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The mental health of UK Gulf war veterans: phase 2 of a two phase cohort study

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Abstract

Objectives To examine the prevalence of psychiatric disorders in veterans of the Gulf war with or without unexplained physical disability (a proxy measure of ill health) and in similarly disabled veterans who had not been deployed to the Gulf war (non-Gulf veterans).

Design Two phase cohort study.

Setting Current and ex-service UK military personnel.

Participants Phase 1 consisted of three randomly selected samples of Gulf veterans, veterans of the 1992-7 Bosnia peacekeeping mission, and UK military personnel not deployed to the Gulf war (Era veterans) who had completed a postal health questionnaire. Phase 2 consisted of randomly selected subsamples from phase 1 of Gulf veterans who reported physical disability (n=111) or who did not report disability (n=98) and of Bosnia (n=54) and Era (n=79) veterans who reported physical disability.

Main outcome measure Psychiatric disorders assessed by the schedule for clinical assessment in neuropsychiatry and classified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition.

Results Only 24% (n=27) of the disabled Gulf veterans had a formal psychiatric disorder (depression, anxiety, or alcohol related disorder). The prevalence of psychiatric disorders in non-disabled Gulf veterans was 12%. Disability and psychiatric disorders were weakly associated in the Gulf group when confounding was adjusted for (adjusted odds ratio 2.4, 99% confidence interval 0.8 to 7.2, P=0.04). The prevalence of psychiatric disorders was similar in disabled non-Gulf veterans and disabled Gulf veterans (19% v 24%; 1.3, 0.5 to 3.4). All groups had rates for post-traumatic stress disorder of between 1% and 3%.

Conclusions Most disabled Gulf veterans do not have a formal psychiatric disorder. Post-traumatic stress disorder is not higher in Gulf veterans than in other veterans. Psychiatric disorders do not fully explain self reported ill health in Gulf veterans; alternative explanations for persistent ill health in Gulf veterans are needed.

Introduction

Population based studies have consistently found that veterans of the 1990-1 Persian Gulf conflict report

symptoms around two to three times more often than appropriate controls.^{1,2} The symptoms reported are multisystem and non-specific such as fatigue, sleeping difficulties, and irritability, which at present are medically unexplained. Markers of serious physical morbidity, such as admission to hospital and mortality, are not increased in Gulf veterans, with the exception of accidents.^{3,4} Complex multivariate statistical analyses have failed to identify a cluster of symptoms, conditions, or causal factors consistent with a new syndrome.⁵

Common psychiatric disorders also seem to be increased in Gulf veterans. Depression, tension headache, and post-traumatic stress disorder accounted for a major proportion of clinical diagnoses in voluntary registers, but these were likely to have been over-represented by veterans who perceived themselves as ill.⁶ Population based studies have also shown that symptoms of depression and post-traumatic stress disorder are reported more commonly in Gulf veterans, but self reported symptoms may overestimate or underestimate psychiatric morbidity and have poor concordance with clinician ratings.^{1,2,7,8}

In civilian populations, medically unexplained symptoms are associated with increased rates of psychiatric disorders.⁹ This may also be the case in Gulf veterans.¹⁰ An association was found between number of symptoms and post-traumatic stress disorder and depression in one sample of US Gulf veterans by using structured psychiatric interviews, but a control group of non-Gulf veterans was not used to test whether this was unique to the Gulf experience.¹¹

The nature of ill health in Gulf veterans remains unclear. We aimed to test the strength of the association between psychiatric disorders and reported ill health in Gulf veterans. We also aimed to test whether psychiatric disorders in Gulf veterans who reported ill health were more common than in non-Gulf veterans with similar levels of ill health.

Participants and methods

Design

We used a two phase study design. Phase 1 was a population based survey using a postal health questionnaire to compare self reported health indices in three randomly selected cohorts of the UK armed forces.

Gulf War Illnesses Research Unit, Guy's, King's, and St Thomas's School of Medicine, London SE5 8AZ

Khalida Ismail
clinical lecturer

Kate Kent
research nurse

Matthew Hotopf
reader

Lisa Hull
research assistant

Paul Seed
statistician

Steve Reid
research fellow

Catherine Unwin
study coