63% higher than that in the comparison group.

Some other indications of differences in the pattern of health service utilisation in Gulf War veterans relative to the comparison group, did not reach statistical significance. Generally, DVA hospitalised Gulf War veterans were more likely than hospitalised comparison group participants to have 'mental and behavioural disorders' or 'injury' as the principal diagnosis, and less likely to have 'circulatory disease' as the principal diagnosis. Self-report- and DVA-hospitalisation results indicate that Gulf War veterans were likely to be hospitalised for a little longer than comparison group participants.

Combined DVA- and Medicare-MBS data showed that consultations with neurologists, gastroenterologists, psychiatrists, respiratory physicians and dermatologists were similar between the two study groups and very uncommon in the previous ten years; recorded for 4% or less of all participants. These results indicate that some of the excesses in adverse health outcomes observed in the Gulf War veterans at follow up, such as increased neurological symptoms, increased risk of irritable bowel syndrome, PTSD and alcohol disorder, increased symptoms of sputum, wheeze and cough, and increased self-reported

doctor-diagnosed dermatitis and eczema, have not resulted in increased consultation with medical specialists for these health outcomes, which could be considered an indicator of severity.

The two study groups also did not differ on their likelihood of consulting GPs, dentists and a variety of allied health professionals including physiotherapists or hydrotherapists, psychologists or accredited counsellors or social workers, chiropractors or osteopaths, audiologists or audiometrists, naturopaths, dieticians or nutritionists, alcohol workers or diabetes educators.

The data does show, however, that the two groups were highly likely to have accessed health services in the year prior to follow up. Between 64% and 85% of all participants had consulted with a GP, for example, in the previous year. In fact, the self-reported rates of consultation in the previous 12 months with a variety of health professions were markedly higher amongst the study participants at follow up than the rates reported in population data for Australian men. For example, consultation with a dentist or dental professional in the previous 12 months was reported by 68% of participants, a rate which is higher than the 62% estimated for Australian adults each year.¹²⁷ Compared with the 2007-8 National Health Survey data for Australian men,¹⁶⁷ follow up study participants were noticeably more likely to report having consulted with a physiotherapist or hydrotherapist (22% vs 9%), chiropractor (14% vs 8%), dietician or nutritionist (7% vs 4%) or accredited counsellor (11% vs 2%). The fact that approximately 40% of all participants had been issued either a DVA Gold Card, a White Card, or both may be a factor in the participants' increased access to health services relative to their Australian peers. The follow up study participants' use of pharmaceuticals, however, seems relatively low, with only one third of participants having filled a script in the previous 12 months.

There are some limited indicators in the data that shed light on the types of medical conditions for which the combined study participants are seeking health services. For example, the most frequent primary diagnosis for DVA hospitalisations was 'musculoskeletal system and connective tissue', recorded for 44% of all hospitalisations, and more than half of the disability claims accepted under VEA or MRCA legislation were under the 'Musculoskeletal system and connective tissue system' SOP. These findings, in combination with the observation made above that participants were more likely than the Australian population to consult with physiotherapists, hydrotherapists or chiropractors, indicate that musculoskeletal disorders are responsible for a substantial proportion of health service use. The second most frequent primary diagnosis for DVA hospitalisation was 'digestive system' and the third was 'mental and behavioural disorder'. Other SOPs most

frequently cited for claims accepted under VEA or MRCA legislation were the 'Nervous system, Sense organs', 'skin and subcutaneous tissue', 'injury', 'mental disorders' and 'neoplasms' SOPs respectively. The main limitation of these findings however, is that they may not necessarily reflect the health outcomes which are most prevalent in the study participants, but rather they may reflect those health outcomes for which there is easier process, acceptance and treatment in the DVA health system.

Health risk factors

In Australia, almost one third of ill health, disability and premature deaths can be attributed to health risk factors.¹²⁷ The health risk factors that we investigated in the study included health behaviours such as smoking, physical activity and dietary behaviour, and biomedical factors including body weight, body mass index and waist circumference. Socioeconomic indices which might influence health, such as income, education, service branch and rank, were also assessed, as were life events that might influence health such as trauma exposure and combat exposure.

On the whole, the two study groups were similar in regard to the health behaviours and biomedical factors investigated, suggesting that these determinants of health are not driving the excess morbidity observed in Gulf War veterans. However, the findings highlighted a few areas where some targeted intervention could improve the overall health of both study groups. Only five percent of all participants ate the minimum recommended serves of vegetables per day,⁸⁴ and 55% of participants ate the minimum recommend serves of fruit.⁸⁴ Four out of five participants in both study groups were overweight or obese, and all measured indicators of body fat had increased significantly in the ten years since baseline. Finally, approximately 60% of participants reported exercise levels that were rated as low or sedentary. It would be safe to say that interventions which increase physical activity and improve dietary habits will decrease body fat and, combined, these changes in health risk factors will improve overall health in the two study groups.

A very positive finding in this follow up study was the large reduction in the tobacco smoking rate which had occurred in both study groups in the ten year period since baseline. In both study groups, one half of those who reported being smokers at baseline, were no longer smokers at follow up. This trend is greater than that observed in the Australian population. The ABS reported a halving of the Australian population smoking rate in the 25 years from 1985-2010 but the decline was primarily amongst those aged mid-20s to mid-40s; the rate in those aged 45 or over (which would represent the majority of our participants) remained stable or increased. At follow up, about 10% of all study participants were current smokers,

and this rate is noticeably lower than the 19% reported by the ABS for Australians aged 45-54 in 2010.¹²⁷

The two study groups were also similar in regard to socioeconomic factors, such as income, education and employment, which can be important determinants of health. Service branch and rank could be considered, to some extent, to be proxies for socioeconomic status, and on these factors the two groups did differ. Throughout the analyses, however, statistical adjustment has been included for service branch and rank. Therefore, the differences in health outcomes observed between the two study groups cannot be explained by these possible determinants of health.

Differences between the two groups in regard to military service activities since the Gulf War, such as other deployments and combat exposure, and exposure to trauma (military or civilian) may also be determinants of health in these study groups. However, it was observed that the two groups were equally likely to have been actively deployed, to have deployed in a combat role, and to have experienced a traumatic life event since the baseline study.

To summarise, behavioural and biomedical health risk factors including physical activity, dietary behaviour, body fat and tobacco smoking, socioeconomic determinants of health including education, income, service branch and rank, and deployment (other than the Gulf War) and traumatic event exposure, do not explain the excess in morbidity observed in the Gulf War veterans at follow up.

Health status and health service utilisation at follow up for participants with disorders at baseline

Multisymptom illness, chronic fatigue, and 12-month major depression, PTSD and alcohol use disorder were outcomes found to be in excess in the Gulf War veteran group at baseline. In the follow up study. approximately ten years later, we found that the presence of one or more of these disorders at baseline has led to substantially poorer health and well-being and greater health service utilisation at follow up in both study groups, and increased DVA disability claims in the Gulf War veteran group.

The deficit observed in physical and psychological health status, also social support, quality of life and health satisfaction at follow up, and excess in demoralisation, days out of role due to illness, hospitalisations, GP visits and scripts dispensed, are all likely indicative of the chronicity and poor prognosis associated with these five baseline disorders.

The excess of these disorders at baseline in Gulf War veterans, has also resulted in greater use of DVA health support services such as disability claims, particularly for claims attributed to Gulf War service. Gulf War veterans with baseline disorders were significantly more likely than Gulf War veterans without baseline disorders to have an accepted claim attributed to the SOPs for 'musculoskeletal system/connective tissue', 'nervous system/sense organs', 'skin and subcutaneous tissue' or 'mental disorders'. It is unclear as to the extent to which these SOPs might reflect the signs or symptoms of the baseline disorders investigated in these analyses. As discussed earlier, however, the more commonly accepted SOPs may not necessarily reflect the health outcomes of most importance to Gulf War veterans, but rather those health outcomes for which the process through DVA is most streamlined.

These findings highlight the importance of improved detection and intervention strategies to reduce the excess morbidity observed in the Gulf War veteran population. Failure to achieve this will no doubt result in their continued long-term decline in health and well-being, and continued incline in health service utilisation including DVA healthcare services.

Mortality and cancer incidence study findings

The cohort included in the mortality and cancer incidence study totalled 4,793 members, comprising the entire deployed group of 1,871 Gulf War veterans and 2,922 comparison group members. Linkage of the cohort to the National Death Index and the Australian Cancer Database was conducted in July 2011. Data was obtained for the period 1st January 1991 to 30th of November 2010 for mortality and to 31st of December 2008 for cancer incidence.

In the 20 year period following the Gulf War, there has been a total of 108 deaths, comprising just 2% of the male cohort. Proportionately there have been slightly fewer deaths in total in the Gulf War veteran group compared to the same aged Australian male population and slightly more deaths in the Gulf War veterans relative to the comparison group. Compared to the Australian population, Gulf War veterans have been at slightly lower risk of 'all-cause' mortality and mortality from cardiovascular diseases and intentional self-harm, but slightly higher risk of mortality among Gulf War veterans has been greatest for cancer-related mortality and 'all-cause' mortality. None of these differences in mortality rates between the Gulf War veterans and Australian population, and the Gulf War veterans and comparison group, achieved statistical significance and therefore the possibility of these findings being observed by chance cannot be excluded. However, statistical power was very

limited due to small numbers. In the same time period, all-cause mortality rates, and mortality from all-external causes, has been statistically significantly lower in the male comparison group than in the same aged Australian male population.

The pattern of findings in relation to all-cause mortality for both study groups and the Australian population is very similar to that observed in the baseline study. Lower SMRs for 'all cause' mortality in the two study groups are consistent with a 'healthy worker effect' whereby workers are, on average, healthier than the general population. Armed forces are generally even healthier than the general population¹⁶⁸ as a result of self selection, medical screening upon recruitment for suitability for military service, ongoing medical screening and maintenance of fitness while serving, access to medical services while serving, and early discharge from the services of the medically unfit. This difference between armed forces personnel and the general population has been termed the 'healthy soldier effect'. It is encouraging to observe that the 'healthy soldier effect' continues to be present in both study groups, with overall death rates lower than expected. However, the effect size is weaker in the Gulf War veteran group, and this may reflect adverse health outcomes consequent to the Gulf War deployment. The increased SMR for cancer-related mortality observed in the Gulf War veteran group, whilst not statistically significant, is of concern. Some studies have shown that the healthy worker effect is weaker for cancers,¹⁶⁹ which might explain the lack of this effect on cancer-related mortality in Gulf War veterans.

Further information about the incidence of cancer in the two study groups is available from the linkage with the Australian Cancer Database. In the 18 year period following the Gulf War, there have been 115 cancers detected; affecting 21/2% of the male cohort. When all cancer types were combined, there was almost exactly the same number of cancers observed in the Gulf War veteran group as was expected in the Australian male population (SIR 99). There were slightly fewer cancers observed in the comparison group than expected (SIR 83). The risk of cancer in the Gulf War veterans was very slightly higher than in the comparison group (HR 120). The numbers of cancers were very small when subgrouped by cancer-type, making further interpretation of the results limited. The most frequently detected cancer-type was melanoma in both study groups. Thyroid cancer was statistically significantly in excess in the comparison group relative to the Australian population, however this finding was based on only five cases and should be interpreted with some caution. There were no other statistically significant differences in cancer incidence of any type between the Gulf War veterans or the comparison group and the Australian population, or between the Gulf War veterans and the comparison group. A five-fold increase in brain cancer observed in Gulf War veterans relative to the comparison group was not statistically significant and was based on less than five cases, but warrants further monitoring.

The conclusions to be drawn from the combined mortality and cancer incidence study results are not particularly clear, mainly due to the small numbers of deaths and cases of cancer at this stage. Overall, the mortality rates and cancer incidence rates in both study groups are lesser or comparable to those observed in the Australian community. This is a positive, but not surprising, result considering that the cohort is still relatively young and had above average fitness upon enlistment with the ADF. Of some concern, however, is the very slight elevation in cancer-related deaths amongst the Gulf War veterans, relative to both the Australian population and the comparison group, paired with the very slight elevation in overall cancer incidence in Gulf War veterans relative to the comparison group, which will need careful monitoring into the future.

The current mortality findings do not support the US Institute of Medicine's 2010 judgement that the weight of the scientific studies have provided "*limited/suggestive evidence of an association*" between deployment to the Gulf War and mortality from external causes, primarily motor-vehicle accidents, and the current cancer incidence findings are largely consistent with the determination that there is, as yet, "*inadequate/insufficient evidence to determine whether an association exists*" between deployment to the Gulf War and any cancer.[11]

New information derived from the extended exposure assessment

In the baseline study, Gulf War exposure assessment was based largely on participant's self-reported experience of a number of possibly health-related exposures such as dust storms, SMOIL, pesticides, biological or chemical weapons, and vaccinations and prophylactic medications such as PB. Where available, some additional sources of information were used to supplement the self-reported exposure data, such as vaccination data recorded in participant's International Certificates of Vaccination, ADF-held information about locations and dates of deployment and other information known about significant events during the Gulf War.

For the purpose of the follow up study, and to augment the exposure data which had already been collected by self-report methods at baseline, a number of additional sources of information relevant to Gulf War exposures were reviewed. These include the Reports of Proceedings, Ships Logs and Ships Medical Journals for the Ships which were deployed as part of the Gulf War, and other reports. An additional strategy used at follow up, to supplement the self-reported exposure information collected at baseline, was to document the pattern of exposures reported across different Ships' complements and other groups deployed to the Gulf War. The purpose of this was to determine whether the personnel on any Ships or other deployed groups could be collectively categorised as belonging to a particular stratum of exposure. The association between strata of exposure based on Ship or deployment, and health outcomes in Gulf War veterans at follow up, were then assessed to see if this method of exposure assessment provided information additional to that achieved when the exposure assessment was based primarily on self-reported data.

The documents reviewed provided some limited support to the robustness of the selfreported levels of exposures. For example, the Ships' Logs and Reports of Proceedings included reports of dust storms in the vicinity of *Brisbane, Sydney* and *Westralia*, and these Ships' companies were amongst those most likely to self-report exposure to dust storms. Malaria prophylaxis was recorded in the Ships Logs for *Darwin* I and II, *Adelaide* and *Success*, those being four of the deployments most likely to self-report taking anti-malarials. A Defence Parliamentary brief on PB use, confirmed that personnel on *Brisbane, Sydney, Westralia* and *Success* were likely to have taken PB, and these companies were also highly likely to self-report PB use relative to other deployments.

One exposure-type of particular concern to Gulf War veterans was the possible exposure to nuclear, biological or chemical warfare agents during their deployment. In the baseline study, about 11% of Gulf War veterans reported that they had been in an area where chemical warfare agents had been used, and 9% reported being exposed to nuclear, biological or chemical warfare. We reviewed the Reports of Proceedings, Ships Logs and Ships Medical Journals for any supporting documentation. There were very large numbers of NBC exercises recorded in the SoPs. Most chemical alarms in the Logs corresponded with an exercise. A very small number of alarms, five on Sydney, four on Darwin II and one on each of Success and Brisbane did not correspond with an exercise noted in either the Logs or RoPs. A possible source of exposure to nuclear, biological or chemical warfare agents was vapour from the demolition of the Khamisiyah weapons storage complex in early March 1991. However, our review of the Reports of Proceedings and Ships Logs revealed no unexplained chemical alarms during the first two weeks of March 1991, when it might be expected that exposure levels were highest. In summary, these documents do not support the likelihood of nuclear, biological or chemical warfare agent exposure amongst Ship-based Gulf War veterans. A Post-Operation Report for Operation Habitat also did not provide useful information about the likelihood of chemical warfare agent exposure in this land-based group. Exposure to gastroenteritis outbreaks was not measured by self-report at baseline, however it has since been speculated that gastroenteritis may be associated with postinfectious irritable bowel syndrome in Gulf War veterans.²¹ The Ships Medical Journals and RoPs did provide some limited information about possible exposure to gastroenteritis outbreaks, as did the Post-operation Report for Operation Habitat. Based on these, a deployment-based metric for possible exposure to gastroenteritis outbreaks was created; however it should be noted that any individuals' actual exposure to gastroenteritis could not be deduced from the documents reviewed.

The primary limitations of the documents reviewed were the lack of direct exposure measurements and the fact that the absence of a record does not necessarily equate to the absence of an exposure. For example, records pertaining to oil slicks on water do not equate to a record or measurement of any individual being exposed to that oil by drinking it, showering it or other avenue. Similarly, the absence of records pertaining to water purification does not mean that water purification was not conducted, nor does the absence of records pertaining to dust storms, or PB use, mean that a particular deployment did not experience these exposures.

Strengths and limitations of the follow up study

Combined, the Australian Gulf War veterans' mortality and cancer incidence study, and the follow up health study, have a number of strengths which give confidence to the observed findings, but also some limitations which affect interpretation.

A major strength of the combined studies was the inclusion of a large military comparison group, randomised and frequency matched to the Australian Gulf War veterans. The comparison group, who were in operational units at the time of the Gulf War and, therefore, considered equally fit to deploy, provide an excellent benchmark against which the health of the Gulf War veterans can be compared with minimal risk of a healthy worker/warrior effect. It is unlikely, for example, that the pre-Gulf War health status of the two groups differed substantially such that it could explain the differences observed in post-Gulf War health. The matching of the two groups on age-category, rank category and service branch, and additional statistical adjustment for these possible health confounders throughout the analyses, renders it also unlikely that differences. While there were differential participation rates in these groups in the baseline study, which could have introduced a degree of bias, follow up rates were more comparable in the follow up study.

The mortality and cancer incidence study included the entire cohort of ADF personnel who deployed to the Gulf War and the entire comparison group, other than two who opted out, and therefore participation bias would not affect the results. Additional strengths, of the mortality and cancer incidence study findings, relate to the relative completeness of the National Death Index and Australian Cancer Registry datasets upon which the study results are based. The National Death Index contains records of all deaths that occurred in Australia since 1980. Whilst the National Death Index registration data is assumed to be as correct as possible, it is expected that some errors exist which may contribute to some misclassification; i.e. some real deaths not detected, or some false death matches made. However such misclassification is considered rare in the National Death Index, unlikely to vary between the Gulf War veterans and comparison groups and, therefore, unlikely to explain differences observed in the mortality outcomes for the two groups. Similarly, the Australian Cancer Registry is considered to have very complete national ascertainment of cancer cases, with minimal misclassification likely.

Whilst mortality rates were able to be tracked for approximately 20 years post deployment, and cancer incidence for approximately 18 years post deployment, the power of the study to detect excess mortality and cancer continues to be limited. The cohort was still quite young at 30 November 2010 (the date to which NDI data was available), with approximately 40% aged between 35-44 years, and the period of follow up was still relatively short for the purpose of detecting disease-related deaths or cancers of long-latency.

The follow up health study achieved a lower participation rate (54% in the Gulf War veteran group and 47% in the comparison group) than that achieved at baseline, with a consequent reduction in statistical power. Smaller number of cases with the health outcomes of interest, than that which might have been achieved with a higher participation rate, limited the study's ability to draw meaningful conclusions about health outcomes with low prevalence; e.g. some cancers, and to address research questions in relation to the factors predicting persistence or recovery from some disorders. However, the participation rate was comparable or better than other recent Gulf War veteran studies. The lower participation rate can render the study vulnerable to participation bias. Participation bias can occur if participants differ from non-participants on characteristics which are associated with the study dependent measures, such as health status. A complete examination of participation bias would require the collection of comprehensive health, demographics and deployment information for all non-participants, which was not available. We were, however, able to compare participants and non-participants using data collected at the time of the baseline study, to assess the extent to which participants were representative of the study groups from which they were drawn. Participants in both groups were older and more likely to have

been Officers in 1991, compared with non-participants. Because this same pattern occurred in both study groups, it is unlikely that those two factors have notably affected the magnitude or direction of differences in health observed between the Gulf War veteran and comparison groups. Nonetheless, statistical adjustment for age and rank in 1991, throughout the analyses, has been a strategy to minimise this possible source of bias. Participating Gulf War veterans had a slightly poorer median SF-12 mental health score than non-participating Gulf War veterans, however the difference was so small that it was also unlikely to have had an impact on the differences in health observed between the participating groups. Finally, participating comparison group members were more likely to have been in the Air Force relative to comparison group non-participants. This difference may contribute to the study slightly overestimating the true health of the comparison group; and supports the statistical adjustment for service type included throughout the analyses. Overall, we believe that participation bias is unlikely to explain the post-Gulf War health differences between groups.

To maximise the robustness and comprehensiveness of the follow up study results, the study design included a number of well validated health instruments, evidence-based algorithms for detecting likely cases of symptom-based illnesses, repeated measures so that change since baseline could be assessed and objectively collected health service utilisation data for up to ten years in the past. The study also used Gulf War deployment-exposure information which was collected from participants at baseline, and supplemented by a review of additional ADF documentation, rather than relying on participants' recall more than 20 years after deployment. Combined, the various methods of data collection provide for a more complete picture of health and exposure in the two study groups than that which could be achieved by any one method alone, and minimise the potential for recall bias, personal motivation or other factors which might influence the results.

There are some specific advantages of accessing DVA, MBS, PBS and RPBS data for the assessment of health service and pharmaceutical utilisation. The data are available electronically and, with participant consent linkage, can be repeated into the future. Also, real time data inputs in many cases minimise error. There is an incentive for patients and providers to provide data as payments are dependent on it, which increases the coverage of the databases. Further, DVA and Medicare Australia has numerous processes in place to check and verify the data. There are some limitations, however, to the DVA and Medicare health data which affect interpretation. PBS and RPBS data, for example, do not capture private prescriptions, over the counter medications (e.g. common analgesics and asthma inhalers), most medications dispensed in hospitals, or medications that cost less than the copayment. Also, the number of scripts dispensed may not be the same as the number of scripts written by medical practitioners nor the same as the number of medications actually

taken by participants. DVA data may reflect health policy, or ease of access, acceptance or treatment for certain types of health outcomes, rather than the pattern of health outcomes amongst its constituents. Of importance here, however, is whether the limitations inherent to these data sources affect the recording of Gulf War veteran health data differently to the recording of the comparison group health data. If it can be assumed that the Gulf War veterans and the comparison group are treated equally within these databases, then differences in health service utilisation observed between the two groups can be confidently attributed to group characteristics and not database characteristics.

Implications for policy and programs

The follow up study results highlight the importance of effective detection and management of existing chronic conditions in Australian veterans of the 1991 Gulf War. Whilst access to health services appears high, to date this does not appear to be translating in to the diagnosis of conditions or syndromes common to Gulf War veterans, such as multisymptom illness, chronic fatigue syndrome, irritable bowel syndrome or alcohol disorder, nor alleviation of the excess morbidity in the Gulf War veteran group.

Ongoing screening of well Gulf War veterans is also important for the purpose of early detection and prevention of long-latency disease such as some cancers, and disorders for which rates appear to be on the rise in Gulf War veterans, such as PTSD and sleep apnoea, and for which valid screening measures are available. Greater awareness among health practitioners of the findings from this study of the types of health and other problems known to occur more commonly in Gulf War veterans should facilitate earlier detection of problems and earlier interventions.

Improved strategies to specifically target psychological health, including suicide prevention, are needed given the clear association between PTSD and Gulf War deployment, and the elevated levels of demoralisation, psychological distress and suicidal ideation in the Gulf War veteran group. Whilst much has been done in recent years by the DVA and ADF in regard to mental health literacy and service provision, the current study findings are clear that the Gulf War veteran group is in need of greater levels of support.

Programs and interventions that effectively maintain and booster Gulf War veterans' social health, particularly functional social support, may also both protect against disease and enhance recovery and productivity.

Programs aimed at positively changing health behaviours, particularly in the areas of healthy eating and physical exercise, will also be of benefit to the overall health of both study groups in this follow up study.

The finding in the current study of a statistically significant association between Gulf War deployment and multisymptom illness, in conjunction with the US Institute of Medicine's recent finding²¹ that the weight of the international research provides "sufficient evidence of an association between deployment to the Gulf War and multisymptom illness", increases the evidence base for greater recognition in Australia of Gulf War-related multisymptom illness.

Implications for future research

The two major studies of health in Australia's Gulf War veterans; i.e. the baseline study at approximately ten years after deployment, and this follow up study more than 20 years after deployment, have both shown persisting and pervasive chronic ill health in Gulf War veterans at levels which are in excess relative to their peers. Rather than a continued focus on the difference in health between Gulf War veterans and peers, future studies of the Gulf War veteran group might consider measuring the extent to which interventions in regard to physical, psychological and social health and health behaviours, improved detection of adverse health outcomes and policy change have alleviated or slowed the excess in risk in Gulf War veterans. The Gulf War Veterans' Health study has been designed as a prospective cohort study and future monitoring of the Gulf War veterans, with a focus on repeat linkages with the NDI, ACD, Medicare, PBS and DVA data would continue to provide useful information relating to temporal trends in the health of Gulf War veterans over time and the efficacy of interventions.

Regarding research involving future deployments, this is likely to be facilitated and reduce the chance of bias by collecting a 'minimum dataset' on all Defence Force personnel prior to deployments, more complete recording of relevant exposures, recruitment into studies early in the post-deployment period and increased mechanisms for data linkage to monitor patterns of health and associated outcomes, with regular contact to collect other variables not available through data linkage. The purpose of this is to both minimise the risk of response bias and inaccurate recall bias and provide more robust evidence for the association between specific exposures and health outcomes.

7 References

- 1. Institute of Medicine. *Gulf War veterans: Measuring health*. Washington, D.C.: National Academy Press, 1999.
- 2. Stevens D. Operation Damask The RAN contribution to the Gulf War. *Australia's Navy* 1991-92, Department of Defence, Canberra 1992:15-20.
- DeFraites RF, Wanat ER, Norwood AE, et al. Investigation of a suspected outbreak of an unknown disease among veterans of Operation Desert Shield/Storm, 123rd Army Reserve Command, Fort Benjamin Harrison, Indiana, April 1992. Washington, DC: Walter Reed Army Institute of Research, 1992.
- 4. Sartin JS. Gulf War illnesses: causes and controversies. Mayo Clin Proc 2000;75:811-9.
- Joseph SC, Comprehensive Clinical Evaluation Program Evaluation Team. A comprehensive clinical evaluation of 20,000 Persian Gulf War veterans. *Mil Med* 1997;162:149-55.
- 6. Persian Gulf Veterans Coordinating Board. Unexplained illnesses among Desert Storm veterans. *Arch Intern Med* 1995;55:262-68.
- 7. The Iowa Persian Gulf Study Group. Self-reported illness and health status among Gulf War veterans: A population-based study. *JAMA* 1997;277:238-45.
- 8. Unwin C, Blatchley N, Coker W, et al. Health of UK servicemen who served in Persian Gulf War. *Lancet* 1999;353:169-78.
- 9. Goss Gilroy Inc. Health study of Canadian Forces personnel involved in the 1991 conflict in the Persian Gulf. Ottawa, Canada, 1998.
- 10. Ishoy T, Suadicani P, Guldager B, et al. State of health after deployment in the Persian Gulf. The Danish Gulf War Study. *Dan Med Bull* 1999;46:416-19.
- 11. Australian Gulf War Veterans' Association. Australian Gulf War Veterans' Association: Submission of the health concerns, exposures and supporting evidence linking veterans' chronic ill health with service in the Persian Gulf, 2000.
- 12. Sim M, Kelsall H. Gulf War illness: a view from Australia. *Philos Trans R Soc Lond B Biol Sci* 2006;361:619-26.
- Kelsall H, Macdonell R, Sim M, et al. Neurological status of Australian veterans of the 1991 Gulf War and the effect of medical and chemical exposures. *Int J Epidemiol* 2005;34:810-19.
- 14. Kelsall H, McKenzie D, Sim M, et al. Comparison of self-reported and recorded vaccinations and health effects in Australian Gulf War veterans. *Vaccine* 2008;26:4290-97.
- 15. Ikin JF, McKenzie DP, Creamer MC, et al. War zone stress without direct combat: the Australian naval experience of the Gulf War. *J Trauma Stress* 2005;18:193-204.
- Ikin JF, Sim MR, Creamer MC, et al. War-related psychological stressors and risk of psychological disorders in Australian veterans of the 1991 Gulf War. *Br J Psychiatry* 2004;185:116-26.
- 17. Kelsall HL, Sim MR, Forbes AB, et al. Symptoms and medical conditions in Australian veterans of the 1991 Gulf War: Relation to immunisations and other Gulf War exposures. *Occup Environ Med* 2004;61:1006-13.
- 18. Kelsall HL, Sim MR, Ikin JF, et al. Reproductive health of male Australian veterans of the 1991 Gulf War. *BMC Public Health* 2007;7:79.
- 19. Forbes AB, McKenzie DP, Mackinnon AJ, et al. The health of Australian veterans of the 1991 Gulf War: Factor analysis of self-reported symptoms. *Occup Environ Med* 2004;61:1014-20.
- Kelsall HL, McKenzie DP, Sim MR, et al. Physical, psychological, and functional comorbidities of multisymptom illness in Australian male veterans of the 1991 Gulf War. *Am J Epidemiol* 2009;170:1048-56.
- 21. Institute of Medicine. *Gulf War and Health Volume 8 Update of health effects of serving in the Gulf War*. Washington, D.C.: The National Academies Press, 2010.
- 22. Selvin S. Practical biostatistical methods. Belmont, California, USA: Wadsworth, 1995.

- 23. Ware JE, Kosinski MA, Keller SD. *SF-12: How to score the SF-12 physical and mental health summary scales.* 3rd ed. Lincoln, Rhode Island: QualityMetric Incorporated, 1998.
- 24. Ware JE, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30:473-83.
- 25. Goldberg DP. *The detection of psychiatric illness by questionnaire*. London: Oxford University Press, 1972.
- 26. Goldberg DP. *Manual of the General Health Questionnaire*. Windsor, England: NFER Publishing, 1978.
- 27. Goldberg D, Gater R, Sartorius N, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychol Med* 1997;27:191-97.
- 28. Anastasi A, Urbina S. *Psychological Testing*. 7th ed. Upper Saddle River, New Jersey: Prentice-Hall, 1997.
- 29. Cronbach L. Coefficient alpha and the internal structure of tests. *Psychometrika* 1951;16:297-334.
- 30. Vieweg BW, Hedlund JL. The General Health Questionnaire (GHQ): A comprehensive review. *Journal of Operational Psychiatry* 1983;14:74-85.
- 31. Derogatis LR, Lipman RS, Rickels K, et al. The Hopkins Symptom Checklist (HSL): A self-report symptom inventory. *Behav Sci* 1974;19:1-15.
- Cherry N, Creed F, Silman A, et al. Health and exposures of United Kingdom Gulf war veterans. Part I: The pattern and extent of ill health. *Occup Environ Med* 2001;58:291-98.
- Kang HK, Mahan CM, Lee KY, et al. Illnesses among United States veterans of the Gulf War: a population-based survey of 30,000 veterans. *J Occup Environ Med* 2000;42:491-501.
- 34. Fukuda K, Nisenbaum R, Stewart G, et al. Chronic multisymptom illness affecting Air Force veterans of the Gulf War. *JAMA* 1998;280:981-88.
- 35. Haley RW, Kurt TL, Hom J. Is there a Gulf War syndrome? Searching for syndromes by factor analysis of symptoms. *Journal of the American Medical Association* 1997;277:215-22.
- 36. Blanchard MS, Eisen SA, Alpern R, et al. Chronic multisymptom illness complex in Gulf War I veterans 10 years later. *Am J Epidemiol* 2006;163:66-75.
- 37. Steele L. Prevalence and patterns of Gulf War illness in Kansas veterans: association of symptoms with characteristics of person, place, and time of military service. *Am J Epidemiol* 2000;152:992-1002.
- Dyck PJ. Quantitating severity of neuropathy. In: Dyck PJ, Thomas PK, Lambert EH, et al., eds. Peripheral Neuropathy. Philadelphia, Pennsylvania: W.B. Saunders Co., 1984:686-97.
- 39. Dyck PJ, Karnes J, O'Brien PC, et al. Neuropathy symptom profile in health, motor neuron disease, diabetic neuropathy, and amyloidosis. *Neurology* 1986;36:1300-8.
- 40. Von Korff M, Ormel J, Keefe FJ, et al. Grading the severity of chronic pain. *Pain* 1992;50:133-49.
- 41. Wolfe F, Clauw DJ, Fitzcharles M-A, et al. The American College of rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care Res* 2010;62:600-10.
- 42. Burney PGJ, Luczynska C, Chinn S, et al. The European Community Respiratory Health Survey. *Eur Respir J* 1994;7:954-60.
- 43. Ferris BG. Epidemiology standardization project. Am Rev Respir Dis 1978;118:1-120.
- 44. Monitoring ACfA. Asthma in Australia 2011. Canberra: AIHW, 2011.
- 45. McFarlane A, Hodson S. *Mental Health in the Australian Defence Force: 2010 ADF Mental Health Prevalence and Wellbeing Study: Full Report*: Department of Defence, 2011.
- 46. Seelig AD, Jacobson IG, Smith B, et al. Sleep patterns before, during, and after deployment to Iraq and Afghanistan. *Sleep* 2010;33:1615-22.
- 47. Chalder T, Berelowitz G, Pawlikowska T, et al. Development of a fatigue scale. *J Psychosom Res* 1993;37:147-53.

- 48. Cella M, Chalder T. Measuring fatigue in clinical and community settings. *J Psychosom Res* 2010;69:17-22.
- 49. Hotopf M, David AS, Hull L, et al. Gulf war illness better, worse, or just the same? A cohort study. *Br Med J* 2003;327:1370-73.
- 50. Johns MW. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. *Sleep* 1991;14:540-5.
- 51. Johns MW. Reliability and factor analysis of the Epworth Sleepiness Scale. *Sleep* 1992;15:376-81.
- 52. Fukuda K, Straus SE, Hickie I, et al. The chronic fatigue syndrome: A comprehensive approach to its definition and study. *Ann Intern Med* 1994;121:953-59.
- 53. Kelsall H, Sim M, McKenzie D, et al. Medically evaluated psychological and physical health of Australian Gulf War veterans with chronic fatigue. *J Psychosom Res* 2006;60:575-84.
- 54. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606-13.
- 55. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders* (*DSM-IV*). 4th ed. Arlington, VA: American Psychiatric Association, 1994.
- 56. Robbins JM, Kirmayer LJ. Attribution of common somatic symptoms. *Psychol Med* 1991;21:1029-45.
- 57. Kessler D, Lloyd K, Lewis G, et al. Cross sectional study of symptom attribution and recognition of depression and anxiety in primary care. *BMJ* 1999;318:436-9.
- Drossman DA. The functional gastrointestinal disorders and the Rome III process. In: Drossman DA, Corazziari M, Delvaux R, et al., eds. Rome III: The functional gastrointestinal disorders. 3 ed. McLean, VA: Degnon Associates, 2006:1-29.
- 59. Digesu GA, Panayi D, Kundi N, et al. Validity of the Rome III Criteria in assessing constipation in women. *Int Urogynecol J Pelvic Floor Dysfunct* 2010;21:1185-93.
- 60. Whitehead WE, Drossman DA. Validation of symptom-based diagnostic criteria for irritable bowel syndrome: a critical review. *Am J Gastroenterol* 2010;105:814-20; quiz 13, 21.
- 61. Kissane DW, Wein S, Love A, et al. The Demoralization Scale: a report of its development and preliminary validation. *J Palliat Care* 2004;20:269-76.
- 62. Campbell-Sills L, Stein MB. Psychometric analysis and refinement of the Connordavidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. *J Trauma Stress* 2007;20:1019-28.
- 63. A D, S T, W Z, et al. *The Middle East Area of Operations (MEAO) Health Study: Census Study Summary Report.* Brisbane, Australia: The University of Queensland, Centre for Military and Veterans Health, 2012.
- 64. Statisics ABo. National Health Survey: users' guide, 2001. Canberra, 2001.
- 65. Australian Bureau of Statistics. 2007-08 National Health Survey: Users Guide. Canberra, 2008.
- 66. ABS. Injury in Australia: A Snapshot, 2004-05 Secondary Injury in Australia: A Snapshot, 2004-05 2006. <u>http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/7B18467197C6</u> <u>9E7BCA256F5400710940?opendocument#The%20proportion%20of%20people%20</u> reportin.
- 67. Australian Institute of Health and Welfare National Injury Surveillance Unit RCfIS, Flinders University of South Australia. National Data Standards for Injury Surveillance Ver 2.1. January ed: AIHW, 1998.
- Killgore WDS, Castro CA, Hoge CW. Preliminary normative data for the Evaluation of Risks Scale - Bubble sheet version (EVAR-B) for large-scale surveys of returning combat veterans. *Mil Med* 2010;175:725-31.
- 69. Sicard B, Jouve E, Blin O, et al. Construction and validation of visual analogue scale for risk assessment. *Encephale* 1999;15:622-9.
- Kilgore W, Vo A, Castro CA, et al. Assessing risk propensity in American soldiers: preliminary reliability and validity of the Evaluation of Risks (EVAR) scale-English version. *Mil Med* 2006;171:233-9.

- 71. Slade T, Johnston A, Oakley Browne MA, et al. 2007 National Survey of Mental Health and Wellbeing: methods and key findings. *Aust N Z J Psychiatry* 2009;43:594-605.
- 72. Kilbourne AM, Lasky E, Pincus HA, et al. The Continuous Improvement for Veterans in Care : Mood Disorders (CIVIC-MD) Study, a VA-Academic partnership. *Psychiatr Serv* 2008;59:483-85.
- 73. Copeland LA, Miller AL, Welsh DE, et al. Clinical and demographic factors associated with homelessness and incarceration among VA patients with bipolar disorder. *Am J Public Health* 2009;99:871-77.
- 74. Kessler RC, Ustun TB. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *International Journal of Methods in Psychiatric Research* 2004;13:93-121.
- 75. Weathers FW, Litz BT, Herman DS, et al. The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. Paper presented at the 9th Annual Conference of the International Society for Traumatic Stress Studies. San Antonio, Texas, 1993.
- 76. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders* (*DSM-5*). 5th ed. Arlington, VA: American Psychiatric Association, 2013.
- 77. Australian Institute of Health and Welfare. Australia's Health 2002: The eighth biennial health report of the Australian Institute of Health and Welfare. Canberra: AIHW, 2002.
- Saunders JB, Aaslane OG, Babor TF, et al. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption - II. Addiction 1993;88:791-804.
- 79. Reinert DF, Allen JP. The alcohol use disorders identification test: an update of research findings. *Alcohol Clin Exp Res* 2007;31:185-99.
- Barry KL, Fleming MF. The Alcohol Use Disorders Identification Test (AUDIT) and the SMAST-13: Predictive validity in a rural primary care sample. *Alcohol Alcohol* 1993;28:33-42.
- Bohn MJ, Babor TF, Kranzler HR. The Alcohol Use Disorders Identification Test (AUDIT): Validation of a screening instrument for use in medical settings. *J Stud Alcohol* 1995;56:423.
- 82. Babor TF, Higgins-Biddle JC, Saunders JB, et al. The alcohol use disorder identification test: guidelines for use in primary care. Geneva: Department of Mental Health and Substance Disorders, World Health Organization, 2001.
- 83. McKenzie DP, McFarlane AC, Creamer M, et al. Hazardous or harmful alcohol use in Royal Australian Navy veterans of the 1991 Gulf War: identification of high risk subgroups. *Addict Behav* 2006 31:1683-94.
- 84. Australian Government National Health and Medical Research Council Department of Health and Ageing. Eat for Health, Australian Dietary Guidelines Summary, 2013.
- 85. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med 1991;32:705-14.
- 86. Donald CA, Ware JEJ. The measurement of social support. *Research in Community and Mental Health* 1984;4:334-35.
- 87. World Health Organization. WHOQOL-BREF Introduction, Administration, scoring and generic version of the assessment. Geneva: WHO, 1996:1-18.
- 88. The WHOQOL Group. Development of the World Health Organization WHOQOL-BREF Quality of Life Assessment. *Psychol Med* 1998;28:551-58.
- 89. Andrews FM, Withey SB. Social indicators of well-being : Americans' perceptions of life quality. New York: Plenum Press, 1976.
- 90. Cummins RA. On the trail of the gold standard for subjective well-being. *Social Indicators of Research* 1995;35:179-200.
- 91. Australian Bureau of Statistics. Mental Health and Wellbeing: Profile of Adults, Australia 1997. Canberra, Australian Capital Territory, 1998.
- 92. Australian Bureau of Statistics. 4363.0.55.002 National Health Survey 2001: Data reference package, 2001. Canberra, 2001.
- 93. Dear K, Henderson S, Korten A. Well-being in Australia: Findings from the National Survey of Mental Health and Well-being. *Soc Psychiatry Psychiatr Epidemiol* 2002;37:503-09.

- 94. World Health Organization. *Obesity: Preventing and managing the global epidemic.* Geneva: World Health Organization, 2000.
- 95. World Health Organization Collaborating Centre for Mental Health and Substance Abuse. *Composite International Diagnostic Interview: CIDI-Auto 2.1 - Administrator's guide and reference*. Sydney: World Health Organization Collaborating Centre for Mental Health and Substance Abuse, 1997.
- 96. Andrews G, Peters L. The psychometric properties of the Composite International Diagnostic Interview. *Soc Psychiatry Psychiatr Epidemiol* 1998;33:80-88.
- 97. Robins LN, Wing J, Wittchen HU, et al. The Composite International Diagnostic Interview: an epidemiological instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Arch Gen Psychiatry* 1988;45:1069-77.
- World Health Organization. The International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). Geneva: World Health Organization, 1992.
- Andrews G, Henderson S, Hall W. Prevalence, comorbidity, disability and service utilisation: Overview of the Australian National Mental Health Survey. *Br J Psychiatry* 2001;178:145-53.
- 100. Silove D, Brooks R, Bateman Steel CR, et al. Explosive anger as a response to human rights violations in post-conflict Timor-Leste. *Soc Sci Med* 2009;69:670-77.
- 101. McFall M, Fontana A, Raskind M, et al. Analysis of violent behavior in Vietnam combat veteran psychiatric inpatients with posttraumatic stress disorder. *J Trauma Stress* 1999;12:501-17.
- 102. Novaco RW, Chemtob CM. Anger and combat-related posttraumatic stress disorder. *J Trauma Stress* 2002;15:123-32.
- 103. Services AGDoH. Medicare services. Secondary Medicare services 19 March 2014 2014. <u>http://www.humanservices.gov.au/customer/subjects/medicare-services</u>.
- 104. Organization WH. About the ATC/DDD system. Secondary About the ATC/DDD system 19/12/2013 2004. <u>http://www.whocc.no/atc_ddd_index/</u>.
- 105. Australian Government National Health and Medical Research Council, Australian Research Council. Revision of the Joint NHMRC/AVCC Statement and Guidelines on Research Practice: Australian Code for the Responsible Conduct of Research. <u>http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/r39.pdf</u> accessed 5 Feb 2014, 2007.
- 106. Stata Statistical Software: Release 12 [program]. 12.0 version. College Station, TX: StataCorp LP, 2011.
- 107. Stata Statistical Software: Release 13 [program]. College Station, TX: StataCorp LP, 2013.
- 108. Muthen LK, Muthen BO. *Mplus: the comprehensive modeling program for applied researchers: user's guide. Version 7.0.* Los Angeles: Muthen & Muthen, 2012.
- 109. Armitage P, Berry G, Matthews JNS. *Statistical methods in medical research*. 4th ed. Oxford, UK: Blackwell, 2002.
- 110. Hardin JW, Hilbe JM. *Generalized linear models and extensions*. 3rd ed. College Station, Texas: Stata Press, 2012.
- 111. Mehta CR, Patel NR. Exact logistic regression : theory and examples. *Stat Med* 1995;14:2143-60.
- 112. Koenker R. Quantile regression. Thousand Oaks, California: Sage, 2005.
- 113. Child D. The essentials of factor analysis. 3rd ed. New York: Continuum, 2006.
- 114. Cattell RB. The scree test for the number of factors. *Multivariate Behavioral Research* 1966;1:245-76.
- 115. Muthen B. A general structural equation model with dichotomous, ordered categorical, and continuous latent variable indicators. *Psychometrika* 1984;49:115-32.
- 116. Sim M, Abramson M, Forbes A, et al. Australian Gulf War Veterans' Health Study Volumes 1-3. Canberra: Monash University for the Commonwealth of Australia, 2003.
- 117. Glass DC, Sim MR, Kelsall HL, et al. What was different about exposures reported by male Australian Gulf War veterans for the 1991 Persian Gulf War, compared with exposures reported for other deployments? *Mil Med* 2006 171:632-38.

- 118. Kelsall H, McKenzie DP, Sim M, et al. Comparison of self-reported and recorded vaccinations and health effects in Australian Gulf War veterans. *Vaccine* 2008;26:4290-97.
- 119. Contact officer: Staff Officer 1 Corporate Health Management; Authorising Officer: Head Defence Health Services. Background Information. Pyridostigmine Bromide Defence Question Time Brief. Canberra: Sent to DVA by Department of Defence in 2008, no date specified.
- 120. Rand RS, Davis DA, Satterwhite MB, et al. Methods of monitoring the Persian Gulf oil spill using digital and hardcopy multiband data. Fort Belvoir, Virginia: U.S. Army Corps of Engineers Topographic Engineering Center, 1992.
- 121. Rostker B. Close-out report. Water Use. In: Defense UDo, ed. Washington: US Department of Defense, 2000:1-24.
- 122. Lorenzo-Seva U, ten Berge J. Tucker's Congruence Coefficient as a meaningful index of factor similarity. *Methodology* 2006;2:57-64.
- 123. Tucker LR. A method for the synthesis of factor analysis. Washington, DC: Department of the Army, 1951.
- 124. Smith B, Smith TC, Ryan MA, et al. A comparison of the postdeployment hospitalization experience of U.S. military personnel following service in the 1991 Gulf War, Southwest Asia after the Gulf War, and Bosnia. *Journal of Occupational and Environmental Hygiene* 2006;3:660-70.
- 125. Kessler RC, Abelson J, Demler O, et al. Clinical calibration of DSM-IV diagnoses in the World Mental Health (WMH) version of the World Health Organization (WHO) Composite International Diagnostic Interview (WMHCIDI). *International Journal of Methods in Psychiatric Research* 2004;13:122-39.
- 126. Campbell_Sills L, Stein M. Psychometric analysis and refinement of the Connor-Davidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. *J Trauma Stress* 2007;20:1019-28.
- 127. Australian Institute of Health and Welfare. *Australia's health 2012*. Canberra: AIHW, 2012.
- 128. Murphy FM, Kang H, Dalager NA, et al. The health status of Gulf War veterans: lessons learned from the Department of Veterans Affairs Health Registry. *Mil Med* 1999;164:327-31.
- 129. Research Advisory Committee on Gulf War Veterans' Illnesses. Gulf War illness and the health of Gulf War veterans: Scientific findings and recommendations. Washington, D.C.: U.S. Department of Veteras Affairs, 2008.
- 130. Kang HK, Li B, Mahan CM, et al. Health of US veterans of 1991 Gulf War: A follow-up survey in 10 years. *J Occup Environ Med* 2009;51:401-10.
- 131. Eisen SA, Kang HK, Murphy FM, et al. Gulf War veterans' health: medical evaluation of a U.S. cohort. *Ann Intern Med* 2005;142:881-90.
- 132. Kang HK, Natelson BH, Mahan CM, et al. Post-traumatic stress disorder and chronic fatigue syndrome-like illness among Gulf War veterans: a population-based survey of 30,000 veterans. *Am J Epidemiol* 2003;157:141-48.
- 133. Ismail K, Kent K, Sherwood R, et al. Chronic fatigue syndrome and related disorders in UK veterans of the Gulf War 1990-1991: results from a two-phase cohort study. *Psychol Med* 2008;38:953-61.
- 134. Tuteja AK, Tolman KG, Talley NJ, et al. Bowel disorders in Gulf War veterans. *Gastroenterology* 2008;34:A31.
- 135. Eisen SA, Kang MK, Murphy FM, et al. Gulf war veterans' health: Medical evaluation of a U.S. cohort. *Ann Intern Med* 2005;142:881-90+I-22.
- 136. Lang K, Saylor J. Gastrointestinal symptoms and the Gulf War Syndrome. *Gastroenterology* 1995;108:A23.
- 137. Sostek MB, Jackson S, Linevsky JK, et al. High prevalence of chronic gastrointestinal symptoms in a National Guard Unit of Persian Gulf veterans. *Am J Gastroenterol* 1996;91:2494-7.
- 138. Proctor SP, Heeren T, White RF, et al. Health status of Persian Gulf War veterans: Self-reported symptoms, environmental exposures and the effect of stress. *Int J Epidemiol* 1998;27:1000-10.

- 139. Tuteja A, Tolman K, Talley N, et al. Bowel disorders in Gulf War veterans. *Gastroenterology* 2008;134:A-31.
- 140. Kang HK, Mahan CM, Lee LY, et al. Illnesses among united states veterans of the gulf war: A population- based survey of 30,000 veterans. *J Occup Environ Med* 2000;42:491-501.
- 141. Gray GC, Reed RJ, Kaiser KS, et al. Self-reported symptoms and medical conditions among 11,868 Gulf War-era veterans: The Seabee health study. *Am J Epidemiol* 2002;155:1033-44.
- 142. Gray GC, Coate BD, Anderson CM, et al. The postwar hospitalization experience of U.S. veterans of the Persian Gulf War. *N Engl J Med* 1996;335:1505-13.
- 143. Gray GC, Smith TC, Knoke JD, et al. The postwar hospitalization experience of Gulf War veterans possibly exposed to chemical munitions destruction at Khamisiyah, Iraq. Am J Epidemiol 1999;150:532-40.
- 144. Wolfe F, Smythe HA, Yunus MB, et al. The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of the Multicenter Criteria Committee. *Arthritis Rheum* 1990;33:1863-64.
- 145. Stimpson NJ, Unwin C, Hull L, et al. Prevalence of reported pain, widespread pain, and pain symmetry in veterans of the Persian Gulf War (1990-1991): The use of pain manikins in Persian Gulf War health research. *Mil Med* 2006;171:1181-86.
- 146. Forman-Hoffman VL, Peloso PM, Black DW, et al. Chronic widespread pain in veterans of the first Gulf War: impact of deployment status and associated health effects. *J Pain* 2007;8:954-61.
- 147. Kuzma JM, Black DW. Chronic wide spread pain and psychiatric disorders in veterans of the first Gulf War. *Curr Pain Headache Rep* 2006;10:85-89.
- 148. Haley RW, Charuvastra E, Shell WE, et al. Cholinergic autonomic dysfunction in veterans with gulf war illness: Confirmation in a population-based sample. *JAMA Neurology* 2013;70:191-200.
- 149. Proctor SP, Heeren T, White RF, et al. Health status of Persian Gulf War veterans: self-reported symptoms, environmental exposures and the effect of stress. *Int J Epidemiol* 1998;27:1000-10.
- 150. Ismail K, Kent K, Brugha T, et al. The mental health of UK Gulf War veterans: phase 2 of a two phase cohort study. *Br Med J* 2002;325:525-76.
- 151. Australian Institute of Health and Welfare. *Australia's health 2008*. Canberra: AIHW, 2008.
- 152. Karlinsky JB, Blanchard M, Alpern R, et al. Late prevalence of respiratory symptoms and pulmonary function abnormalities in Gulf War I Veterans. *Archives International Medicine* 2004;164:2488-91.
- 153. Gray GC, Kaiser KS, Hawksworth AW, et al. Increased postwar symptoms and psychological morbidity among U.S. Navy Gulf War veterans. *Am J Trop Med Hyg* 1999;60:758-66.
- 154. Macfarlane G, Hotopf M, Maconoche N, et al. Long-term mortality amongst Gulf War veterans: Is there a relationship with experiences during deployment and subsequent morbidity? *Int J Epidemiol* 2005;34:1403-08.
- 155. Gade DM, Wenger JB. Combat exposure and mental health: the long-term effects among US Vietnam and Gulf War veterans. *Health Econ* 2011;20:401-16.
- 156. Kang HK, Li B, Mahan CM, et al. Health of US veterans of 1991 Gulf War: a follow-up survey in 10 years. *J Occup Environ Med* 2009;51:401-10.
- 157. Li B, Mahan CM, Kang HK, et al. Longitudinal health study of US 1991 Gulf War veterans: changes in health status at 10-year follow-up. *Am J Epidemiol* 2011;174:761-8.
- 158. Brailey K, Vasterling JJ, Sutker PB. Psychological aftermath of participation in the Persian Gulf War. In: Lundberg A, ed. The environment and mental health: a guide for clinicians. Mahwah, New Jersey: Erlbaum, 1998:83-101.
- 159. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. *Journal of the American Medical Association* 1999;282:1737-44.

- 160. McKenzie DP, Creamer M, Kelsall HL, et al. Temporal relationships between Gulf War deployment and subsequent psychological disorders in Royal Australian Navy Gulf War veterans. *Soc Psychiatry Psychiatr Epidemiol* 2010;45:843-52.
- 161. Hawthorne G, Korn S, Creamer M. Australian peacekeepers: Long-term mental health status, health service use and quality of life Technical Report. Unpublished manuscript: Department of Psychiatry, University of Melbourne, Australia, 2013.
- 162. Panagioti M, Gooding P, Tarrier N. A meta-analysis of the association between posttraumatic stress disorder and suicidality: the role of comorbid depression. *Compr Psychiatry* 2012;53:915-30.
- 163. Stein DJ, Chiu WT, Hwang I, et al. Cross-national analysis of the associations between traumatic events and suicidal behavior: findings from the WHO World Mental Health Surveys. *PLoS ONE [Electronic Resource]* 2010;5:e10574.
- 164. Nock MK, Deming CA, Fullerton CS, et al. Suicide among soldiers: a review of psychosocial risk and protective factors. *Psychiatry* 2013;76:97-125.
- 165. Russell R. Social health: an attempt to clarify this dimension of wellbeing. *Int J Health Educ* 1973;16:74-82.
- 166. McDowell I. *Measuring health: a guide to rating scales and questionnaires. Third edition.* 2nd ed. New York: Oxford University Press, 2006.
- 167. Statisics ABo. National Health Survey: summary of results, 2007-08. ABS cat. no. 4364.0. Canberra: ABS, 2009.
- 168. Darby S, Muirhead C, Doll R, et al. Mortality among United Kingdom servicemen who served abroad in the 1950s and 1960s. *Br J Ind Med* 1990;47:793-804.
- 169. Greenberg R, Mandel J, Pastides H, et al. A meta-analysis of cohort studies describing mortality andcCancer incidence among chemical workers in the United States and Western Europe. *Epidemiology* 2001;12:727-40.

8 Appendices

8.1 Appendix 1 Abbreviations

List of Abbreviations

AAARnet	Australian Academic and Research Network
ABS	Australian Bureau of Statistics
ACD	Australian Cancer Database
adj OR	statistically adjusted (for potential confounders such as age
	category) odds ratio
adj mean diff	statistically adjusted difference between means
adj median diff	statistically adjusted difference between medians
adj RR	statistically adjusted risk ratio
ADF	Australian Defence Force
AEC	Australian Electoral Commission
AF1	American factor number 1; the first of three factors derived from the
	EVAR-B described by American authors
AF2	American factor number 2; the second of three factors derived from
	the EVAR-B described by American authors
AF3	American factor number 3; the third of three factors derived from the
	EVAR-B described by American authors
Average	Average number of personnel onboard the ship for the reporting
complement	period in the Ship's Medical Journal
AIHW	Australian Institute of Health and Welfare
Air Force	Royal Australian Air Force (unless otherwise specified)
APPVA	Australian Peacekeeper and Peacemaker Veterans' Association
Army	Australian Army (unless otherwise specified)
ATC	Anatomical Therapeutic Chemical (coding system)
AUDIT	The Alcohol Use Disorders Identification Test
BMI	Body mass index
CDC	Centers for Disease Control
CD-RISC 10	The 10-item version of the Connor Davidson-Resilience Scale
CDT	Clearance Diving Team
CFQ	Chalder Fatigue Scale – not abbreviated to CFS to avoid confusion
	with "Chronic Fatigue Syndrome".
CIDI	Composite International Diagnostic Interview, for making psychiatric
	diagnoses such as major depression, in epidemiological studies
СО	Commissioned Officer
COPD	Chronic obstructive pulmonary disease

CI	Confidence interval, the probability that a population parameter such
	as a risk ratio, will fall between two specified values
CHT	Collection, Holding and Transfer
CMPT	tank Compartment
DCX's	Damage Control Exercises - these are when/where the defence
	force practices battle damage, fires, floods, casualties, etc
DRMS	Defence Records Management System
DSM-IV	4th edition of the Diagnostic and Statistical Manual of Mental
	Disorders
DVA	Australian Government Department of Veterans' Affairs
et al	and others
EFA	Exploratory factor analysis
EVAR-B	The Evaluation of Risks Scale - Bubble Sheet Version
FF1	French factor number 1; the first of five factors derived from the
	EVAR-B described by French authors
FF2	French factor number 2; the second of five factors derived from the
	EVAR-B described by French authors
FF3	French factor number 3; the third of five factors derived from the
	EVAR-B described by French authors
FF4	French factor number 4; the fourth of five factors derived from the
	EVAR-B described by French authors
FF5	French factor number 5; the fifth of five factors derived from the
	EVAR-B described by French authors
FMO	Fleet Medical Officer - senior medical officer with Fleet Command
FTP	File Transfer Protocol
GHQ-12	12-item General Health Questionnaire, a measure of psychological
	distress
GWV	Gulf War veteran
GWVHS	Gulf War Veterans' Health Study
HMAS	His/Her Majesty's Australian Ship
HR	Hazard ratio
HVRF	Hunter Valley Research Foundation
IBS	Irritable Bowel Syndrome
ICD	International Classification of Diseases
ICV	International Certificate of Vaccination
IED	Intermittent Explosive Disorder
IQR	Interquartile range, the difference between the 25^{th} and 75^{th}
	percentiles

-SMED Leading Seaman Medic (All sailor ranks are broken into tw				
	elements, the first two letters are their actual rank and the remainder			
	are their category or qualification)			
MBS	Medicare Benefits Schedule			
MCS	12 item Short Form Health Survey Mental Component Summary			
MEAO	Middle East Area of Operation			
MFO	Multinational Force and Observers			
MOS	Medical Outcomes Study			
MSEQ	Military Service Experience Questionnaire			
N (or n)	Number of participants			
NAA	National Archives of Australia			
NAPS	Nerve Agent Pre-treatment Set (Anti-nerve agent pills)			
NOAA	National Oceanic and Atmospheric Administration			
Navy	Royal Australian Navy (unless otherwise specified)			
NBC	Nuclear, Biological, Chemical			
NBCD	Nuclear, Biological, Chemical Defence			
NBCDX or NBCDEX	Nuclear, Biological, Chemical Defence exercise			
NCO	Non-commissioned Officer			
NDI	National Death Index			
NOS	Not otherwise specified			
NSMHW	National Survey of Mental Health and Wellbeing			
OR	odds ratio			
P value	probability value			
PB	Pyridostigmine bromide, a prophylactic measure against nerve gas,			
	also known as NAPS			
PBS	(Australian Government) Pharmaceutical Benefits Scheme			
PCL	Posttraumatic stress disorder Check List			
PCL-C	Posttraumatic stress disorder Check List – civilian			
PCL-S	Posttraumatic stress disorder Check List – specific			
PCS	12 item Short Form Health Survey Physical Component Summary			
PDF	Portable Document Format			
PHQ-9	9 item Patient Health Questionnaire			
PLS	Percent Life Satisfaction score derived from the Life Satisfaction			
	scale			
PS	population sample			
PTE	Potentially traumatic events			
PTSD	Posttraumatic stress disorder			
PY	person years			

RAAF	Royal Australian Air Force
RAN	Royal Australian Navy
RoP	Report of Proceedings
RPBS	Repatriation Pharmaceutical Benefits Scheme
RR	Risk ratio
SD	Standard deviation
SF-12	12 item Short Form Health Survey
SF-36	36 item Short Form Health Survey
SIQ	Symptom Interpretation Questionnaire
SIR	Standardised incidence ratio
SLE	Systemic lupus erythematosus
SMJ	Ships' Medical Journal
SMOIL or SMOID	Smoke and Oil cloud or Smoke, Oil and Dust cloud
SMR	Standardised mortality ratio
SOP	Statement of principle
SPSS	Statistical Package for the Social Sciences
STDs	Sexually transmissible diseases
ТМЈ	Temporomandibular Joint
UK	United Kingdom
UIN	Unique identification number
UN	United Nations
UNSCOM	United Nations Special Commission
UNTSO	United Nations Truce Supervision Organization
US or USA	United States of America
USNS	United States Naval Ship
WHO	World Health Organization
WHOQOL-Bref	26-item World Health Organization brief Quality of Life questionnaire

8.2 Appendix 2 Study group definitions

Study group definitions

Definition of the Gulf War veteran group

Gulf War veterans are defined as all Australian Defence Force (ADF) personnel, from the Royal Australian Navy, Australian Army, and the Royal Australian Air Force, who served in the Gulf War and who are listed on the Department of Veterans' Affairs Nominal Roll for that conflict. To be included on the Nominal Roll an ADF member must have been deployed to the Gulf sometime during the period 2 August 1990 to 4 September 1991.

The Nominal Roll includes:

- ADF personnel on temporary as well as permanent postings. The majority of ADF members listed on the Nominal Roll deployed as part of Operation Ozone and Operation Damask, or with overseas forces as part of Operations Desert Shield and Desert Storm.
- Personnel who were members of the Navy, Army or Air Force Reserves.
- Personnel on board the second deployment of HMAS Darwin which reached the Gulf just after the war ended, serving from 13 June 1991 to 4 September 1991.
- Personnel who went to Kurdistan in northern Iraq as part of Operation Habitat to provide humanitarian aid from 16 May 1991 until 30 June 1991.
- Operation Blazer personnel who were deployed to Iraq immediately after the war ended in support of the United Nations Special Commission (UNSCOM) to oversee the destruction of weapons of mass destruction.
- Support personnel who deployed to the Middle East to provide logistic support to the ships and aircraft. These include personnel from the Royal Australian Air Force (RAAF) Mobile Air Terminal Unit (MATU), and the Navy Logistic Support Element (LSE).

The Nominal Roll does NOT include:

- Those personnel who were on other Defence duties in the Middle East at the time of the Gulf War and who were deployed in support of other Defence duties or United Nations (UN) peacekeeping operations. These include personnel serving with the UN Truce Supervision Organisation (UNTSO) in Beirut, South Lebanon, Israel and Syria as well as those deployed as part of the Multinational Force and Observers (MFO) in the Sinai.
- Subjects who were in non-Defence roles in the area of the Gulf, for example embassy personnel and reporters.
- Personnel deployed to UNSCOM as part of Operation Blazer after 4 September 1991.
- Personnel deployed to the Gulf and the Red Sea in support of Operations Damask IV IX after 4 September 1991.

At baseline, the total eligible Gulf War veteran sample totalled 1,871. After removing those found, at that time, to be deceased or overseas long-term, the recruitable sample was 1,808. Of those, 1,456 (80.5%) participated in the baseline study, and they comprise the Gulf War veteran sample for the Australian Gulf War Veterans' Follow Up Health Study.

Definition of the comparison group

Comparison group subjects for the study are defined as Australian Defence Force personnel who were:

- operational in the Royal Australian Navy, Australian Army or Royal Australian Air Force at the time of the Gulf War;
- eligible to be deployed to the Gulf, but either not sent to the Gulf or not otherwise eligible for inclusion on the Gulf War Nominal Roll according to the criteria provided above.

The list of participants for the comparison group was established at the time of the baseline study. A list of ADF personnel posted to Maritime, Land or Air Operational Units as at 1 August 1990 was combined with a second list of those posted to Maritime, Land or Air Operational Units as at 1 August 1991. These lists included personnel on either permanent postings or temporary attachments to ships, units or squadrons including members of the Navy, Army or Air Force Reserves. The two dates were selected to ensure that those personnel who were posted to operational units during the period of the Gulf War were not missed for comparison group selection. From these lists Gulf War veterans, as defined by their inclusion on the Gulf War Nominal Roll, were removed leaving an eligible comparison sample of 5,481 Navy, 6,481 Army and 14,494 Air Force personnel.

From the eligible comparison sample for each service type, subjects were randomly selected using frequency matching to the Gulf War veteran group. The criteria used for the frequency matching varied across Service type. Navy comparison group subjects were matched with Navy Gulf War veteran group subjects according to sex and 3-year age bands. The rank distribution within the Army units, which were deployed to the Gulf War, was considered not representative of the larger Army operational force, and therefore the Army comparison group subjects were matched with Army Gulf War veteran group subjects according to sex, year of birth and two service rank categories ('Officer' and 'Other ranks'). Similarly the distribution of personnel in aircrew versus non-aircrew roles within the Air Force operational force, and therefore the Air Force comparison group subjects were matched with Air Force Gulf War veteran group subjects according to sex, year of birth and two services were matched with Air Force Gulf War veteran group subjects according to sex, year of birth of representative of the larger Air Force Gulf War veteran group subjects according to sex, year of birth and the two job categories (Aircrew and Non-Aircrew).

At baseline, the final eligible comparison group sample was 2,924. After removing those found, at that time, to be deceased (n=31) or overseas long-term (n=97), the recruitable sample was 2,796. Of those, 1,588 (56.7%) participated in the baseline study, and they comprise the comparison group sample for the Australian Gulf War Veterans' Follow Up Health Study.

8.3 Appendix 3 Health measures and occupational exposures collected at baseline and follow up

Health measures and occupational exposures collected at baseline and follow up

A number of health outcomes and occupational exposures were measured during the baseline study, during the follow up study, or as part of both studies. Table 1 shows the occupational exposures measured during the baseline or follow up studies and the mode of data collection. Table 2 shows the health information which was collected from participants during the baseline and/or follow up studies, and the mode of data collection. Health information which was collected via linkage to the Medicare Australia database, the PBS and RPBS databases and the DVA-held health databases, are described in the Health Service utilisation chapter.

	2003	Study 2000-	2012 2011-		
Occupational exposure measured Collected via	Self-report questionnaire	DVA/ADF records	Self-report questionnaire	ADF/other records	
Active (war or peacekeeping) deployments	1	\checkmark	\checkmark	-	
Serving status, discharge year, length of ADF service, Rank – current or at discharge	1	1	\checkmark	-	
Military postings including Unit/Ship/squadron, duties and type of area worked in.	1	1	-	-	
GW deployment related locations, duties, Operation, Ship/unit/squadron.	1	\checkmark	-	-	
GW deployment related immunisations or prophylactic medications including number of vaccinations, pyridostigmine bromide, and anti-malarials	1	1	-	1	
GW or non-GW deployment related chemical and environmental exposures including chemical warfare agents, pesticides and repellants, depleted uranium, atmospheric smoke and oil, dust, infectious agents, contaminated food and water, exhaust, fuels, solvents.	1	1	-	1	
Disease outbreaks and other medical conditions documented during the GW deployment, and use of health professionals during deployment.	-	-	-	1	
GW or non-GW deployment related military service stressors including actual or threatened attack, exposure to or responsibility for the death or suffering of others, feelings of helplessness or lack of control, lack of a sense of preparedness, malevolent environment, lack of support or unit cohesion.	1	1	-	-	
Civilian employment	1	-	\checkmark	-	
Post deployment appraisals including self-pride, any recognition from others, improved leadership.	1	-	-	-	

Table 1 Occupational exposures measured, mode of data collection and Study phase for the Australian Gulf War veterans' baseline and Follow Up Health Studies

Table 2 Health information collected directly from participants, mode of data collection and study phase for the Australian Gulf War veterans' baseline and Follow Up Health Studies

		Baseline Health Study 2000-2003				Follow Up Health Study 2011- 2012		
Health measure Administered/collected by	Nurse	Doctor's examination	Psychologist's interview	Self-report questionnaire	Self-report questionnaire	Telephone interview		
Blood tests								
Haematological tests (CBE and ESR)	1	-	-	-	-	-		
Biochemical analyses (U&As, serum calcium and phosphates, LFTs, random plasma glucose, CRP)	~	-	-	-	-	-		
Serology tests (EBV IgG, CMV IgG, Hep C core Ab)	1	-	-	-	-	-		
Physical examination								
Anthropometrics	1	-	-	-	-	-		
Blood pressure	1	-	-	-	-	-		
Visual acuity	1	-	-	-	-	-		
Respiratory function using spirometry	1	-	-	-	-	-		
Skin prick tests for atopy	1	-	-	-	-	-		
Urinalysis for blood, protein, glucose and nitrites	1	-	-	-	-	-		
Physical examination of the thyroid, the cardiovascular, respiratory, gastrointestinal, neurological and musculoskeletal systems, skin and nails, and lymph nodes	•	1	-	-	-	-		
Fitness test	-	1	-	-	-	-		
Psychological health interview								
Composite International Diagnostic Interview v.2.1	-	-	\checkmark	-	-	\checkmark		
Demographics								
Date of birth, marital status, education, occupational status, period of unemployment, income source	-	-	-	1	1	-		
Income level	-	-	-	-	1	-		
Country of birth, Aboriginal or Torres Strait Islander, language spoken at home	-	-	-	\checkmark	-	-		
Health questionnaires								
Respiratory symptoms and reported conditions	1	-	-	-	\checkmark	-		
Symptoms of extreme tiredness and fatigue and identification of cases of chronic fatigue	-	1	-	-	1	-		

General health (eg. SF12, GHQ-12)	-	-	-	1	\checkmark	-
Health symptoms in the past month	-	-	-	1	\checkmark	-
Neuropathic symptoms in the past month	-	-	-	\checkmark	\checkmark	-
Diagnosed medical conditions	-	1	-	\checkmark	\checkmark	-
Prescribed medication in past month	-	1	-	1	\checkmark	-
Hospitalisations in past 12 months	-	-	-	\checkmark	\checkmark	-
Days in bed or at home due to health in past two weeks	-	-	-	\checkmark	\checkmark	-
Reproductive outcomes	-	-	-	\checkmark	\checkmark	-
Stressful life events	-	-	\checkmark	\checkmark	\checkmark	1
Symptoms of PTSD	-	-	\checkmark	\checkmark	\checkmark	-
Smoking history	-	-	-	\checkmark	\checkmark	-
Alcohol use history	-	-	\checkmark	\checkmark	\checkmark	1
Diet and exercise	-	-	-	-	\checkmark	-
Health service use and visits to health professionals	-	-	-	-	\checkmark	-
Injuries in the past 12 months; activity, health service use, impairment	-	-	-	-	\checkmark	-
Pain	-	-	-	-	\checkmark	-
Symptoms of depression	-	-	-	-	\checkmark	-
Irritable Bowel Syndrome (Rome III)	-	-	-	-	\checkmark	-
Sleep pattern and sleepiness	-	-	-	-	\checkmark	-
Risk evaluation	-	-	-	-	\checkmark	-
Symptom Interpretation	-	-	-	-	\checkmark	-
Demoralization Scale	-	-	-	-	\checkmark	-
Suicidal ideation	-	-	-	-	\checkmark	-
Resilience	-	-	-	-	\checkmark	-
Quality of life and life satisfaction	-	-	-	-	\checkmark	-
Social health including social support, group participation and involvement with ex-service organisations	-	-	-	-	\checkmark	-
Financial strain	-	-	-	-	\checkmark	-
Homelessness	-	-	-	-	\checkmark	-
Convictions and Incarcerations	-	-	-	-	✓	-

8.4 Appendix 4 Participant questionnaire



Gulf War Veterans' Health Study - 2011 Follow Up PARTICIPANT QUESTIONNAIRE



HMAS *Brisbane*, HMAS *Adelaide*, HMAS *Success*, HMAS *Darwin* and HMAS *Sydney* in the Gulf of Oman (Photo: LSPH Kym Degener)



HMAS *Brisbane* Gulf Deployment (Photo: Navy PR)



Preparing against a chemical warfare threat. (Photo: Navy PR)
THANK YOU

for participating in the Gulf War Veterans' Health Study 2011 Follow Up

Please read the following instructions for completing the questionnaire

- 1. It is important that you have read and signed the Consent Form that accompanied this questionnaire.
- 2. Please be sure to read each question and its instructions very carefully.
- 3. Unless directed otherwise, EVERY question should be completed if possible. Please choose the best available response to each question, even if there is not one that suits perfectly. Some parts of the questionnaire may seem repetitive, but each section has it's own unique purpose.
- 4. Please use **BLACK OR BLUE PEN ONLY** to complete the questionnaire. If you make a mistake simply cross it out and clearly mark the correct answer.
- 5. When completing the questionnaire please place crosses 🕱 in the boxes. Please do NOT circle the boxes 🗌
- 6. Alternatively, when required, please write clear numbers in the number boxes provided.





7. If you have any questions please call the Monash University research team on 1800 729 913. Please call any time during business hours, Eastern Standard Time, Monday to Friday, or leave a message outside of these hours.

SUPPORT

If you find completing this questionnaire distressing in any way you can talk to someone about it. Please consider:

- Lifeline 13 11 14
- Defence All Hours Support Line (AHSL) 1800 628 036
- Veterans and Veterans' Families Counselling Service (VVCS) 1800 011 046

SECTION A - BACKGROUND INFORMATION

Please provide some information about your personal or demographic details and how these have changed since 1st January 2001.

A1.	What is your date of birth? DDMMM	YYYY
A2.	What is your <u>current</u> marital status? Choose one 1 Married or de facto 2 Divorced 3 Separated but not divorced 4 Widowed	 Never married Other (please specify)
A3.	Since 1 st January 2001, has your marital status <u>ch</u> Select all that apply Since 1 st January 2001 I have: Not changed my marital status	nanged? Been widowed
	 Married, or started living with a partner Divorced Separated but not divorced 	Other <i>(please specify)</i>
Α4.	Which category best describes the highest educa Choose one 1 Secondary school up to grade 10	 ational qualification you have <u>completed</u>? Undergraduate degree Post-graduate degree Other (please specify)
A5.	Since 1 st January 2001 have you had a period of u I No 2 Yes	unemployment greater than 3 months? period of unemployment 1 No 12 Yes ealth problems?
A6.	What is your main source of income now? Choose one 1 Wage or salary 2 Child allowance 3 Dividends/interest/income from investments 4 Superannuation/annuity 5 Own business or share in a partnership	 DVA-provided pension/income support Other government pension/allowance/benefit Other (<i>please specify</i>)

Y Y Y Y Y Y Y Y

 B4. Have you been on an ADF operational deployment since 1st January 2001? (war-like, peace operations, peacekeeping, peace-monitoring, or humanitarian support) This does not include training exercises or good will visits (flying the flag).

1 Yes 2 No, If NO please go to **Section C** on page 6.

B5. If YES to B4 on previous page, please indicate which of the following major Operations you have been deployed on since <u>1st January 2001</u>? (please complete as much information as you can).

Note: We ask whether you were involved in a combat role for each deployment. For the purpose of this question <u>a combat role has been defined as either</u>:

- during deployment your main duties were any of combat (e.g. Infantry, Artillery, etc), Security, Training local police / army, Oil platform protection, Clearance diver, Boarding party, EOD (Bomb disposal, IED Technician) + Engineering Source OR
- during deployment you had experiences such as coming under fire; discharging own weapon; being in a threatening situation and unable to respond; potential for combat exposure (e.g. experienced in-direct fire), went on combat patrols or missions, feared you had been exposed to a contagious disease, toxic agent or injury (e.g. radioactivity, HIV, or chemical warfare); in danger of being killed or injured; handled/ saw dead bodies; there were casualties among people close to you; you were witness to human degradation and misery; your own actions or inactions resulted in injury or death to others.

Country	Operation name	Year your deployment/s started	Number of times deployed in that year	Total time deployed in MONTHS in that year	Combat role (select if YES)					
Afghanistan		2001								
supporting operations in		2002								
Afghanistan		2003								
							2004			
		2005								
		2006								
		2007								
		2008								
		2009								
				2010						
		2011								
Iraq or areas	OP BASTILLE	2001								
operations in Iraq	rting tions	2002								
	☐ 1 OP FALCONER	2003								

Country	Operation name	Year your deployment/s started	Number of times deployed in that year	Total time deployed in MONTHS in that year	Combat role (select if YES)
☐ Iraq or areas		2003			
operations in Iraq	CATALIST	2004			
		2005			
		2006			
		2007			
		2008			
		2009			
	□ 1 OP KRUGER	2009			
		2010			
		2011			
Solomon		2003			
ISIAIIUS		2004			
		2005			
		2006			
		2007			
		2008			
		2009			
		2010			
		2011			
□ ₁ Bougainville	OP BEL ISI II	2001			
		2002			
		2003			

Country	Operation name	Year your deployment/s started	Number of times deployed in that year	Total time deployed in MONTHS in that year	Combat role (select if YES)
□ 1 East Timor		2001			
	TANAGER	2002			
	☐ 1 OP CITADEL	2002			
		2003			
		2004			
	OP SPIRE	2004			
		2005			
	☐ 1 OP ASTUTE, OP CHIRON, OP TOWER	2005			
		2006			
		2007			
		2008			
		2009			
		2010			
		2011			

B6. Since 1st January 2001 what other war like, peace operations, peacekeeping, peace-monitoring or humanitarian support operations have you been deployed on, including assisting the Multinational Force and Observers (e.g. OP Mazurka) or UN missions (e.g. OP Palate, OP Riverbank, OP Azure), Humanitarian Missions (e.g. OP Sumatra Assist, OP Pakistan Assist), secondments to foreign militaries (e.g. OP Enduring Freedom, OP Herrick) and border protection (e.g. OP Resolute)? If none, skip to Section C on the next page.

Country	Operation name	Year your deployment/s started	Number of times deployed in that year	Total time deployed in MONTHS in that year	Combat role (select if YES)

SECTION C - CIVILIAN EMPLOYMENT

C1. Since 1st January 2001, have you held any civilian (non-ADF) jobs for more than 3 months?

 \Box_2 Yes \rightarrow Please complete the table below. □ 1 No → Please go to C2 over the page.

provided. Please include any jobs where you may have been contracted back to an ADF-related work place or Operation. Please start with any non-ADF job you had in January 2001 and add new jobs in order. **Please estimate what year you started each job and the number of years and months you held that job**. It may be useful to refer to your personal records, such as an old copy of a resume, to remind you about jobs which you may have forgotten. For every job that you have held outside of the ADF for 3 months or more since 1st January 2001, please complete the table below. There are some examples

4 8	4 8		4 8
4 <i>O</i>	4 <i>O</i>		(7 (M)
Je Ce	Scie R tech	N/A	Science & technology
S:	ZS	N/A	CSIRO
Materials fatiguet-stin	Manag erials ?. Unit, n 'lied' a	/m	r unaging Materials Science Unit, some applied research
Materials engineer	ber tinl	Lear withou mily t	nunger
4 yrs 4 mo	S yrs O mo	O sır	2 Jrs 6
Y 9 9 9	V V V X	3005	2004

Your civilian jobs held for more than 3 months since January 2001

ss	s	ss	s	ss
<i></i>	<i>x</i>	<i>א</i> ע	<i>x</i>	
ΥΥΥ	ΥΥΥ	ΥΥΥ	ΥΥΥ	ΥΥΥ
\succ	\succ	\succ	\succ	\succ

No. of weeks per year							
No. of hours per week							
Country (if not Australia)							
Industry							
Employer							
Main job duties							
Job Title							
Duration job held (years and months)	Jrsmo	yrs mo	om no	Jrs	yrs mo	yrs mo	yrsmo
Year started	$\gamma \mid \gamma \mid \gamma \mid \gamma$	YYYY	YYYY	YYYY	YYYY	YYYY	<u>Υ Υ Υ Υ</u>

- C2. Since January 2001, have you done any of the following types of <u>voluntary work</u> for emergency service, community welfare, health or humanitarian aid organisations?
 Choose all that apply
- Search and rescue
- First aid/medical care \square
 - Fire fighting
- Counselling/supportive listening
- Overseas humanitarian aid work
 - None of the above

	SECTIO					EING		
	SECTIO	ND-F	1EALT			EING		
D1.	In general, would you say you	r health is	3:					
	1 Excellent 2 Very	good	<u></u> ₃ Go	bod	□₄ Fai	r	☐₅ Poor	
D2.	The following items are about	activities	you might	do during	a typical da	iy. Does <u>y</u>	our health	now
	IImit you in these activities?	t so, now	/ much?		Ŀ	Yes, imited a Lot	Yes, Limited a Little	No, Not Limited at All
a.	Moderate activities , such as m bowling, or playing golf	ioving a ta	able, pushi	ng a vacuui	m cleaner,	1	2	3
b.	Climbing several flights of stairs	6				1	2	3
D3.	During the <i>past 4 weeks</i> , hav daily activities <i>as a result of y</i>	e you had our phy :	d any of th sical heal t	e following <u>th</u> ?	problems v	vith your w	ork or other	regular
a.	Accomplished less than you w	ould like			🗌 1 Yes	6	2 NO	
b.	Were limited in the kind of work	or other	activities			3	2 NO	
D4.	During the <i>past 4 weeks</i> , hav	e you had	d any of th	e following	problems v	vith your w	ork or other	regular
	daily activities <u>as a result of a</u>	iny emot	<u>ionai proi</u>	<u>piems</u> (suc		g depresse		5)?
a.	Accomplished less than you w	ouid like				5		
D.		as carei	uny as usu	Iai		•		
D5.	During the <i>past 4 weeks</i> , how outside the home and housew	v much di ork)?	d <u>pain</u> inte	erfere with	your norma	l work (incl	luding both	work
	□ 1 Not at all □ 2 A litt	le bit	□ ₃ Mo	oderately	🗌 ₄ Qui	te a bit	_ ₅ Extre	emely
Thes For e	e questions are about how you ach question, please give the c	feel and one answ	how things er that con	s have bee nes closes	n with you o t to the way	during the , you have	<u>past 4 wee</u> been feeling	<u>ks</u> . J.
D6.	How much of the time during t	he <u>past</u> ∡	4 weeks.					
			All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
a.	Have you felt calm and peaceful	?	1	2	3	4	5	6
b.	Did you have a lot of energy?		1	2	3	4	5	6
C.	Have you felt down?		1	2	3	4	5	6
D7.	During the <i>past 4 weeks</i> , how interfered with your social acti	v much of vities (like	the time h visiting w	as your p h ith friends,	relatives, e	<u>Ith or emc</u> etc.)?	otional prol	<u>plems</u>
	All of 2 Mos	t of Fime	₃ Sc	ome of Time	□₄ A lit	ttle of Time	₅ Non the]	e of Time
SF-12 Outcor	® Health Survey © 1994, 2000 QualityM nes Trust (MOT). (SF-12 Australia/New	letric Incorp Zealand Sta	orated – All ri Indard Versio	ghts reserved n 1.0.)	. SF-12 ® is a	registered trad	demark of the N	ledical
D8.	How much bodilv pain have v	ou had d	urina the r	ast 4 wee	ks?			
	$\square_1 \text{ None } \square_2 \text{ Very mile}$		Mild	4 Mod	erate 🗋 ₅	Severe	G Very	/ severe
			•					
			ð					

D9. We would like to know how your health has been in general over <u>the past few weeks</u>. Choose the answer which you think most nearly applies to you.

	Have you recently:						
a. been able to concentrate on whatever you're doing?							
	☐ 1 Better than usual	\square_2 Same as usual	$\Box_{\mathfrak{z}}$ Less than usual	☐ ₄ Much less than usual			
	b. lost much sleep over wo	orry?					
	☐ 1 Not at all	2 No more than usual	☐ ₃ Rather more than usual	☐ ₄ Much more than usual			
	c. felt that you are playing	a useful part in things?					
	☐ ₁ More so than usual	\square_2 Same as usual	☐ ₃ Less useful than usual	4 Much less useful			
	d. felt capable of making d	ecisions about things?					
	☐ 1 More so than usual	2 Same as usual	☐ ₃ Less so than usual	Much less capable			
	e. felt constantly under stra	ain?					
	☐ 1 Not at all	2 No more than usual	☐ ₃ Rather more than usual	☐ ₄ Much more than usual			
	f. felt you couldn't overcor	me your difficulties?					
	☐ 1 Not at all	2 No more than usual	☐ ₃ Rather more than usual	☐ ₄ Much more than usual			
	g. been able to enjoy your	normal day-to-day activi	ties?				
	☐ 1 More so than usual	\square_2 Same as usual	☐ ₃ Less so than usual	☐ ₄ Much less than usual			
	h. been able to face up to	your problems?					
	☐ 1 More so than usual	2 Same as usual	☐ ₃ Less able than usual	4 Much less able			
	i. been feeling unhappy a	nd depressed?					
	☐ 1 Not at all	2 No more than usual	☐ ₃ Rather more than usual	☐ ₄ Much more than usual			
	j. been losing confidence	in yourself?					
	☐ 1 Not at all	2 No more than usual	☐ ₃ Rather more than usual	☐ ₄ Much more than usual			
	k. been thinking of yoursel	f as a worthless person?)				
	□ 1 Not at all	2 No more than usual	☐₃ Rather more than usual	☐ ₄ Much more than usual			
	I. been feeling reasonably	happy, all things consid	ered?				
	☐ 1 More so than usual	About same as usual	☐ ₃ Less so than usual	☐ ₄ Much less than usual			

© David Goldberg, 1978. Published by GL Assessment Limited. The Chiswick Centre 414 Chiswick High Rd, London W4 5TF, UK. This edition published 1992. GL Assessment is part of the Granada Learning Group.

D10. Please indicate whether or not you have suffered any of the following symptoms in the *past month*, and if so, please indicate whether your symptoms were mild, moderate or severe in nature.

In the past month have you suffered from:	NO Not at all	YES Mild	YES Moderate	YES Severe
1. Chest pain	1	2	3	4
2. Headaches	1	2	3	4
3. Rapid or pounding heart beat	1	2	3	4
4. Irritability / outbursts of anger	1	2	3	4
5. Shortness of breath	1	2	3	4
6. Wheezing	1	2	3	4
7. Sleeping difficulties	1	2	3	4
8. Feeling jumpy / easily startled	1	2	3	4
9. Feeling unrefreshed after sleep	1	2	3	4
10. Fatigue	1	2	3	4
11. Double vision	1	2	3	4
12. Intolerance to alcohol	1	2	3	4
13. Itchy or painful eyes	1	2	3	4
14. Rash or skin irritation	1	2	3	4
15. Skin infections e.g. boils	1	2	3	4
16. Skin ulcers	1	2	3	4
17. Shaking	1	2	3	4
18. Tingling or burning sensation in hands or feet	1	2	3	4
19. Loss of sensation in hands or feet	1	2	3	4
20. Feeling distant or cut off from others	1	2	3	4
21. Constipation	1	2	3	4
22. Flatulence or burping	1	2	3	4
23. Stomach cramps	1	2	3	4
24. Diarrhoea	1	2	3	4
25. Indigestion	1	2	3	4
26. Dry mouth	1	2	3	4
27. Mouth ulcers	1	2	3	4
28. Toothache	1	2	3	4
29. Persistent cough	1	2	3	4
30. Lump in throat	1	2	3	4
31. Sore throat	1	2	3	4
32. Forgetfulness	1	2	3	4
33. Dizziness, fainting or blackouts	1	2	3	4
34. Seizures or convulsions	1	2	3	4
35. Feeling disorientated	1	2	3	4
36. Loss of concentration	1	2	3	4
37. Difficulty finding the right word	1	2	3	4
38. Pain on passing urine	1	2	3	4
39. Passing urine more often	1	2	3	4
40. Loss of control over bladder or bowels	1	2	3	4
41. Burning sensation in the sex organs	1	2	3	4

BLACK Pantone 2945C

In the past month have you suffered from	NO Not at all	YES Mild	YES Moderate	YES Severe
<u>In the past month</u> have you suffered nom.				
42. Loss of interest in sex	1	2	3	4
43. Problems with sexual functioning	1	2	3	4
44. Increased sensitivity to noise	1	2	3	4
45. Increased sensitivity to light	1	2	3	4
46. Increased sensitivity to smells or odours	1	2	3	4
47. Ringing in the ears	1	2	3	4
48. Avoiding doing things or situations	1	2	3	4
49. Pain, without swelling or redness, in several joints	1	2	3	4
50. Stiffness in several joints	1	2	3	4
51. General muscle aches or pains	1	2	3	4
52. Loss of balance or coordination	1	2	3	4
53. Difficulty speaking	1	2	3	4
54. Low back pain	1	2	3	4
55. Night sweats which soak the bed sheets	1	2	3	4
56. Feeling feverish	1	2	3	4
57. Tender or painful swelling of lymph glands in neck, armpit or groin	1	2	3	4
58. Loss of, or decrease in, appetite	1	2	3	4
59. Nausea	1	2	з	4
60. Vomiting	1	2	3	4
61. Distressing dreams	1	2	З	4
62. Unintended weight gain greater than 4kg	1	2	3	4
63. Unintended weight loss greater than 4kg	1	2	3	4

D11. Please indicate whether or not you have suffered any of these symptoms in the *past month*.

In the past month have you experienced:	No	Yes
1. Difficulty lifting objects above your head, or from a high shelf	1	2
2. Difficulty undoing buttons	1	2
3. Difficulty turning doorknobs or unscrewing jars	1	2
4. Difficulty getting up from sitting in a chair or couch without the use of your arms	1	2
5. Problems with tripping, or your feet slapping, while walking	1	2
6. Difficulty recognising hot from cold water	1	2
7. Difficulty feeling pain, cuts or injuries	1	2
8. Feeling unsteady walking on uneven ground	1	2
9. Feeling unsteady walking in the dark	1	2
10. Feeling like you may fall over because of your unsteadiness	1	2
11. Numbness, "asleep feeling" or prickling sensation in your hands or arms	1	2
12. Numbness, "asleep feeling" or prickling sensation in your feet or legs	1	2
13. Burning, deep aching pain or tenderness in your hands or arms	1	2
14. Burning, deep aching pain or tenderness in your feet or legs	1	2
15. Unusual sensitivity or tenderness of your skin when clothes or bedclothes rub against you	1	2
16. Feeling like you will faint, or fainting, when you stand up from a lying or sitting position	1	2
17. Difficulty swallowing food (more than occasionally)	1	2

D12. We are interested in learning more about your pain intensity and disability. For the following questions with a scale of 0-10 please place a cross in **ONE** box only. Please complete these questions regardless of whether you have pain.

U		,		•								
a. How we	ould yo	u rate yo	our pain	on a 0-1	10 scale	at the p	resent ti	ime, tha	t is <u>righ</u> a	<u>t now</u> , w	here 0	is 'no pai
and 10	is 'pair	n as bad	as could	d be'?								
	0	1	2	3	4	5	6	7	8	9	10	Pain
No pain												as bad a could b
. In the g	<u>ast 6 r</u>	<u>months</u> ,	how int	ense wa	as your v	vorst pa	in rated	on a 0-1	10 scale	where 0) is 'no p	pain' and
10 is 'p	ain as l	bad as c	ould be'	?								
	0	1	2	3	4	5	6	7	8	9	10	Pain
No pain												as bad a could b
		-	-									
c. In the p	<u>ast 6 r</u>	<u>nonths</u> ,	on the a	average	how in	tense wa	as your p	oain rate	ed on a 0	-10 scal	e where	e 0 is 'no
pain ar	10 10 IS	pain as	bad as		e?(Inat	is, your	usual pa	ain at tin	nes you	were ex	perienci	ng pain.)
Nencin	U		2	С	4	э 	0		•	9		Pain
No pain												as bad a could b
											_	
I. About h	iow ma	iny days	in the <u>Ia</u>	<u>st 6 mo</u>	nths ha	ve you b	een kep	ot from			davs	•
your us	ual acti	ivities (w	ork, scho	ool or ho	buseworl	k) becau	ise of pa	iin?				
e. In the r	oast 6 i	months.	how mu	uch has	pain inte	erfered v	vith vour	r dailv a	ctivities ı	rated on	a 0-10	scale
where) is 'no	interfere	ence' an	d 10 is '	unable t	o carry o	on any a	ictivities	??			
	0	1	2	3	4	5	6	7	8	9	10	Unable
No	e 🗌											to carr
	-											activitie
. In the p	ast 6 r	nonths,	how mu	ch has p	ain chai	nged you	ur ability	to take	part in re	ecreatior	nal, socia	al and
family a	octivities	s where	0 is 'no d	change'	and 10 i	s 'extren	ne chang	ge'?				
	0	1	2	3	4	5	6	7	8	9	10	
lo chang))											Extrem change
												5
. In the p	ast 6 i	<u>nonths</u> ,	how mu	ich pain	has cha	anged yo	our ability	y to worl	k (includi	ing hous	ework)	where 0 i
'no cha	nge' an	nd 10 is '	extreme	change'	?					-		
	0	1	2	3	4	5	6	7	8	9	10	
No change	• 🗌											Extrem
												-
Please in	dicate	below if	vou ha	ve had	pain or	tenderi	ness ov	er the n	oast 7 d	avs in a	nv of th	ne areas
isted bel	ow. Be	sure to	mark rig	ght and	left side	es sepai	rately.	-			5	
☐ Shoi	ılder I	eft		Upper	lea Left				Joper ba	ack		
	ılder F	2iaht		Unner	lea Ria	ht			ower ba	ack		
				opper					Jeck			
	er arm,	Lett		Lower	leg, Leπ						6 (1)	
	er arm,	Right		Lower	leg, Rig	nt			No pain	in any o	of these	e areas
Lowe	er arm,	Left		Jaw, Le	eft							
Low	er arm,	Right		Jaw, R	ight							
Hip,	Left			Chest								
	Riaht		\Box	Abdom	nen							
,p,												

D14. Th	nese next questions are about your respiratory health.	NO	YES
1.	 Have you had wheezing or whistling in your chest at any time in the last <u>12 months</u>? No □₂ Yes, If YES → a. Have you been at all breathless when the wheezing noise was present? b. Have you had this wheezing or whistling when you did not have a cold? 	1	2
2.	Have you been woken by an attack of coughing at any time in the last <u>12 months</u> ?	1	2
3.	Do you usually cough first thing in the morning (or getting up if on night shift)?	1	2
4.	Do you <i>usually</i> cough during the day or at night?	1	2
lf	NO to ALL of questions 2, 3 and 4 above, please skip to question 6 on this page.	NO	YES
5.	If YES to ANY of Questions 2, 3 and 4, would you have coughed like this for as much as 3 months in each of the past 2 years?	1	2
6.	Do you <i>usually</i> bring up any phlegm from your chest first thing in the morning in winter?	1	2
7.	Do you usually bring up any phlegm from your chest during the day, or at night in the □ 1 No □ 2 Yes, If YES	• winter? No 🔲 2	Yes
8.	Have you ever had asthma? □ 1 No □ 2 Yes, If YES a. Was this confirmed by a doctor? □ 1 No □ 2 Yes b. At what age did it start?	No □₂ s) for asthn	Yes na?
9.	Have you <u>ever</u> had chronic bronchitis? □ No □ 2 Yes, If YES a. Was this confirmed by a doctor? □ 1 No □ 2 Yes b. At what <u>age</u> did it start?	chronic bro	onchitis?

10. Have you ever had emphysema?

⊥ 1 No L 2 Yes, If YES —				
a. Was this confirmed by a doctor?	2 Yes			
b. At what <u>age</u> did it start?	years			
c. Are you currently taking any medicine (including inha	alers, aeros	ols or tablet	s) for emph	ysema?
\square_1 No \square_2 Yes, If YES, please name them				
11. Have you ever had Chronic Obstructive Pulmonary Disease	e (COPD)?			
1 NO 2 YES, If YES				
a. Was this confirmed by a doctor?	2 Yes			
b. At what <u>age</u> did it start?	years			
c. Are you currently taking any medicine (including inh	alers aeros	ols or tablet	s) for COPF)?
\square_1 No \square_2 Yes, If YES, please name them				
We are interested in your sleep patterns, tiredness	and experi	ences of fa	atigue.	
D15. Please rate your current sleeping pattern (i.e. last 2 weeks).	Mild	Moderate	Severe	Very severe
a. Difficulty falling asleep	2	3	4	5
b. Difficulty staying asleep	2	3	4	5
c. Problem waking up early	2	3	4	5
D16 How extisting /dispatisfied are you with your current sloop pr	attorn?			
\square Very satisfied \square . Satisfied \square . Neutral		satisfied	🗌 . Ver	v dissatisfie
		Satisfied		y dissatishe
D17. We would like to know more about any problems you have h	had with fee	ling tired, v	weak or lac	king in
energy <u>In the last month.</u> Please answer all the questions to you most closely. If you have been feeling tired for a long wh	by selecting	the answe	er which ap	plies to
when you were last well.		No moro	Moro	
	than usual	than usual	than usual	than usual
a. Do you have problems with tiredness?	1	2	3	4
b. Do you need to rest more?	1	2	3	4
c. Do you feel sleepy or drowsy?	1	2	3	4
d. Do you have problems starting things?	1	2	3	4
e. Do you lack energy?	1	2	3	4
f. Do you have less strength in your muscles?	1	2	3	4
g. Do you feel weak?	1	2	3	4
h. Do you have difficulty concentrating?	1	2	3	4
i. Do you make slips of the tongue when speaking?	1	2	3	4
j. Do you find it more difficult to find the correct word?	1	2	3	4
	Better than usual	No worse than usual	Worse than usual	Much worse than usual
k. How is your memory?				Π.
		L 2		4

C	018. Ho sit	ow likely are you to doze off or fall asleep in the following uations, in contrast to feeling just tired?	Would never doa	Slight chance of dozing	Moderate chance of dozing	High chance of dozing
	a. Si	tting and reading	1	2	3	4
	b. W	atching TV	1	2	3	4
	c. Si	tting, inactive in a public place (eg. Theatre, meeting)	1	2	3	4
	d. As	a passenger in a car for an hour without a break	1	2	3	4
	e. Ly	ing down to rest in the afternoon when circumstances permit	1	2	3	4
	f. Si	tting and talking to someone	1	2	3	4
	g. Si	tting quietly after a lunch without alcohol	1	2	3	4
	h. In	a car, while stopped for a few minutes in the traffic	1	2	3	4
	©I	VI.W. Johns 1990-97	_			
)19. a.	In the past 12 months, have you experienced extreme tiredness or fatigue following your normal activities?	1	No, go to D2 Yes, answer	0 the next qu	estion
	b.	In the past 12 months, have you felt extremely tired or fatigued following your normal activities every day, or almost every day, for <u>one month or longer</u> ?	1 2	No, go to D2 Yes, answer	0 the question	ns below
	C.	When did this feeling of being extremely tired or fatigued <u>first</u> begin? <i>Record month and year</i>		M	YYY	Υ
	d.	When did you last experience this feeling of being extreme tired or fatigued? <i>Record the month and year. If still present,</i> <i>the current month and year.</i>	ely <i>record</i>	MM	YYY	Y
	e.	Has this feeling of being extremely tired or fatigued been <i>present continuously</i> over this period or has it tended to <i>relapse and recur</i> ?	1	Present cont Relapsed an	inuously d recurred	
	f.	How many months in total have you experienced this extrem	e tirednes	s or fatigue?	M	M
	g.	What was the longest period of time you experienced it for	? (months	5)	M	M
	h.	When did this longest period of time begin? <i>Record month and year</i>		MM	YYY	Y
	i.	Have you seen a medical doctor about this extreme tiredness or fatigue?	1 2	NO, go to D2 YES, answer	20 r the next qu	uestion
	j.	In what year did you first see a medical doctor about this extreme tiredness or fatigue?			YYY	Y
	k.	Did the doctor find a cause for the extreme tiredness or fatig	gue?			
		\square_1 No \square_2 Yes, please specify cause if known				

l

D20	Over the <i>last 2 weeks</i> , how often have y by any of the following problems?	you be	een bothered	Not at all	Several days	More than half the days	Nearly every day
а	Little interest or pleasure in doing things			1	2	3	4
b	Feeling down, depressed, or hopeless			1	2	3	4
C	Trouble falling or staying asleep, or sleeping	ng too	much	1	2	3	4
d	Feeling tired or having little energy			1	2	3	4
е	Poor appetite or overeating			1	2	3	4
f.	Feeling bad about yourself—or that you ar yourself or your family down	re a fa	ilure or have let	1	2	3	4
g	Trouble concentrating on things, such as r or watching television	eadin	g the newspaper	1	2	3	4
h	Moving or speaking so slowly that other pennoticed. Or the opposite—being so fidgety have been moving around a lot more than	eople (or res usual	could have stless that you	1	2	3	4
i.	Thoughts that you would be better off dead in some way	d, or o	f hurting yourself	1	2	3	4
j.	If you selected any problems in the items a to do your work, take care of things at hom	a to i a ne, or	above, how <u>diffic</u> get along with otl	a <u>ult</u> have t her people	these proble e?	ems made it	for you
	□ 1 Not difficult at all □ 2 Somewhat	difficul	lt	fficult	₄ Extren	nely difficult	
D21	Listed below are conditions you may or is select the reason that <u>corresponds to I</u> Please select only one response for each of	may n how y condit	ot have ever ex ou might expla ion	perienceo <i>in that c</i>	d. For each ondition	condition,	please
	 If I had a <u>prolonged headache</u>, I would probably think that it is because: 	1 2 3	I am emotionally There is someth A loud noise, brig	r upset ing wrong ght light oi	with my mu	scles, nerve else has irrit	s or brain ated me
	 If I was <u>sweating a lot</u>, I would probably think that it is because: 	1 2 3	I must have a fe I'm anxious or r The room is too	ever or inf nervous warm, l'm	ection overdressed	d or working	too hard
	3. If I got <u>dizzy all of a sudden</u> , I would probably think it is because:	1 2 3	There is someth I am not eating I must be under	iing wrong enough o [.] a lot of s	y with my he r I got up too tress	art or blood o quickly	pressure
	4. If I noticed my mouth was dry, I would probably think that is because:	1 2 3	I must be scare I need to drink r There is someth	d or anxio more liqui ning wron	ous about so ds g with my sa	omething alivary gland	ds
	 If I felt my heart <u>pounding in my chest</u>, I would probably think that this is because: 	1 2 3	l've exerted my I must be really There must be s	self or dru excited o something	ink a lot of c r afraid g wrong with	coffee n my heart	
	 If I felt <u>fatigued</u>, I would probably think that it is because: 	1 2 3	I'm emotionally I've been over e I'm anaemic or	exhauste exerting m my blood	d or discour iyself or not is weak	aged exercising	enough
	 If I noticed my <u>hand trembling</u>, I would probably think that it is because: 	1 2 3	I might have so I'm very nervou I've tired the mu	me sort o s ıscle in m	f neurologica y hand	al problem	
	 If I had <u>trouble sleeping</u>, I would probably think that it is because: 	1 2 3	Some kind of pa I'm not tired or I I'm worrying too	in or physi had too i much or l	cal discomfo nuch coffee must be ner	rt is keeping ∘ ∿ous about	me awake something

If my <u>stomach was upset</u>, I would probably think that it is because:	$ \begin{array}{c} 1 \\ 2 \\ 1 \\ 2 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\$	e worried m ave the flu c	yself sick or stomach i	rritation	agroo with	mo
10. If Liest my appetite, Lwould probably			thing to eat			me
think that it is because:	∐ 1 I ha as	ave been ea much food	ating too mu as before	ch or my be	ody doesn't	need
	\square_2 I'm \square_3 I ha	worrying so ave some s	much that foo tomach or ir	od just does itestinal pro	n't taste good oblem	d anymore
 If I had <u>a hard time catching my</u> <u>breath</u> I would probably think that it is because: 	□ 1 My □ 2 The □ 3 I'm	lungs are co e room is st over excite	ongested from tuffy or there ed or anxious	n infection, ir e is too muc s	ritation or he h pollution	art trouble in the air
12. If I noticed numbness or tingling in	□₁ ľm	under emot	tional stress			
my hands or feet, I would probably think that it is because:	2 The	ere is somet	hing wrong w	ith my nerv	es or blood o	circulation
	∐ ₃ I ar	m cold or my	/ hand or foot	went to sle	ер	
13. If I was <u>constipated or irregular,</u> I would probably think that it is		ere is not ei	nough fruit c on is koonin	or fibre in m	y diet	ar
because:		ere is some	thing wrong	with my bo	owels or inte	estine
	alour io to			hoolth pro	blomo	
that people sometimes	have wi	th their sto	e about the mach and i	nealth pro	opiems	
 D22. 1. In the last 3 months, how often did you have discomfort or pain anywhere in your abdomen? 2. For women: Did this discomfort or pain of the d	Never, go t Less than o Dne day a Two to thre Doccur only	o D23 on th one day a m month ee days a mo	e next page nonth onth lo30	☐ ₅ One ☐ ₅ More ☐ ⁊ Ever	e day a week e than one d ry day oly because	ay a week I have
during your menstrual bleeding and not o	other times	s? 🗋 2 Y	′es ha	ad menopau	use or I am a	a male
3. Have you had this discomfort or pain 6 n	nonths	🗌 1 N		es		
or longer?		Never or rarely	Sometimes	Often	Most of the time	Always
4. How often did this discomfort or pain get better or stop after you had a bowel movement?		1	2	3	4	5
5. When this discomfort or pain started, dic have more frequent bowel movements?	d you	1	2	3	4	5
6. When this discomfort or pain started, dic have less frequent bowel movements?	d you	1	2	3	4	5
7. When this discomfort or pain started, we stool (bowel movements) looser?	ere your	1	2	3	4	5
8. When this discomfort or pain started, how often did you have harder stools?		— .				
Q In the last 3 menths, how often did			2	3	4	5
you have hard or lumpy stools?		1	2	3	4	5

~		Never	Seldom	Sometimes	Often	All the Time
C	over the <u>past two weeks</u> now often have you felt:					
1.	There is a lot of value in what I can offer others.	1	2	3	4	5
2.	My life seems to be pointless.	1	2	3	4	5
3.	There is no purpose to the activities in my life.	1	2	3	4	5
4.	My role in life has been lost.	1	2	3	4	5
5.	I no longer feel emotionally in control.	1	2	3	4	5
6.	I am in good spirits.	1	2	3	4	5
7.	No one can help me.	1	2	3	4	5
8.	I feel that I cannot help myself.	1	2	3	4	5
9.	I feel hopeless.	1	2	3	4	5
10.	I feel guilty.	1	2	3	4	5
11.	I feel irritable.	1	2	3	4	5
12.	I cope fairly well with life.	1	2	3	4	5
13.	I have a lot of regret about my life.	1	2	3	4	5
14.	Life is no longer worth living.	1	2	3	4	5
15.	I tend to feel hurt easily.	1	2	3	4	5
16.	I am angry about a lot of things.	1	2	3	4	5
17.	I am proud of my accomplishments.	1	2	3	4	5
18.	I feel distressed about what is happening to me.	1	2	3	4	5
19.	I am a worthwhile person.	1	2	3	4	5
20.	I would rather not be alive.	1	2	3	4	5
21.	I feel sad and miserable.	1	2	3	4	5
22.	I feel discouraged about life.	1	2	3	4	5
23.	I feel quite isolated or alone.	1	2	3	4	5
24.	I feel trapped by what is happening to me.	1	2	3	4	5

D23. For each statement below, indicate how strongly the statement has applied to you.

D24. For each item, please choose the box that best indicates how much you agree with the following statements as they apply to you over the <u>last month</u>. If a particular situation has not occurred recently, answer according to how you think you would have felt.

	Not true at all	Rarely true	Sometimes true	Often true	True nearly all the time
a. I am able to adapt when changes occur.	1	2	3	4	5
b. I can deal with whatever comes my way.	1	2	3	4	5
 c. I try to see the humorous side of things when I am faced with problems. 	1	2	3	4	5
d. Having to cope with stress can make me stronger.	1	2	3	4	5
 e. I tend to bounce back after illness, injury or other hardships. 	1	2	3	4	5
 f. I believe I can achieve my goals, even if there are obstacles. 	1	2	3	4	5
g. Under pressure, I stay focused and think clearly.	1	2	3	4	5
h. I am not easily discouraged by failure.	1	2	3	4	5
 I think of myself as a strong person when dealing with life's challenges and difficulties. 	¦h₁	2	3	4	5
j. I am able to handle unpleasant or painful feelings lik sadness, fear and anger.	e 🔄 1	2	3	4	5

Copyright © 2001, 2003, 2007 by Kathryn M. Connor, M.D. and Johnathon R.T. Davidson, M.D.

conditions since January 2001. If YES, please indicate the year you were first diagnosed, whether you have been treated by a medical doctor This could include medications requiring a prescription or other medications brought 'over the counter' such as Ventolin, Aspirin, and Voltaren. D29. We would like to know whether a medical doctor has diagnosed you with, or treated you for, any of the following medical problems or Name of medication(s) for this condition in the past year, and whether you have taken any medications for the condition in the past month Yes Yes □² Yes □ ² Yes □ ₂ Yes Yes Yes □ ² Yes Medication taken in past month □ ₂ Yes ہ م 5 2 5 \Box_2 Yes □² Yes □ 2 Yes If you require support in relation to any issues you have identified in this questionnaire, No L ° Z ° Z ۰ ۲ °N N ° N ۰ ۲ °N − _ _ _ _ _ No _ ^ _ No -No Yes Yes Yes □ ² Yes Yes □ 2 Yes □ 2 Yes □ 2 Yes we encourage you to refer to the support services listed on the inside cover. in the past year If YES **Treated by** ~ ~ ~ 5 a doctor D25. In the past 12 months, have you ever felt that life is not worth living? ٩ ° Z ° Z ٥ ٥ ٥ ° Z No -D26. In the past 12 months, have you ever felt so low that you thought _____ ____ _ _ _ _ diagnosed D27. In the past 12 months, have you made a suicide plan? <u>Year</u> D28. In the past 12 months, have you attempted suicide? 5 7 5 5 5 2 5 5 Yes ---____ ____ _ _____ ٩ ____ Has a medical doctor diagnosed you Heart attack / Myocardial infarction with, or treated you for, any of the conditions since January 2001? following medical problems or about committing suicide? Heart failure / Cardiac failure High blood pressure High cholesterol Migraines Epilepsy Angina Stroke <u>.</u> 2. ц 4 ю. <u>ن</u> ω с.

Ĩ	as a medical doctor diagnosed you				If YES		
	with, or treated you for, any of the following medical problems or conditions since January 2001?	No	Yes	<u>Year</u> diagnosed	Treated by a doctor in the <u>past year</u>	Medication taken in <u>past month</u>	Name of medication(s)
ெ	Motor neurone disease	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
10.	Multiple sclerosis	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
.1	Pneumonia	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
12.	Stomach or duodenal ulcers	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
13.	Colitis / Crohn's disease	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
14.	Functional dyspepsia	-		YYYY	□ 1 No □ 2 Yes	□ 1 No □ 2 Yes	
15.	Hepatitis	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
16.	Cirrhosis of the liver	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
17.	Polyp/s in the bowel	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
18.	Kidney disease e.g. stones, infection, bleeding	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
19.	Bladder disease e.g. infection, bleeding	-		Y Y Y Y	□ 1 No □ 2 Yes	1 No 2 Yes	
20.	Diabetes	-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	
21.	Temporomandibular Joint (TMJ) Dysfunction	-		YYYY	□ 1 No □ 2 Yes		
22.	Traumatic Brain Injury	-		YYYY	□ 1 No □ 2 Yes	□ 1 No □ 2 Yes	
23.	Fibrositis or fibromyalgia	-		YYYY	□ 1 No □ 2 Yes	1 No 2 Yes	

На	as a medical doctor diagnosed you					If YES		
	with, or treated you for, any of the following medical problems or conditions since January 2001?	No	Yes	<u>Year</u> diagnosed	Trea a d in the J	ted by octor <u>oast year</u>	Medication taken in <u>past month</u>	Name of medication(s)
24.	Eye or vision problems e.g. glaucoma	-	7	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
25.	Sinus problems	-	3	Y Y Y Y	, No	□ ₂ Yes	1 No 2 Yes	
26.	Hearing loss	-	5	Y Y Y Y	¹ No	□ ₂ Yes	1 No 2 Yes	
27.	Dermatitis	-	7	YYYY	no No	□ ₂ Yes	1 No 2 Yes	
28.	Eczema	-	7	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
29.	Psoriasis	-	5	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
30.	Malignant melanoma	-	³	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
31.	Other skin cancer e.g. squamous cell or basal cell skin cancers	-	7	YYYY	PNO -	□ ₂ Yes	1 No 2 Yes	
32.	Other kind of cancer, tumour or malignancy <i>(please specify type)</i>	-		YYYY	N L		□ 1 No □ 2 Yes	
33.	Chronic Fatigue Syndrome	-	2	YYYY	, No	□ ₂ Yes	□ 1 No □ 2 Yes	
34.	Impotence	-	3	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
35.	Alcohol abuse or dependency	-	7 7	Y Y Y Y	, No	□ ₂ Yes	1 No 2 Yes	
36.	Drug abuse or dependency	-	5	YYYY	, No	□ ₂ Yes	1 No 2 Yes	
37.	Anxiety or stress	-	7	YYYY	, No		1 No 2 Yes	

Ĩ	ss a medical doctor diagnosed vou					If YES					
	with, or treated you for, any of the following medical problems or conditions since January 2001?	° Z	Yes	<u>Year</u> diagnosed	Tre a in the	ated by doctor <u>past year</u>		ledication taken in <u>ast month</u>	Name	e of medication(s)	
38.	Depression	-		YYYY	, No			Vo 🗌 2 Yes			
39.	Post Traumatic Stress Disorder	-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	γγγγ	, No	□ ₂ Yes	- -	Vo 🗌 2 Yes			
40.	Other psychiatric or psychological condition needing treatment or counselling <i>(please specify)</i>	-		γγγγ	°2 □	□² Yes		vo □₂ Yes			
41.	Sleep apnoea	-		YYYY	S N	□ ₂ Yes		Vo 🗌 2 Yes			
42.	Multiple chemical sensitivity	-		YYYY	• •			Vo 🗌 2 Yes			
43.	Carpal tunnel syndrome	-		YYYY	P N	□ ₂ Yes		Vo 🗌 2 Yes			
44.	Osteoporosis	_	5	YYYY	No No	□ ₂ Yes		Vo 🗌 2 Yes			
45.	Osteoarthritis	-	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	YYYY	° - D	□ ₂ Yes	-	Vo 🗌 2 Yes			
J¥ ∎	ES to doctor diagnosed or treated ostec Neck	arthrit	is, pleε Hand	ase indicate mair	n body sit oack	e/s that this	has been	a problem at: e	□ Feet	Other	
46.	Rheumatoid arthritis			YYYY	P N N		-	Vo			
¥ ₩	ES to doctor diagnosed or treated rheur Neck Shoulder Elbow	natoid	arthriti Hand	is, indicate main	body site oack	/s this has b □ Hip	een a pro	bblem at: e 🛛 Ankle	□ Feet	Other	
47.	Other inflammatory arthritis e.g. ankylosing spondylitis, psoriatic, Reiter's	-	7	YYYY	۰ ۲			Vo 🔲 2 Yes			
, ₹	ES to doctor diagnosed or treated infl Neck	amma	tory ar Hand	thritis, indicate	main boc back	ly site/s this □ Hip	has bee Kne	n a problem at: e		Other	

Has a medical doctor diagnosed vou				If YES		
with, or treated you for, any of the following medical problems or conditions since January 2001?	No No	les	<u>Year</u> diagnosed	Treated by a doctor in the <u>past year</u>	Medication taken in <u>past month</u>	Name of medication(s)
48. Gout			YYYY	🗌 1 No 🔲 2 Yes	□ 1 No □ 2 Yes	
If YES to doctor diagnosed or treated gout,	indicate	e main land	body site/s this	has been a problem a Jack	t: Mnee Ankle	Feet Other
49. Other musculoskeletal condition, specify	, r		γγγ	🗌 1 No 🔲 2 Yes	□ 1 No □ 2 Yes	
If YES to doctor diagnosed or treated musc	uloskele H	etal co land	ndition, indicate	main body site/s this hack Direction	as been a problem at: ☐ Knee	Feet Other
Please list <u>any other</u> medical problems or o	onditions	s whic	h a medical doct	or has diagnosed you	with, or treated you for, si	nce January 2001?
			YYYY	1 No 2 Yes	□ 1 No □ 2 Yes	
			Y Y Y Y	1 No 2 Yes	□ 1 No □ 2 Yes	
			Y Y Y Y	□ 1 No □ 2 Yes	□ 1 No □ 2 Yes	
			YYYY	🗌 1 No 🔲 2 Yes	□ 1 No □ 2 Yes	
D30. During the past twelve months ha	ve you	been	hospitalised ov	ernight or longer bec	ause of illness or injur	ن
□ ₁ No □ ₂ Yes If YES, please specify <u>why</u> and for <u>hc</u>	w many	v days				
1 st hospitalisation in past 12 months			tays	Why?		
2 nd hospitalisation in past 12 months			fays	Why?		
3^{rd} hospitalisation in past 12 months			tays	Why?		
4 th hospitalisation in past 12 months			davs	Whv?		

D31. <u>Excluding any time spent in hospital</u>, have you visited any of the following or consulted any of these health professionals for your <u>own health</u> in the <u>past 12 months</u>?

a. Outpatients section of a hospital	1 NO	2 Yes
b. Casualty or emergency ward	1 NO	2 Yes
c. Day clinic for minor surgery or diagnostic tests other than X ray	1 NO	2 Yes
d. General practitioner	1 No	2 Yes
e. Specialist doctor	1 NO	2 Yes
f. Dentist or dental professional	1 No	2 Yes
g. Accredited counsellor	1 NO	2 Yes
h. Alcohol and drug worker	1 NO	2 Yes
i. Psychologist	1 NO	2 Yes
j. Social worker/welfare officer	1 No	2 Yes
k. Physiotherapist/hydrotherapist	1 NO	2 Yes
I. Chiropractor	1 No	2 Yes
m.Osteopath	1 NO	2 Yes
n. Diabetes educator	1 No	2 Yes
o. Dietician/Nutritionist	1 NO	2 Yes
p. Naturopath	1 No	2 Yes
q. Audiologist/Audiometrist	1 NO	2 Yes
r. Other, please specify type of health professional	☐ 1 No	2 Yes

D32. In the past <u>two weeks</u>, how many times have you consulted the following health professionals? Write "0" (zero) if you have not consulted one of these health professionals in the past two weeks.

a. General Practitioner

b. Specialist doctor

times
times

D33. Thinking back over the past <u>two weeks</u>, did you stay in bed or at home all or part of any day because you did not feel well or as a result of illnesses or injury?

1 No 2 Yes

- D34. We would now like to ask you some questions about your pregnancy history (if you are female) or that of your spouse/partner/s (if you are male). You may need to refer to your spouse/partner/s, or to your Child Health Record, to assist you in answering these questions.
 - 1. Have you been pregnant or fathered a pregnancy (including miscarriages, ectopic pregnancies or terminations) since January 2000?
 - **No**, please go to **question 2** on the next page.
 - **Yes**, please complete the following table for each of your pregnancies that have occurred since January 2000. For pregnancies involving twins, triplets or more, use a column for each baby.

		1⁵ ^t pregnancy	2 nd pregnancy	3 rd pregnancy	4 th pregnancy
	Live birth	1	1	1	1
	Live birth but baby died within 28 days of birth	2	2	2	2
What was the outcome	Still birth	3	3	3	з
of this pregnancy?	Ectopic pregnancy	4	4	4	4
	Miscarriage	5	5	5	5
	Termination	6	6	6	6
	Currently pregnant	7	7	7	7
Month / Year of pregnancy outcome?		M M Y Y Y Y			
How many weeks was the pregnancy?		weeks	weeks	weeks	weeks
Baby's sex		 1 Male 2 Female 3 Unknown 	 1 Male 2 Female 3 Unknown 	 1 Male 2 Female 3 Unknown 	 1 Male 2 Female 3 Unknown
If this pregnancy resulted in a live birth, what was the birth weight?		grams	grams	grams	grams

- 2. Since January 2000, have you and your partner experienced difficulties getting pregnant despite trying for at least 12 months?
 - \square_1 No, please go to **Section E** on the next page.

a. What year did those di	fficulties getting pregnant begi	n?	YYYY year
b. Have you sought or ur	ndertaken infertility treatment?	1 NO	2 Yes
c. If YES, were any cause	es for your infertility found?	1 No	Yes, please specify
d. Have you managed to	get pregnant or father a pregn	ancy since the	en?

 \square_1 No \square_2 Yes \longrightarrow Which year?

YYYY

SECTION E - INJURY

The following questions ask you about *injuries* you have had in the *past 12 months* such as sprains, broken bones, burns, cuts, heavy knocks etc that were bad enough to interfere with your daily activities.

E1. How many times *in the past 12 months* have you had any injury that was bad enough to interfere with your daily activities?

0	None,	, skip to E3	on the next pag	ge. 🗌 1 Or	ie 🗌 2 Two	□ ₃ Three	□₄ Four
5	Five	🗌 6 Six	7 Seven		🗌 🤋 Nine	🗌 10 Ten or m	ore

E2. Please complete the table below in relation to the <u>*two most recent injuries*</u> in the past 12 months.

а	What was the main cause of your injury?	Most recent choose one cause)	Second most recent (choose <u>one</u> cause)
а.	Motor vohiolo – volu as driver	—	—
	Meter vehicle – you as unvei		
	Motor venicie – you as passenger	2	2
	Motor cycle – you as driver	3	3
	Motor cycle– you as passenger	4	4
	Cycling	5	5
	As a pedestrian	6	6
	Other transport related	7	7
	Struck by or collision with a person	8	8
	Struck by or collision with an object	9	9
	Firearm	10	10
	Cut or pierced by an object, e.g. knife/tool/other implement	11	11
	Machinery in operation	12	12
	Falling over (on the same level or less than 1 metre)	13	13
	Falling over (drop of 1 metre or more)	14	14
	Near drowning	15	15
	Fire, flames, or smoke	16	16
	Hot liquid, steam, gas, object or solid substance	17	17
	Poisoning - accidental or intentional overdose of medication	18	18
	Poisoning - accidental or intentional swallowing poisonous substa	nces 🔲 19	19
	Electricity	20	20
	Bite or sting	21	21
	Other injury cause, <i>please specify</i>	22	22

Good job - you are well past half way

b. What best describes the type of activity you were doing when you were injured?	Most recent (choose one activity)	Second most recent (choose <u>one</u> activity)
Working for an income - while in the ADF (incl. travel to/from we	ork) 🔲 1	1
Working for an income – not in the ADF (incl. travel to/from wor	[•] k) ²	2
Other type of work, e.g. volunteer work, housework	3	3
Sports activity	4	4
Leisure activity	5	5
Formal educational activity (student, incl. travel to and from)	6	6
Other injury cause, please specify	7	7
c. Did you attend the following for the injury	cent S	Second most recent injury

you received?		
Hospital as an inpatient	1 No 2 Yes	1 No 2 Yes
Emergency/casualty department	1 No 2 Yes	1 No 2 Yes
Outpatient clinic at hospital	🗌 1 No 🗌 2 Yes	🗌 1 No 🗌 2 Yes
General practitioner or specialist	1 No 2 Yes	1 No 2 Yes
Other health professional	🗌 1 No 🗌 2 Yes	1 No 2 Yes
d. Did you have time off work or study due to the injury?If YES, how many days did you have off work or study?	□ 1 No □ 2 Yes days	☐ 1 No ☐ 2 Yes days
e. On any other days did you cut down on anything you usually do because of the injury?	1 No 2 Yes 3 Don't know	 1 No 2 Yes 3 Don't know
f. Were you under the influence of alcohol, or any other substance, when you were injured?	☐ 1 No ☐ 2 Yes ☐ 3 Don't know	☐ 1 No ☐ 2 Yes ☐ 3 Don't know

E3. Did <u>any</u> injury you received in the <u>past 3 years</u> involve the following?

	a. Being dazed, confused or "seeing stars"?	1 No	2 Yes	
	b. Not remembering the injury?	1 No	2 Yes	
	c. Losing consciousness (knocked out)?	1 NO	2 Yes 7	
	If YES to E3.c , approximately how long were you \Box_1 less than 1 minute \Box_2 1-4 minutes	u unconsc 3 5-30	ous (knocked out) minutes	for?]₄ more than 30 minutes
E4.	How often do you have five or more 'standard' one occasion?	drinks (se	e Guide page 33)	containing alcohol on

□ 1 Never	2 Less than once	3 Monthly	🗌 4 Weekly	☐ ₅ Daily or almost daily
	a month			

SECTION F - RISK TAKING				
F1. Read each of the following statements, and along the scale of boxes shown between two ways you might feel, mark the box that best describes your feelings RIGHT NOW.				
I feel like gambling	vory much			
I am driving and the lights turn yellow, I feel like				
stopping 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20				
I don't The lights suddenly go out in an unfamiliar stairwell	I proceed			
move 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	immediately			
avoiding I feel like	taking on the world			
	21 22 23 24 25			
I feel like diving from a diving board, which is	vondow			
Very nign 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20				
l like	- 1			
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20				
the thrill I seek				
or danger				
I take a dangerous If I am in a hurry	l take a			
short-cut	safe detour			
	21 22 23 24 25			
negotiation I am open to	confrontation			
	21 22 23 24 25			
direct I prefer to	be supervised			
	21 22 23 24 25			
reason I give priority to	action			
	21 22 23 24 25			
at loud volume I like to listen to music verv softly				

not at all		completely
	I prefer discussions, which are	
animated		calm
weakens me	A hostile situation	reinforces me
1 2 3 4	5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	22 23 24 25
I confront it	A menacing dog approaches	l run away
		22 23 24 25
I take	Faced with a potentially dangerous event	l instantly
	5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	
	Seeing a person who is drowning, I first	
dive in		call for help 22 23 24 25
well planned	I prefer work that is	not planned
well planned 1 2 3 4		not planned
well planned 1 2 3 4	I prefer work that is	
well planned 1 2 3 4 all of the time 1 2 3 4	I prefer work that is 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I am right 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	not planned 22 23 24 25 never 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4	I prefer work that is 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I am right 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I am right 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	not planned 22 23 24 25 never 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4	I prefer work that is 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I am right 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I emphasise 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4	I prefer work that is	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4 very fast 1 2 3 4	Iprefer work that is 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I am right 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I emphasise 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I emphasise 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 I like to drive 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4 very fast 1 2 3 4	I prefer work that is	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4 very fast 1 2 3 4 very fast 1 2 3 4	I prefer work that is </td <td>not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 22 23 24 25 very slow 22 23 24 25 very fast 25 24 25</td>	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 22 23 24 25 very slow 22 23 24 25 very fast 25 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4 very fast 1 2 3 4 very fast 1 2 3 4	I prefer work that is 	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 22 23 24 25 very slow 24 25 22 23 24 25
well planned 1 2 3 4 all of the time 1 2 3 4 precision 1 2 3 4 very fast 1 2 3 4 very fast 1 2 3 4 not at all 1 2 3 4	I prefer work that is I am right I am phasise I like to drive I like to listen to music with a tempo that is I like to listen to music with a tempo that is I tend to take risks	not planned 22 23 24 25 never 22 23 24 25 speed 22 23 24 25 very slow 24 25 22 23 24 25 very slow 22 23 24 25 uery slow 24 25 25 uery slow 24 25 26 uery slow 25 24 25 uery slow 25 26 26 uery slow 26 27 26 uery slow 27 27

	SECTION G - LIFE EVENTS				
G1.	Over the past 12 months , have any of the following happened to you/your house shortage of money? could not pay electricity, gas or telephone bills on time could not pay for car registration or insurance on time pawned or sold something unable to heat my home sought financial help from friends or family went without meals sought assistance from welfare/community organizations no/none of the above	≥hold becaus	se of a		
G2 .	Since 1 st January 2001 have you stayed one or more nights in a homeless shelte park, or in an abandoned building?	r, on the stre	et, in a		
	No 2 Yes a. If YES, for how long in total since January 2001?				
G3.	Have you ever been convicted of a crime in a court of law (including civil court, crimilitary court)?	<i>how long</i> riminal court	or		
	since January 2001				
G4.	 34. Have you <u>ever</u> been sent to jail by a judge in a court (or spent time on remand awaiting a court hearing)? No 2 Yes a. If YES, when was this (select all that apply) and for how long in total were you in jail during the times shown below? 				
	prior to August 1990 for how long				
	between August 1990 and December 2000 for how long				
	since January 2001 for how long				
G5 .	Please answer the following questions about other very stressful events that migh your life since January 2001 .	ht have happ	bened in		
1	Since January 2001	No	Yes		
1.	member of an organised non-military group?	1	2		
2.	Did you serve as a <u>peacekeeper</u> or <u>relief worker</u> in a <u>war zone</u> or in a place where there was ongoing <u>terror</u> of people because of political, ethnic, religious or other conflicts?) 1	2		
3.	vvere you an unarmed civilian in a place where there was a war, revolution, military coup or invasion? (By this we mean a civilian not directly involved in the armed conflict)	1	2		

	Since January 2001	No	Yes
4.	Did you live as a civilian in a place where there was ongoing terror of civilians for political, ethnic, religious or other reasons?	1	2
5.	Were you a refugee – that is, did you flee from your home to a foreign country or place to escape danger or persecution?	1	2
6.	Were you kidnapped or held captive?	1	2
7.	Were you exposed to a toxic chemical or substance that could cause you serious harm?	1	2
8.	Were you involved in a life threatening automobile accident?	1	2
9.	Did you have any other life- threatening accident, including on your job?	1	2
10.	Were you involved in a major natural disaster, like a devastating flood, hurricane or earthquake?	1	2
11.	Were you in a man-made disaster, like a fire started by a cigarette, or a bomb explosion?	1	2
12.	Did you have a life threatening illness?	1	2
13.	Were you badly beaten up by a spouse or romantic partner?	1	2
14.	Were you badly beaten up by anyone <u>else</u> ?	1	2
15.	Were you mugged, held up, or threatened with a weapon?	1	2
	The next two questions are about sexual assault. The first is about rape. We define this as someone either having sexual intercourse with you or penetrating your body with a finger or object when you did not want them to, either by threatening you or by using force.		

		NO	Yes
16.	Since January 2001, did this happen to you?	1	2
17.	Other than rape, were you sexually assaulted or molested?	1	2
18.	Has someone stalked you – that is, followed you or kept track of your activities in a way that made you feel you were in serious danger?	1	2
19.	Did someone very close to you die unexpectedly; for example, they were killed in an accident, murdered, committed suicide, or had a fatal heart attack at a young age?	1	2
20.	Did you have a son or daughter who had a life threatening illness or injury?	1	2
21.	Did anyone very close to you have an extremely traumatic experience, like being kidnapped, tortured or raped?	1	2
22.	Did you see someone being badly injured or killed, or unexpectedly see a dead body?	1	2
23.	Did you <u>do</u> something that <u>accidentally</u> led to the serious injury or death of another person?	1	2
24.	Did you on purpose either seriously injure, torture or kill another person?	1	2
25.	Did you see atrocities or carnage such as mutilated bodies or mass killings?	1	2
26.	Did you experience any <u>other</u> extremely traumatic or life-threatening event that we haven't asked about yet?	1	2

If you require support in relation to any issues you have identified in this questionnaire, we encourage you to refer to the support services listed on the inside cover.

G6. Below is a list of problems that people sometimes have in response to stressful life experiences. Please read each one carefully, then select one of the responses to the right to indicate how much you have been bothered by that problem <u>in the past month</u>.

		Not at all	A little bit	Moderately	Quite a bit	Extremely
1.	Repeated, disturbing memories, thoughts or images of a stressful experience from the past?	1	2	3	4	5
2.	Repeated, disturbing dreams of a stressful experience from the past?	1	2	3	4	5
3.	Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?	1	2	3	4	5
4.	Feeling very upset when something reminded you of a stressful experience from the past?	1	2	3	4	5
5.	Having physical reactions (eg heart pounding, trouble breathing, sweating) when something reminded you of a stressful experience from the past?	1	2	3	4	5
6.	Avoiding thinking about or talking about a stressful experience from the past or avoiding having feelings related to it?	1	2	3	4	5
7.	Avoiding activities or situations because they reminded you of a stressful experience from the past?	1	2	3	4	5
8.	Trouble remembering important parts of a stressful experience from the past?	1	2	3	4	5
9.	Loss of interest in activities that you used to enjoy?	1	2	3	4	5
10.	Feeling distant or cut off from other people?	1	2	3	4	5
11.	Feeling emotionally numb or being unable to have loving feelings for those close to you?	1	2	3	4	5
12.	Feeling as if your future somehow will be cut short?	1	2	3	4	5
13.	Trouble falling or staying asleep?	1	2	З	4	5
14.	Feeling irritable or having angry outbursts?	1	2	3	4	5
15.	Having difficulty concentrating?	1	2	З	4	5
16.	Being "super alert" or watchful or on guard?	1	2	3	4	5
17.	Feeling jumpy or easily startled?	1	2	3	4	5
18.	Having strong negative beliefs about yourself, other people, or the world? (e.g. having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)	1	2	3	4	5
19.	Blaming yourself or somebody else strongly for a stressful experience from the past or for what happened after it?	1	2	3	4	5
20.	Having strong negative feelings such as fear, horror, anger, guilt or shame?	1	2	3	4	5
21.	Taking too many risks or doing things that cause you harm?	1	2	3	4	5

SECTION H - LIFE STYLE				
H1. Are you a current smoker, former smoker or have you never been a smoker?				
 Current 2 Former 3 Never, if NEVER skip to H2 If you are a <u>current</u> or <u>former</u> smoker: a. What is the average number of cigarettes you smoke/d per day? 				
b. At what age did you start smoking?				
c. If former smoker, at what age did you stop?				
d. How many years in total have you smoked, not counting periods of time when you quit smoking?				
H2. a. How often do you have a drink containing alcohol?				
Never 1 Never 2 2 Once a month 3 2 to 4 times 4 2 to 3 times 5 4 or more 6 a month 7 a week				
If Never, skip to question H3 on the next page.				
Standard Drinks Guide				
Full Strength Mid Strength Light Beer Full Strength Mid Strength Light Beer Middy/Pot* Middy/Pot* Middy/Pot* Standard Serve Beer Beer 2.7% Beer Beer 2.7% Full Strength Mid Strength Light Beer 4.9% Strength Light Beer of Sparkling 4.9% 3.5% Alc./Vol 4.9% 3.5% Alc./Vol Beer 4.9% Beer 3.5% Z.7% Wine/				
Alc./Vol 11.5% Alc/Vol				
1.5 1.5 1 22 0.9 1 1.8 7 38 375ml 340ml 30ml 700ml 60ml 100ml 180ml 750ml 4 Litres Pre-mix Alcoholic Spirit Nip Bottle Port/Sherry Standard Average Bottle Cask Wine				
Spirits Soda 40% of Spirits Glass Serve Restaurant of Wine 12% 5% Alc/Vol 5.5% Alc/Vol Alc/Vol 40% Alc/Vol 18% Alc/Vol of Wine Serve of Wine 12% Alc/Vol 12% Alc/Vol 12% Alc/Vol Alc/Vol				
* NSW, WA, ACT = Middy; VIC, QLD, TAS = Pot; NT = Handle; SA = Schooner				
b. How many 'standard' drinks (see Guide above) containing alcohol do you have on a typical day when you are drinking?				
$\square_1 \text{ 1 or } 2 \square_2 \text{ 3 or } 4 \square_3 \text{ 5 or } 6 \square_4 \text{ 7 or } 9 \square_5 \text{ 10 or more}$				
c. How often do you have six or more drinks on one occasion?				
\square_1 Never \square_2 Less than \square_3 Monthly \square_4 Weekly \square_5 Daily or almost daily				
d. How often during the last year have you found that you were not able to stop drinking once you had started?				
Image: Never Image: Less than once a month Image: Monthly once a month Image:				

	e. How often during of drinking?	g the last year have y	ou failed to do what v	was normally expecte	ed from you because
	☐ 1 Never	2 Less than once a month	☐ ₃ Monthly	☐ ₄ Weekly	Daily or almost daily
	f. How often during	the last year have yession?	ou needed a drink in	the morning to get yo	ourself going after a
	☐ 1 Never	2 Less than once a month	3 Monthly	☐ ₄ Weekly	Daily or almost daily
	g. How often during	, the last year have y	ou had a feeling of g	uilt or remorse after d	Irinking?
	☐ 1 Never	Less than once a month	3 Monthly	4 Weekly	Daily or almost daily
	h. How often during	the last year have y been drinking?	ou been unable to re	member what happe	ned the night before
	☐ 1 Never	Less than once a month	☐ ₃ Monthly	☐ ₄ Weekly	☐ ₅ Daily or almost daily
	i. Have you or som	eone else been injure	ed as a result of your	drinking?	
	1 No	2 Yes, but not in	the last year	\square_{3} Yes, during the	e last year
	j. Has a relative, a suggested you cu	friend, a doctor or oth ut down?	ner health profession	al been concerned at	oout your drinking or
	1 No	2 Yes, but not in	the last year	☐ ₃ Yes, during the	e last year
НЗ	This question is ab	out vour usual consi	unntion of vegetable	s including fresh fro	zen and tinned
	vegetables. Please or cooked leaumes	note that <u>one servin</u> one medium potato	ng size of vegetables or one cup of lettuc	is equal to $\frac{1}{2}$ cup of $\frac{1}{2}$ cup of $\frac{1}{2}$ cup and $\frac{1}{2}$	cooked vegetables
	How many serves of	of vegetables do you	<i>usually</i> eat each da	y?	-
	Don't eat veget	ables			
	or less	² 2 serves ∐ ₃ 3 s	serves ∟₄ 4 serve	s ∟₅ 5 serves	l ₀ 6 serves or more
H4.	This question is ab Please note that <u>or</u> two smaller fruits (e or ½ cup of fruit juit	out your usual consu <u>ne serving size</u> of fru e.g. apricots or plums ce.	Imption of fruit incluc it is equal to one me s), about 20 grapes o	ding fresh, frozen and dium sized fruit (e.g. or cherries, 1 ½ table	d tinned fruit. apple or orange), espoons of sultanas
	How many serves of	of fruit do you <u>usuall</u> y	∠ eat each day?		
	 Don't eat fruit 1 serve or less 	² 2 serves 🗌 3 3 s	serves 🗌 4 serve	es □₅ 5 serves	☐ 6 serves or more

- **H5.** The next few questions are about <u>walking for fitness, recreation and sport</u>. Please do not include <u>any</u> other walking that you may have done for other reasons.
 - a. In the *last 2 weeks*, have you *walked* for fitness, recreation or sport?

	\square_1 Yes \square_2 No, go to H6 below \square_3 Permanently unable to walk, go to H6 below			
	b. How many times did you walk for fitness, recreation or sport in the <i>last 2 weeks</i> ?			
	c. What was the <i>total amount</i> of time you spent walking for <i>fitness, recreation or sport in the <i>last 2 weeks</i>? <i>hrs and minutes</i></i>			
H6.	The next few questions are about <u>moderate and vigorous exercise</u> . Please exclude walking that you may have done for fitness, recreation or sport and household chores, gardening or yard work.			
	 a. In the <u>last 2 weeks</u> did you do any exercise which caused a <u>moderate</u> (but not large) increase in heart rate or breathing, that is, moderate exercise? 1 Yes Is No, go to question d below. 			
	b. How many times did you do any moderate exercise in the <u>last 2 weeks</u> ?			
	c. What was the <i>total amount</i> of time you spent doing <i>minutes and minutes moderate exercise in the <u>last 2 weeks</u>?</i>			
	d. In the last 2 weeks did you do any other exercise which caused a <i>large</i> increase in heart rate or			

- d. In the last 2 weeks did you do any other exercise which caused a *large* increase in heart rate or breathing, that is, vigorous exercise?
 - \square_1 Yes \square_2 No, go to Section I.
- e. How many times did you do any vigorous exercise in the *last 2 weeks*?

times	
hrs and	minutes

f. What was the *total amount* of time you spent doing vigorous exercise in the *last 2 weeks*?
SECTION I - SOCIAL NETWORKS AND SUPPORT

11. About how many close friends and close relatives do you have (people you feel at ease with and can talk to about what is on your mind)?

Write in the number of close friends and relatives; if none, write "0":

12. People sometimes look to others for companionship, assistance, or other types of support. How often is each of the following kinds of support available to you if you need it?

	None of the time	A little of the time	Some of the time	Most of the time	All of the time
a. Someone to help you if you were confined to bed	1	2	3	4	5
 Someone you can count on to listen to you when you need to talk 	1	2	3	4	5
c. Someone to give you good advice about a crisis	1	2	3	4	5
d. Someone to take you to the doctor if you needed it	1	2	3	4	5
e. Someone who shows you love and affection	1	2	3	4	5
f. Someone to have a good time with	1	2	3	4	5
g. Someone to give you information to help you understand a situation	1	2	3	4	5
h. Someone to confide in or talk to about yourself or your problems	1	2	3	4	5
i. Someone who hugs you	1	2	3	4	5
j. Someone to get together with for relaxation	1	2	3	4	5
 k. Someone to prepare your meals if you were unable to do it yourself 	1	2	3	4	5
I. Someone whose advice you really want	1	2	3	4	5
m.Someone to do things with to help you get your mind off things	1	2	3	4	5
n. Someone to help with daily chores if you were sick	1	2	3	4	5
o. Someone to share your most private worries and fears with	1	2	3	4	5
p. Someone to turn to for suggestions about how to deal with a personal problem	1	2	3	4	5
q. Someone to do something enjoyable with	1	2	3	4	5
r. Someone who understands your problems	1	2	3	4	5
s. Someone to love and make you feel wanted	1	2	3	4	5

13. About how many voluntary groups or organisations do you belong to – like parent groups, clubs or lodges, church groups, etc (*"voluntary" means because you want to*).



Write in the number, if none, write "0"

 How active are you in the affairs of these gromany, just count those you feel closest to.) 1 Very active, attend most meetings 2 Fairly active, attend fairly often 	Dups or clubs you belong to □₃ Not active, belong □₄ Do not belong to	? <i>(if you belon</i> g but hardly eve any groups or e	<i>g to a great</i> er go clubs
15. Are you involved with any ex-service organis	sations?	1 No	2 Yes
I6. Do you commemorate significant military relate ANZAC Day services, participate in marches of	ed occasions such as attend or attend dawn services?	🗌 1 No	2 Yes
Well done - you	, are almost finishe	id.	

SECTION J - QUALITY OF LIFE

The following questions ask how you feel about your quality of life, health and other areas of your life. If unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response. Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the *last two weeks*.

J1.	How would	you rate your qua	ality of life?
-----	-----------	-------------------	----------------

	or 2 Poor	☐ ₃ Neither poor nor good	4 Good	\Box_{5} Very good
12 How potiofics	l ara yau with ya	ur booltb?		

□ 1 Very dissatisfied

2 Fairly dissatisfied

Satisfied
 Very satisfied

□ ₃ Neither satisfied nor dissatisfied

The following questions ask about how much you have experienced certain things in the *last two weeks*.

		Not at all	A small amount	A moderate amount	A great deal	An extreme amount
J3.	To what extent do you feel that physical pain prevents you from doing what you need to do?	1	2	3	4	5
J4.	How much do you need any medical treatment to function in your daily life?	1	2	3	4	5
J5.	How much do you enjoy life?	1	2	3	4	5
J6.	To what extent do you feel your life to be meaningful?	1	2	3	4	5

		Not at all	Slightly	Moderately	Very	Extremely
J7.	How well are you able to concentrate?	1	2	3	4	5
J8.	How safe do you feel in your daily life?	1	2	3	4	5
J9.	How healthy is your physical environment?	1	2	3	4	5

		Not at all	Slightly	Somewhat	To a great extent	Completely
J10. Do y	ou have enough energy for everyday life?	1	2	3	4	5
J11. Are y	you able to accept your bodily appearance?	1	2	3	4	5
J12. Have	e you enough money to meet your needs?	1	2	3	4	5
J13. How in yo	available to you is the information that you need ur daily life?	1	2	3	4	5
J14. To w activ	hat extent do you have the opportunity for leisure ities?		2	3	4	5

J15. How well are you able to get around physically?

I₁ Not at all

2 Slightly

3 Moderately 4 Very

 ₅ Extremely

The following questions ask you to say how good or satisfied you have felt about various aspects of your life over the <u>last two weeks</u>.

	Very dissatisfied	Fairly dissatisfied g	satisfied or lissatisfied	Satisfied	Very satisfied
J16. How satisfied are you with your sleep?	1	2	3	4	5
J17. How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
J18. How satisfied are you with your capacity for work?	1	2	3	4	5
J19. How satisfied are you with yourself?	1	2	3	4	5
J20. How satisfied are you with your personal relationships?	1	2	3	4	5
J21. How satisfied are you with your sex life?	1	2	3	4	5
J22. How satisfied are you with the support you get from your friends?	1	2	3	4	5
J23. How satisfied are you with the conditions of your living place?	1	2	3	4	5
J24. How satisfied are you with your access to health services?	1	2	3	4	5
J25. How satisfied are you with your transport?	1	2	3	4	5

J26. How often do you have negative feelings such as blue mood, despair, anxiety, depression?
$\square_1 \text{ Never} \square_2 \text{ Infrequently} \square_3 \text{ Sometimes} \square_4 \text{ Frequently} \square_5 \text{ Always}$
J27. How do you feel about your life as a whole, taking into account what has happened in the last year and what you expect to happen in the future? Please choose ONE response. 1 1 2 Pleased 3 Mostly satisfied 4 Mixed
SECTION K - WEIGHT, WAIST AND HIP CIRCUMFERENCE
We would now like you to measure your weight using scales and to measure your waist and hip circumference using the tape measure supplied. So that measurements are collected in a standard way for all study participants, please follow the given instructions.
Please weigh yourself using scales. How much do you weigh in light clothing without shoes, to the nearest kg?
 For an accurate <u>waist</u> measurement: Stand comfortably straight up, weight evenly distributed across both legs, feet 25-30 cm apart. Measure directly over your skin or no more than one item of light clothing. Have the tape measure fitting snug, but not compressing the skin. Take the measurement after breathing out normally. Measure at the halfway point between your lowest rib and the top of your hipbone. This will be roughly in-line with your belly button.
measure here
 At "Reading 1" below, record your waist measurement in centimetres (cm) to one decimal place (nearest millimetre).
Repeat and record your waist measurement at Reading 2.
For example, if your waist measurement is 95cm and 6mm, record it as 95 . Compared to the second s
Waist Reading 1 . cm Waist Reading 2 . cm

 For an accurate <u>hip</u> measurement: Stand comfortably straight up, feet together, with your muscles relaxed. Measure directly over your skin or no more than one item of light clothing. Hold the tape horizontally, have the tape measure snug, but not compressing the skin. Measure at the point where your buttocks extend the maximum when viewed from the side. Any fatty aprons should be excluded from the measurement.
 Record your hip measurement in centimetres (cm) to one decimal place (nearest millimetre) at Reading 1 below. Repeat and record your hip measurement at Reading 2.
Hip Reading 1 . cm Hip Reading 2 . cm
SECTION L - TELEPHONE INTERVIEW
This study includes an important over-the-phone interview about your psychological health.
L1. Please provide the most appropriate phone number/s to contact you on to arrange that interview.
Please provide STD code if not a mobile phone number Please provide STD code if not a mobile phone number
 L2. Please indicate the best days and times to call you about the interview appointment. week days, in the morning afternoon evening weekends, in the morning afternoon evening
Other:
please provide more information if necessary
SECTION M - OTHER HEALTH INFORMATION OR COMMENTS
health or well-being concerns or additional comments you have?
1 NO 2 YES
If YES, please give details in the space provided here.

SECTION N - CONTACT DETAILS

Note: to ensure confidentiality of your stored health information, this page will be removed and filed separately from the rest of the questionnaire.

It is important that we be able to contact you in the future. We may need to ask you about the information you have provided in this questionnaire, or contact you about important study findings or follow-up investigations. To ensure that we have the most up-do-date contact details, please provide the following information:

Surname:			
All given names:			
Your preferred given name:			

If you changed your surname or given names since January 2001, please write your previous name in full here.

Please give your current address, telephone contact numbers and email addresses

Street address:	
Suburb/Town:	
State:	Postcode:
Phone number/s:	Н.
	W.
	M.
Email address/es:	Н.
	W.

ALTERNATIVE CONTACT DETAILS

INSTRUCTIONS: In case you move and we lose contact with you, please give us the names of up to two relatives or friends who may be able to tell us where you are. These should be people who are at long-term addresses but who are <u>not living with you</u>. We would only use these alternative contacts in the event that we could not contact you at the address you have provided on the previous page.

FIRST ALTERNATIV	VE CONTACT
Surname:	
Given names:	
Street address:	
Suburb/Town:	
State:	Postcode:
Phone number:	
Email address:	
SECOND ALTERNA	ATIVE CONTACT
Surname:	
Given names:	
Street number:	
Street:	
Suburb/Town:	
State:	Postcode:
Phone number:	
Email address:	
-	

PLEASE RETURN THIS QUESTIONNAIRE WITH THE SIGNED CONSENT FORM IN THE REPLY PAID ENVELOPE PROVIDED.



8.5 Appendix 5 Mail out materials



հվինեկներիներին հերհերիներին համաներին

BSP: <bsp key> - <sequence number> <Title> <first name> <last name> <Address 1> <Address 2> <SUBURB> <STATE> <POSTCODE>



AUSTRALIAN GULF WAR VETERANS' HEALTH STUDY - 2011 FOLLOW - UP

Dear [insert Mr or Ms Surname]

In 2000-2003, Monash University conducted the Australian Gulf War Veterans' Health Study in which you participated as either a Gulf War veteran or military comparison group member. That study comprised one of the most comprehensive investigations of veterans' health ever conducted world-wide. The study findings have resulted in significant recognition of health outcomes in Australian service personnel and have influenced health services and policy.

I am very pleased to now invite you to take part in the Australian Gulf War Veterans' Health Study 2011 Follow-Up of all participants from the 2000-2003 baseline study. This follow-up study, 20 years after the Gulf War, will assess the longer term physical, psychological and social health and wellbeing of Gulf War veterans and the comparison group members. The study will contribute valuable knowledge to veteran, defence and civilian communities about the longer-term health impacts of war-related and other military activities and experiences.

In this follow-up study we will collect your health information through a postal questionnaire and an over-the-phone interview, with additional health data collected from linkage with databases held by the Department of Veterans' Affairs (DVA) and Medicare Australia. Importantly, the information that you provide about your own health will be entirely confidential and any personal details, which may identify you in any way, will not be passed to the DVA. Your answers will not in any way affect any pension, benefits or health services which you are entitled to from DVA, or to which you may become entitled in the future. If you wish, you can discontinue your participation in this study at any time.

Please read the enclosed Explanatory Statement which is designed to provide you with all the information you should require to make an informed decision about participating. It is very important that as many people as possible participate, whether you are a Gulf War veteran or military comparison group member, unwell or in good health, working or retired.

Thank you for considering this invitation. We look forward to including you in this important study.

Yours sincerely,

Julul

Professor Malcolm Sim, Director, Monash Centre for Occupational and Environmental Health

Phone: 1800 729 913 Email: moncoeh-veteranstudy@monash.edu Website: www.coeh.monash.org



Explanatory statement

AUSTRALIAN GULF WAR VETERANS' HEALTH STUDY - 2011 FOLLOW-UP

Introduction

In the period 2000-2003 you participated in the Australian Gulf War Veterans' Health Study as a Gulf War veteran or military comparison group member. The study was conducted by Monash University and it aimed to determine whether the physical and psychological health of Australian veterans of the 1990/1991 Gulf War differed from a comparison group of Australian Defence Force (ADF) personnel who were not deployed to the Gulf War. That study's significant findings have been published and presented internationally and have influenced veteran and defence health policy and services.

The Monash University Centre for Occupational and Environmental Health (MonCOEH) is now undertaking an important follow-up study of the health and well-being of all people who participated in the 2000-2003 baseline study. This study is funded by the Department of Veterans' Affairs (DVA).

The aim/purpose of this research

The overall aim of this follow-up study is to assess the longer term physical, psychological and social health and well-being of Gulf War veterans and the comparison group members. It will investigate the persistence of, or recovery from, multisymptom disorder, psychological conditions, chronic fatigue and other conditions that may have been present at baseline, and the factors which predict persistence or recovery. The study will also investigate quality of life and functioning, and use of health services and medicines and servicerelated entitlements since the baseline study and into the future.

Possible benefits

This follow up study will provide valuable new information about long-term or chronic health conditions in Australian veterans, about new conditions which may have arisen since the baseline study and the determinants for any decline or improvements in health or well-being. The findings will help inform DVA, ADF and the international military and veteran community of the long term health needs of veterans so they can continue to create policies and care pathways that are evidence-based.

Participants

All participants of the baseline study, that is veterans of the Gulf War and a comparison group of ADF personnel who were not deployed to the Gulf War, will be invited to participate. The comparison group members are important in that they provide a measure of health representative of the wider ADF community and their information will assist in identifying service related activities other than the Gulf War which may affect health.

Your initials here

What does the research involve?

The study involves completing a comprehensive postal questionnaire about your health and well-being, life-style and work history since 2001; a telephone interview to assess your psychological health; and data linkage to obtain further information about health services utilisation, medication use and eligibility for service-related entitlements. ADF members and Defence employees are considered on duty whilst participating.

The postal questionnaire is included in this mailed invitation package, and can be completed by you in your own time. The telephone interview to assess your psychological health will be conducted by a trained interviewer. You will be phoned to arrange a suitable time.

Additional information about your health service utilisation, pharmaceutical use, and medical care will be collected through linkage with Medicare Australia to access Pharmaceutical Benefits Scheme (PBS), Repatriation Pharmaceutical Benefits Scheme (RPBS) and Medicare data. Information on your medical care, allied health, nursing home, pharmaceutical items and entitlements provided by DVA will be obtained through linkage with DVA databases.

We would like to access your Medicare and DVA health data dating back to the time of the baseline study, and also at regular intervals into the future for approximately 20 years. In this way we aim to assess several aspects of health service and medication utilisation since the baseline study and forward in time. Data for the period 1 January 2001 to 31 December 2031 will be sought. A sample of the information that may be included in the Medicare or PBS claims history data is shown on the back of the Consent Form in this invitation package. To ensure accurate linkage to those databases we will need information from you such as Medicare Card Number and a DVA File Number (where applicable and available).

It is important for the study to access a variety of sources of health information because serving, nonserving and veteran personnel may use different Defence, DVA, Medicare or alternative health services at different times in their lives. The Medicare or DVA data, for example, may provide information about medical specialists seen or medications taken in the past that participants have forgotten, whilst the questionnaire allows participants to report the use of alternative health services which may not fall under Medicare or DVA scheme data. By investigating all of these sources of data, we aim to capture a comprehensive picture of participants' health.

If you wish to participate in this study, please complete the Consent Form and questionnaire and return these in the Reply Paid envelope provided as soon as possible. By signing the Consent Form you will be indicating that you agree to your health information being collected from the sources mentioned above, and stored and analysed only for the purposes of research related to this study.

If you do not wish to participate in any part of the study, please indicate this by completing and signing the Consent Form and returning it in the Reply Paid envelope provided.

Risks and inconveniences

Risks and inconveniences involved with participation include time incurred and the possibility of some emotional distress in answering questions about life and service experiences. Completing the postal questionnaire could take about one hour, as would the telephone psychological health interview. The postal questionnaire and telephone interview may include questions about stressful or upsetting experiences, or questions which elicit unpleasant or distressing memories or feelings. You may prefer to answer the questions with a supportive person present. Alternatively, if you feel distressed it may be helpful to phone a friend or a local supportive community group. In addition there are 24-hour counselling services available over the phone such as Lifeline on 13 11 14. Serving ADF members may choose to access the Defence All Hours Support Line (AHSL) on 1800 628 036 or eligible former-serving personnel may access the Veterans and Veterans' Families Counselling Service (VVCS) on 1800 011 046. The questionnaire items have been kept as concise as possible, only including questions which are necessary to the investigations of the study. Whilst it is important that you answer as many questions as possible, you may leave a question blank if you prefer not to answer it. The telephone interview will be conducted by a trained interviewer experienced in health research, sensitive to the feelings of participants, and bound by a professional code of ethics and confidentiality.

Can I withdraw from the research?

Being in this study is voluntary and you are under no obligation to consent to participate. You may choose to complete all or some parts of the questionnaire, interview or other data collection. If you wish, you can discontinue your participation in this study at any time. You may withdraw your consent for future linkage with Medicare or DVA health data at any time. Your participation will not affect any pension, benefits or health services which you are entitled to from DVA, or to which you may become entitled in the future.

There will be no detriment to the career of serving Australian Defence Force personnel who choose not to participate or choose to withdraw from the study. The *Australian Defence Force Human Research Ethics Committee Guidelines for Volunteers* is included in this package and explains further your rights as a volunteer.

Confidentiality and privacy – What will happen to my data?

Your answers will be completely confidential and any personal health details, which may identify you in any way, will not be passed to the Department of Veterans' Affairs or Department of Defence.

All of the information gained in the study will be held securely by Monash University for a minimum of five years in adherence with the University's regulations and the various provisions of the *Privacy Act 1988*. All data will be stored in a secure, restricted-access area. Any data stored on computers will be password protected and administrative files relating to the study will only be accessible by staff employed on this project. To ensure the confidentiality of the information, the collected health data will have all identifying information removed and will be held in storage using code numbers. Any necessary transfer of your contact details to the telephone interview team will be conducted using secure, encrypted systems.

In extreme circumstances some information may be subject to mandatory reporting legislation or obtainable, by a third party, via a court order.

Dissemination of results

The results of the study will be presented as aggregated data so that no individual participants can be identified. The study's findings will be reported to the DVA and as articles for publication in scientific peer-reviewed journals. A summary of findings will be posted on the MonCOEH website at www.coeh.monash.org

Future investigations

To assist us in continuing to measure the long-term health of the study group, we may need to contact you in future. This may be to ask you about your health, validate health information we have received from other sources or invite you to participate in future investigations. To achieve this we request that you inform us of any changes to your contact details (such as address and telephone number) and also, where requested in the questionnaire, provide details of an alternative contact person who we could contact in the event that we lose touch with you. If we do contact you, you will be under no obligation to participate in any proposed investigations.

Enquiries, concerns or complaints

If you have any questions about your participation in the study you can contact the MonCOEH research team by phone on 1800 729 913 or by email to moncoeh-veteranstudy@monash.edu Alternatively you can contact the Chief Investigator, Professor Malcolm Sim at:

MonCOEH, The Alfred Centre 99 Commercial Rd, Melbourne VIC 3004 Tel: 03 9903 0582 Fax: 03 9903 0556 Email: Malcolm.Sim@monash.edu

If you have a complaint concerning the manner in which this research is being conducted, please contact the Monash University Human Research Ethics Committee (MUHREC) and quote the project number shown below.

MUHREC (Project no. CF11/0756-2011000370) Executive Officer, MUHREC Building 3e Room 111 Research Office Monash University VIC 3800 Tel: 03 9905 2052 Fax: 03 9905 3831 Email: muhrec@monash.edu

Alternatively, you may prefer to contact the DVA or Australian Defence HRECs which have also approved this study. Their contact details are as follows:

DVA HREC (Reference no. E011/003 (5.2)) DVAHREC Coordinator Department of Veterans' Affairs PO Box 9998, Canberra ACT 2601 Tel: 02 6289 6204 Fax: 02 6289 6173 Email: ethics.committee@dva.gov.au

Australian Defence HREC (Protocol no. 621-11) Executive Secretary, ADHREC CP2-7-101 Department of Defence Canberra ACT 2600 Tel: 02 6266 3837 Fax: 02 6266 3072 Email: ADHREC@defence.gov.au





AUSTRALIAN DEFENCE HUMAN RESEARCH ETHICS COMMITTEE - GUIDELINES FOR VOLUNTEERS

Thank you for taking part in Defence Research. Your involvement is much appreciated. This pamphlet explains your rights as a volunteer.

What is the Australian Defence Human Research Ethics Committee?

- ADHREC is the Australian Defence Human Research Ethics Committee. It was established in 1988, to make sure that Defence complied with accepted guidelines for research involving human beings.
- After World War II (WWII), there was concern around the world about human experimentation. The Declaration of Helsinki was made in 1964, which provided the basic principles to be followed wherever humans were used in research projects.
- The National Health and Medical Research Council (NHMRC) in Australia has published the National Statement on Ethical Conduct in Human Research (NHMRC 2007). This Statement describes how human research should be carried out.
- ADHREC follows both the Declaration of Helsinki and the NHMRC Statement.

What Australian Defence Human Research Ethics Committee approval means

- If you are told that the project has ADHREC approval, what that means is that ADHREC has reviewed the research proposal and has agreed that the research is ethical.
- ADHREC approval does not imply any obligation on commanders to order or encourage their Service personnel to participate, or to release personnel from their usual workplace to participate. Obviously, the use of any particular personnel must have clearance from their commanders but commanders should not use ADHREC approval to pressure personnel into volunteering.

Voluntary participation

- As you are a volunteer for this research project, you are under no obligation to participate or continue to participate. You may withdraw from the project at any time without detriment to your military career or to your medical care.
- At no time must you feel pressured to participate or to continue if you do not wish to do so.
- If you do not wish to continue, it would be useful to the researcher to know why, but you are under no obligation to give reasons for not wanting to continue.

Informed consent

- Before commencing the project you will have been given an information sheet which explains the project, your role in it and any risks to which you may be exposed.
- You must be sure that you understand the information given to you and that you ask the researchers about anything of which you are not sure.
- If you are satisfied that you understand the information sheet and agree to participate, you should initial every page of the information sheet and keep a copy.
- Before you participate in the project you should also have been given a consent form to sign. You must be happy that the consent form is easy to understand and spells out what you are agreeing to. Again, you should keep a copy of the signed consent form.

Clinical trials

The NHMRC requires that the researcher provide a nominal roll of study participants where the study is a clinical trial (eg when the researchers are trialling a new treatment or device). For trials conducted by large Defence institutions like the Defence Science and Technology Organisation, the Submarine and Underwater Medicine Unit, the Army Malaria Institute, the Institute of Aviation Medicine or the Centre for Military and Veterans' Health, this roll is kept by them on ADHREC's behalf. These records will not be used to consider your medical employment standard or for compensation purposes.

All ADHREC protocol files are secured in a locked filing cabinet and only the Secretariat has access to these. ADHREC will not pass your contact information to a third party without your permission.

Complaints

- If at any time during your participation in the project you are worried about how the project is being run or how you are being treated, then you should speak to the researchers.
- If you don't feel comfortable doing this, you can contact the Executive Secretary of ADHREC. Contact details are:

Executive Secretary Australian Defence Human Research Ethics Committee Department of Defence CP2-7-101 PO Box 7911 CANBERRRA BC ACT 2600 AUSTRALIA

Telephone: (02) 6266 3837 Facsimile: (02) 6266 3072 Email: ADHREC@defence.gov.au

More information

• If you would like to read more about ADHREC, visit the ADHREC website at: http://www.defence.gov.au/health/research/adhrec/i-adhrec.htm (Internet).

28 March, 2011

Graham V. Sloper Commodore AM RAN (Rtd)

Dear [participant],

In 2000-2003 you participated in the first Gulf War Veterans' Health Study, either as a veteran of the first Gulf War or as a military comparison group member. The Monash University research team recently mailed to you an invitation to participate in a Follow up Health Study. They have not received your questionnaire or a response about participating.

As the Commanding Officer of HMAS *SUCCESS* with an embarked detachment from the 16th Air Defence Regiment in the first Gulf War from August 1990 to February 1991, and now as someone heavily involved as a pension officer assisting veterans with their disability claims with the DVA, I strongly encourage you to participate in this important health study.

The Study provides a rare opportunity for you to provide detailed information about your health. The research will assess current health in the study groups as well as factors that have affected health over time. These factors may include service related medical, chemical and environmental exposures, information on which was collected in the first Study.

The Follow Up Study measures a number of physical, psychological and social health and wellbeing outcomes. You can complete whichever parts of the Study you feel comfortable with. Further information about this and other aspects of the Follow up Study are provided in the *enclosed documents which I encourage you to read*. Please be assured that the research is conducted independently by Monash University and the information that you provide is protected by privacy legislation and ethics committee approvals.

The findings of the study will be published and will inform the medical community, the veteran community, and veteran and military health policy makers and service planners of the longer term health needs of veterans. Major health studies take considerable time and resources to organise, and do not take place very often. Therefore, I again encourage you to take part so that your health and experiences are included. The Study data collection phase will be closing at the **end of July 2012**.

Thank you for your consideration of participation in this important research.

Yours sincerely

Stoper.

(G: V. Sloper) Commodore AM RAN (Rtd)



PRESIDENT DEPUTY PRESIDENT COMMISSIONER

TELEPHONE (02) 6289 6733 FACSIMILE (02) 6289 6257

TELEPHONE (02) 6289 6736

TELEPHONE (02) 6289 6744

Australian Gulf War Veterans' Health Study – 2011 Follow Up

I am writing to invite you to participate in the Australian Gulf War Veterans' Health Study 2011 Follow Up. I would encourage you to become involved if you can.

This Study will build on our understanding of any health effects which may have arisen from service in the Gulf War and improve our knowledge of the health of members of the Australian Defence Force. This was a recommendation from the first Australian Gulf War Veterans' Health Study, published in 2003, which the Government of the day accepted. In particular, the Follow Up Study will look at:

- long-term physical and mental health;
- quality of life and social functioning; and
- use of health services and medicines.

This Follow Up Study is part of a larger project which will also investigate cancer and mortality in the study group, and undertake some analyses of blood serum samples which were stored at the time of the first study. You will be contacted separately about those aspects of the research, if necessary. Overall, the research will provide a comprehensive assessment of several aspects of the health of Australian Gulf War veterans at least 20 years after the Gulf War, compared to other ADF personnel who did not deploy to the Gulf.

For the Follow Up Study to be successful, it is vital that as many individuals as possible participate. A high participation rate is required in order to obtain scientifically valid results that give a true representation of the health of the Gulf War cohort.

This study is funded by the Department of Veterans' Affairs (DVA) but will be undertaken by an independent medical research team from Monash University. The records will be subject to the provisions of the *Privacy Act 1988* which regulates their use, storage and disclosure, and all aspects of the study will be subject to Ethics Committees' review. An Advisory Committee, which includes representatives from the Gulf War Veterans' Association, Naval Association of Australia, Department of Defence (Navy), Monash University and DVA, is oversighting the study.

The study has important implications for veterans of all conflicts, ADF personnel and the family members of veterans and Defence members, particularly in informing the development of DVA health policy and services. I urge you to participate.

Yours sincerely

M.A. Kelly AO DSC Major General Commissioner 10 August 2011



PARTICIPANT CONSENT FORM Australian Gulf War Veterans' Health Study 2011 Follow Up

Important information

Complete this form to consent to participation in the Australian Gulf War Veterans' Health Study 2011 Follow Up by completing the postal questionnaire and telephone interview; and to request the release of DVA health data, and Medicare, Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) claims information to the Australian Gulf War Veterans' Health Study 2011 Follow Up; or to indicate that you do not wish to participate in the Study.

Any changes to this form must be initialled by you, the signatory. Incomplete forms may result in the study not being provided with your information.

By signing this form, I acknowledge that:

- 1. I have read and understood the information about the Study as outlined in the Explanatory Statement. I have had the opportunity to ask questions and am fully informed about the Study.
- 2. I understand that participation in the Study is voluntary, that I can choose not to participate in part or all of the Study, and that I can withdraw at any time without penalty or detriment to career or hindrance to future medical care.

PARTICIPANT DETAILS
Mr Mrs Miss Ms Other
Family name:
First given name:
Other given name(s):
Date of birth: DDD MM M YYYYY
Permanent address:
Postal address (if different to above):
To consent to participate in the entire study, please tick all of boxes 1, 2 and 3 below. Alternatively, please tick the boxes for the parts of the study that you agree to.
1. I agree to participate in the Australian Gulf War Veterans' Health Study 2011 Follow Up by completing the postal questionnaire and telephone interview.
2. I agree to DVA providing my DVA health data to the Australian Gulf War Veterans' Health Study 2011 Follow Up for the period 01/01/2001 to 31/12/2031. (If you have ever had a DVA file number, please provide one here.)
DVA file number if available
3. I authorise Medicare Australia to provide my Medicare, PBS and RPBS claims history to the Australian Gulf War Veterans' Health Study 2011 Follow Up for the period
My Medicare card number is:
OR None of the above; I do not wish to participate in any part of the study.
DECLARATION I declare that the information on this form is true and correct.
Signature: Date: D M M Y

A sample of the information that may be included in your Medicare claims history:

Date of service	Date of Processing	ltem number	Item description	Provider charge	Schedule Fee	Benefit paid	Patient out of pocket	Bill type
20/04/09	03/05/09	00023	Level B consultation	\$38.30	\$34.30	\$34.30	\$4.00	Cash
22/06/09	23/06/09	11700	ECG	\$29.50	\$29.50	\$29.50		Bulk Bill

Scrambled ordering Provider number*	Scrambled rendering Provider number*	Date of referral	Rendering Provider postcode	Ordering Provider postcode	Hospital	Provider derived major speciality	Item category
	999999A		2300		N	General Practitioner	1
999999A	999999A	20/04/09	2300	2302	N	Cardiologist	2

A sample of the information that may be included in your PBS claims history:

Date of supply	Date of prescribing	PBS item code	Item description	Patient category	Patient contribution	Net Benefit	Scrambled Prescriber number*
06/03/09	01/03/09	03133X	Oxazepham Tablet 30mg	Concessional Ordinary	\$5.30	\$25.55	9999999
04/07/09	28/05/09	03161J	Diazepam Tablet 2mg	General Ordinary	\$30.85		9999999

Pharmacy postcode	Form Category	ATC Code	ATC Name	Prescriber derived major speciality
2560	Original	N05 B A 04	Oxazepam	General Practitioner
2530	Repeat	N05 B A 01	Diazepam	Psychiatrist

* Scrambled Prescriber number refers to a unique scrambled prescriber number identifying the doctor who prescribed the prescription. Generally, each individual prescriber number will be scrambled and the identity of that prescriber will not be disclosed.



International Postage Information

Australian Gulf War Veterans' Health Study – 2011/12 Follow- Up

Dear study member,

Thank you for considering participation in this study. We have noticed that you have an address outside of Australia. Please be assured that you can still participate fully in the study if you wish, including the over-the-phone interview which would be conducted at no cost to you. At page 40 of the questionnaire, please provide comprehensive phone contact information so that we can call to arrange the phone interview at an appropriate time at your location. Unfortunately and contrary to the standard information in this invitation package we cannot provide a Reply Paid envelope for you to return your questionnaire and Consent Form from an overseas address. However, we have provided an addressed envelope for your convenience and appreciate your generosity in returning the study questionnaire and Consent Form to us if you choose to participate.

If you do not wish to participate in any part of the study please email us on <u>moncoeh-veteranstudy@monash.edu</u> to advise us of this decision. Please be sure to provide your full name and date of birth so that we can be sure to update the correct record in our database.

Thank you again. We look forward to hearing from you.

Yours sincerely

Julall

Prof Malcolm Sim Director, Monash Centre for Occupational and Environmental Health

Email: moncoeh-veteranstudy@monash.edu Website: www.coeh.monash.org/gwfollowup.html

BSP: <bsp key> - <sequence number> <Title> <first name> <last name> <Address 1> <Address 2> <SUBURB> <STATE> <POSTCODE>

Dear [title] [surname],

We would like to thank you for your participation in the Gulf War Veterans' Health Study Follow Up. The time and effort that you have committed to the Study is greatly appreciated. Currently XX people have participated in the Study and recruitment is planned to close at the end of June 2012.

For those people who have not responded to their Study invitation, we have mailed some additional information about the Study and a slightly revised Consent Form for their consideration. That mailout emphasises each participant's right to complete whichever parts of the study they are comfortable with and to separately consent to the telephone interview.

We take this opportunity to remind you of your rights as a participant in this research. If you wish you can discontinue participation at any time. That means that you can withdraw any information that you have already provided and withdraw or adjust any part of your consent to take part in the study.

If you require any further information please do not hesitate to contact us by phone on 1800 729 913 or by email to <u>moncoeh-veteranstudy@monash.edu</u>.

Thank you again for taking part in this important study.

Yours sincerely,

Professor Malcolm Sim Principal Investigator Australian Gulf War veterans' Health Study Follow Up Head, Monash University Centre for Occupational and Environmental Health (MonCOEH)

[Date]



<Title> <first name> <last name> <id> <Address 1> <Address 2> <SUBURB> <STATE> <POSTCODE>

Dear <first name>,

I would like to thank you for your participation in the Gulf War Veterans' Health Study Follow Up. The time and effort that you have committed to the Study is greatly appreciated.

The research team have noticed that you did not sign the Consent Form that you sent to us. Without your signature we cannot include you in those parts of the study that involve linkage to Medicare and DVA Health data (items 2 and/or 3 on the Consent Form).

For your convenience we have returned the Consent Form and ask that you sign and date this and return it to us in the Reply Paid envelope provided.

I take this opportunity to remind you of your rights as a participant in this research. If you wish you can discontinue participation at any time. That means that you can withdraw any information that you have already provided and withdraw or adjust any part of your consent. If you require any further information please do not hesitate to contact us by phone on 1800 729 913 or by email to moncoeh-veteranstudy@monash.edu or you can view additional information provided at http://www.coeh.monash.org/gwfollowup.html.

Thank you again for taking part in this important study.

Yours sincerely,

Julial

Professor Malcolm Sim Principal Investigator, Australian Gulf War veterans' Health Study Follow Up Head, Monash University Centre for Occupational and Environmental Health (MonCOEH) [Date]



<Title> <first name> <last name> <id> <Address 1> <Address 2> <SUBURB> <STATE> <POSTCODE>

Dear <first name>,

I would like to thank you for your participation in the Gulf War Veterans' Health Study Follow Up. The time and effort that you have committed to the Study is greatly appreciated.

The research team have noticed that you did not return a completed Consent Form. You completed and returned the study questionnaire and provided contact information for the telephone interview, therefore your agreement to participate in these parts of the Study were assumed. However, we are not clear of your wishes in regard to allowing the research team access to your Medicare or DVA health data. We have enclosed another copy of the Study Consent Form for your consideration and request that you complete it and return it to us in the Reply Paid envelope.

You are under no obligation to agree to the Medicare and DVA health data linkage. If you only agree to the research team using the questionnaire and interview information that you have already provided then only tick item 1 on the Consent Form. *If you also agree to the researchers accessing your Medicare and/or DVA health data, then please also tick items 2 and/or 3. Please also provide a Medicare number and/or DVA file number if you have one.* **If you prefer to consent to Medicare or DVA health data linkage for a shorter time period in to the future than that shown on the Consent Form, please change the end date shown on the Form at items 2 and 3, writing in the future linkage date that you consent to. Please initial this change.**

Whichever options you agree to on the Consent Form, please ensure that all other requested information is completed; i.e. your full name, date of birth and current address, and please be sure to sign and date the form.

I take this opportunity to remind you of your rights as a participant in this research. If you wish you can discontinue participation at any time. That means that you can withdraw any information that you have already provided and withdraw or adjust any part of your consent. If you require any further information please do not hesitate to contact us by phone on 1800 729 913 or by email to moncoeh-veteranstudy@monash.edu or you can view additional information provided at http://www.coeh.monash.org/gwfollowup.html.

Thank you again for taking part in this important study.

Yours sincerely,

Jula A.

Professor Malcolm Sim Principal Investigator, Australian Gulf War veterans' Health Study Follow Up Head, Monash University Centre for Occupational and Environmental Health (MonCOEH) [Date]

Further information about the Gulf War Veterans' Health Study Follow Up

The Follow up Study invitation packs that you have already received included a formal Explanatory Statement that is included again (in this pack) for your convenience. **Below we provide further information**, based on feedback we have received, which you may find useful in making your decision about participating in the Study.

Your choice in consenting to separate parts of the Study

A new Study Consent Form included in this pack (on blue paper) presents the Study in four parts;

- 1. the postal questionnaire;
- 2. the psychological health telephone-interview;
- 3. Linkage to DVA held health-data; and
- 4. Medicare Australia data linkage.

The Consent Form presents you with the options to consent to all or any of these four parts, or to decline all participation. Within any of these parts of the study, you can provide whatever level of information you are comfortable with.

In the postal questionnaire, you can choose to answer whichever questions you feel comfortable with.

In the psychological health telephone-interview you can choose to answer whichever questions you feel comfortable with, however in some areas the programmed interview cannot continue without previous core answers having been provided.

We have sought your permission to access your Medicare data for the period 01/01/2001 to 31/12/2031, so that we can collect health information back to the time of the first study, and forward in time without having to locate you again to obtain your signed consen. The same dates have been set for the DVA-held health data linkage. Please note that these sources of health data do not contain personal health notes such as those a doctor makes.

If you prefer to consent to Medicare or DVA-health data linkage for a shorter time period in to the future, <u>please change the end date shown on the Consent Form at items 2 and 3, writing in the future</u> <u>linkage date that you consent to. Please initial this change.</u>

The health outcomes included in the postal questionnaire

The postal questionnaire includes a wide range of measures of your physical health, psychological health, social health and general well-being. They include:

Physical health, psychological health, social health and well-being measures in the postal questionnaire	Question numbers	Page numbers
General health summary (physical and psychological)	D1 – D8	8
General mental health (psychological)	D9, a-l	9
Multi-symptom illness based on 63 health symptoms (mainly physical, some psychological)	D10, 1-63	10-11
17 neurological symptoms (physical)	D11 , 1-17	11
Pain intensity and associated disability (physical)	D12 a-g and D13	12
Respiratory health symptoms and conditions (physical)	D14, 1-11	13-14
Sleep patterns and tiredness (physical)	D15 - D18	14-15

Fatigue and chronic fatigue (physical)	D19 a - k	15
Depression (psychological)	D20 a-j	16
Symptom attribution (physical and psychological)	D21, 1-13	16-17
Gastrointestinal disturbance (physical)	D22, 1-10	17
Demoralisation and suicidal ideation (psychological)	D23, 1-24, D25-D28	18 & 19
Resilience (psychological)	D24, a-j	18
49 medical conditions and associated medications (mainly physical, some psychological)	D29	19-23
Hospitalisation and visits to health professionals (physical and psychological)	D30, D31, D32	23-24
Pregnancy outcomes since the first study (physical)	D34	24-25
Injury (physical)	E1-E3	26-27
Risk taking (psychological)	F1	28-29
Adverse life events (physical, psychological, social and well-being)	G1-G5	30-31
Posttraumatic stress symptoms (psychological)	G6	32
Tobacco and alcohol use (physical)	H1-H2	33-34
Diet and exercise (physical)	H3-H6	34-35
Social networks and support (social)	11-16	36-37
Quality of life and life satisfaction (well-being)	J1-J27	37-39
Weight, height (for BMI), waist, hip measures (physical)	Section K	39-40

You need only complete whichever parts of the questionnaire you feel comfortable answering.

The psychological health interview

We are administering the Composite International Diagnostic Interview (CIDI) over the phone to assess participants for the presence or absence of psychological disorders. The CIDI was also used in the first Gulf War Veterans' Health Study. The CIDI was developed by the World Health Organization and is specifically designed for research where it is necessary to assess large numbers of participants in a standardised and objective way. The CIDI has been used to assess psychological health in national Australian and US population studies.

Interviewers have been trained in the use and interpretation of the CIDI, but they are not psychological health professionals. The interviewers employed for the Gulf War Veterans' Health Study Follow Up are highly experienced in the administration of sensitive health research instruments. Further, they have received training by the Monash research team in the administration of the CIDI and ways to handle difficulties which might arise during the interview with appropriate referral when necessary.

If you choose to complete the CIDI interview, you have the option of answering whichever CIDI questions you feel comfortable with, but in some areas the CIDI program cannot continue without previous core answers having been provided.

Exposure assessment and the relationship with longer term health

We collected extensive Gulf War and other military-related exposure information in the first Gulf War veterans' Health Study questionnaire, and we will use that information in this Follow up Study to investigate associations between exposures relevant to the Gulf War and other military service, and current health outcomes. This is the reason why we are not collecting exposure information from you again. Exposures measured at the time of the baseline study include:

- vaccinations and prophylactic medications including pyridostigmine bromide (NAPS),
- SMOIL (smoke and oil from burning oil wells) and airborne dust
- pesticides and repellents,
- biological and chemical warfare agents,
- depleted uranium,
- infectious disease agents,
- petroleum products, solvents, CARC paint and vehicle exhaust,
- extremes of heat and cold, and
- psychological stressors.

Where possible we supplemented the self-reported exposure data with any additional objective data available and with known service characteristics such as branch of service, rank, Operation, and deployment dates and locations.

The Advisory Committee

Since October 2010 the Study has been overseen by an Advisory Committee with representatives from the ADF, Naval Association, Gulf War Veterans' Association and the DVA. Recently the Advisory Committee has been expanded to include representation from the RSL and the Australian Peacekeeper and Peacemaker Veterans' Association.

Use of the Follow up Study information and further possible research

The data being collected for the Follow up Study is extensive and will provide considerable information about the longer term physical and psychological health of Australian Gulf War veterans and the military comparison group. The research team will use the results of the Follow up Study to assess changes in health since the first study and investigate factors that might affect persistence of or recovery from ill-health over time including previously reported service-related exposures. For this Follow up Study to be as informative and as scientifically valid as possible a good participation rate is required. The results of this Follow up Study may identify the need for further health studies of specific sub-groups of the participants and exposures, for which the necessary Ethics Committee approvals and funding would have to be obtained by the research team.

Additional questions and answers about the Follow up Study

Further information can be found at <u>http://www.coeh.monash.org/gwfollowup.html</u> or you can contact the research team directly on 1800 729 913 or by email on <u>moncoeh-veteranstudy@</u> <u>monash.edu</u>.

Study ID:

PARTICIPANT CONSENT FORM Australian Gulf War Veterans' Health Study 2011 Follow Up

MONASH University

Important information

Complete this form to consent to participation in the Australian Gulf War Veterans' Health Study 2011 Follow Up by completing the postal questionnaire and telephone interview; and to request the release of DVA health data, and Medicare, Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) claims information to the Australian Gulf War Veterans' Health Study 2011 Follow Up; or to indicate that you do not wish to participate in the Study.

Any changes to this form must be initialled by you, the signatory. Incomplete forms may result in the study not being provided with your information.

By signing this form, I acknowledge that:

- 1. I have read and understood the information about the Study as outlined in the Explanatory Statement. I have had the opportunity to ask questions and am fully informed about the Study.
- 2. I understand that participation in the Study is voluntary, that I can choose not to participate in part or all of the Study, and that I can withdraw at any time without penalty or detriment to career or hindrance to future medical care.

Mr 🗆 Mrs 🗆 Miss 🗆 Ms 🗆 Other
Family name:
First given name: Other given name (s):
Date of birth: D D M M Y Y Y Y
Permanent address:
Postal address (if different to above):
To consent to participate in the entire study, please tick all of boxes 1, 2, 3 and 4 below. Alternatively, please tick the boxes for the parts of the study that you agree to.
1. I agree to participate in the Australian Gulf War Veterans' Health Study 2011 Follow Up by completing part or all of the postal questionnaire.
2. I agree to participate in the Australian Gulf War Veterans' Health Study 2011 Follow Up by completing part or all of the psychological health telephone interview.
3. I agree to DVA providing my DVA health data to the Australian Gulf War Veterans' Health Study 2011 Follow Up for the period 01/01/2001 to 31/12/2031. (If you have ever had a DVA file number, please provide one here.)
DVA file number if available
4. I authorise Medicare Australia to provide my Medicare, PBS and RPBS claims history to the Australian Gulf War Veterans' Health Study 2011 Follow Up for the period 01/01/2001 to 31/12/2031. My Medicare card number is: Image: Claim Content of Co
OR None of the above; I do not wish to participate in any part of the study .
DECLARATION I declare that the information on this form is true and correct.
Signature _/_/_20

A sample of the information that may be included in your Medicare claims history:

Date of service	Date of Processing	ltem number	Item description	Provider charge	Schedule Fee	Benefit paid	Patient out of pocket	Bill type
20/04/09	03/05/09	00023	Level B consultation	\$38.30	\$34.30	\$34.30	\$4.00	Cash
22/06/09	23/06/09	11700	ECG	\$29.50	\$29.50	\$29.50		Bulk Bill

Scrambled ordering Provider number*	Scrambled rendering Provider number*	Date of referral	Rendering Provider postcode	Ordering Provider postcode	Hospital indicator	Provider derived major speciality	Item category
						General	
	999999A		2300		Ν	Practitioner	1
999999A	999999A	20/04/09	2300	2302	N	Cardiologist	2

A sample of the information that may be included in your PBS claims history:

Date of supply	Date of prescribing	PBS item code	Item description	Patient category	Patient contributi on	Net Benefit	Scrambled Prescriber number*
06/03/09	01/03/09	03133X	Oxazepham Tablet 30mg	Concessional Ordinary	\$5.30	\$25.55	9999999
04/07/09	28/05/09	03161J	Diazepam Tablet 2mg	General Ordinary	\$30.85		9999999
Pharmacy postcode	Form Category	ATC Code	ATC Name	Prescriber derived major speciality			
2560	Original	N05 B A 04	Oxazepam	General Practitioner			
2530	Repeat	N05 B A 01	Diazepam	Psychiatrist			

* Scrambled Prescriber number refers to a unique scrambled prescriber number identifying the doctor who prescribed the prescription. Generally, each individual prescriber number will be scrambled and the identity of that prescriber will not be disclosed.

POSTAGE PAID AUSTRALIA

DPID BARCODE

BSP: XXXX - X <TITLE> <FIRST NAME> <LAST NAME> <ADDRESS 1> <ADDRESS 2> <SUBURB> <STATE> <POSTCODE>



Department of Epidemiology & Preventive Medicine School of Public Health and Preventive Medicine Faculty of Medicine, Nursing and Health Sciences

AUSTRALIAN GULF WAR VETERANS' HEALTH STUDY - 2011 FOLLOW-UP

Dear <TITLE> <LAST NAME>

You were recently sent a package inviting you to participate in the Gulf War Veterans' Health Study 2011 Follow Up. We have not heard from you and encourage you to again consider taking part. Please disregard this reminder card if you have recently responded to our invitation.

The study will contribute valuable knowledge to veteran, defence and civilian communities about the longer-term health impacts of war-related and other military activities and experiences. For the study to be successful, it is vital that as many people as possible participate. This includes the young and the old, those unwell and those who enjoy good health. Please be assured that your responses will be retained confidentially by the University.

We urge you to read the invitation package that was sent to you. If you need additional information, or a new invitation package, please contact the Monash study team on the free call number 1800 729 913 or email moncoeh-veteranstudy@monash.edu

We look forward to hearing from you soon.

Yours sincerely,

Professor Malcolm Sim

Director, Monash Centre for Occupational and Environmental Health (MonCOEH)

Postal address: Monash University, The Alfred Centre, Melbourne VIC 3004 Street address: Level 6, Alfred Centre, 99 Commercial Rd, Melbourne VIC 3004 Phone: 1800 729 913 Email: moncoeh-veteranstud/@monash.edu Website: www.coeh.monash.org



Department of Epidemiology & Preventive Medicine School of Public Health and Preventive Medicine Faculty of Medicine, Nursing and Health Sciences

DPID BARCODE

BSP: XXXX - X <TITLE> <FIRST NAME> <LAST NAME> <ADDRESS 1> <ADDRESS 2> <SUBURB> <STATE> <POSTCODE>

AUSTRALIAN GULF WAR VETERANS' HEALTH STUDY - 2011 FOLLOW-UP

Dear <TITLE> <LAST NAME>

Recently you were invited to participate in the Gulf War Veterans Health Study 2011 Follow Up. We have not heard from you and send this reminder to encourage you to consider taking part. If you have recently forwarded to us your completed Consent Form indicating that you do not wish to participate, or the completed Consent Form and study questionnaire because you do wish to participate, then please disregard this reminder letter.

This important study provides a valuable opportunity to comprehensively document information about the long term health effects of war and other military service. The study can only be successful if as many invited participants as possible take part. Importantly that includes all those who enjoy good health, as well as those who are unwell. Your participation, however, is completely voluntary.

Please be assured that any information you provide as part of this research will be held confidentially by Monash University and that no health information which identifies you in any way will be passed on to the Department of Veterans' Affairs or the Australian Defence Force. Further, your answers will not in any way affect any DVA or Defence pension, benefit or health service to which you are entitled.

For your convenience, we have enclosed another copy of the study Explanatory Statement, Consent Form, postal questionnaire and Reply-paid envelope. If you need further information please do not hesitate to contact the Monash study team on the free call number 1800 729 913 or email moncoeh-veteranstudy@monash.edu

We look forward to hearing from you soon.

Yours sincerely,

Mulul A

Professor Malcolm Sim Director, Monash Centre for Occupational and Environmental Health (MonCOEH)



Department of Epidemiology & Preventive Medicine School of Public Health and Preventive Medicine Faculty of Medicine, Nursing and Health Sciences

> First name Surname Street address Suburb State Postcode

AUSTRALIAN GULF WAR VETERANS' HEALTH STUDY – 2011 FOLLOW-UP

Dear [insert Mr or Ms Surname]

Recently you were invited to participate in the Gulf War Veterans Health Study 2011 Follow Up. We have not heard from you and send this reminder to encourage you to consider taking part. If you have recently forwarded to us your completed Consent Form indicating that you do not wish to participate, or the completed Consent Form and study questionnaire because you do wish to participate, then please disregard this reminder letter.

This important study provides a valuable opportunity to comprehensively document information about the long term health effects of war and other military service. The study can only be successful if as many invited participants as possible take part. Importantly that includes all those who enjoy good health, as well as those who are unwell. Your participation, however, is completely voluntary.

Please be assured that any information you provide as part of this research will be held confidentially by Monash University and that no health information which identifies you in any way will be passed on to the Department of Veterans' Affairs or the Australian Defence Force. Further, your answers will not in any way affect any DVA or Defence pension, benefit or health service to which you are entitled.

For your convenience, we have enclosed another copy of the study Explanatory Statement, Consent Form, postal questionnaire and Reply-paid envelope. If you need further information please do not hesitate to contact the Monash study team on the free call number **1800 729 913** or email **moncoeh-veteranstudy@monash.edu**.

We look forward to hearing from you soon.

Yours sincerely,

Julul

Professor Malcolm Sim Director, Monash Centre for Occupational and Environmental Health (MonCOEH)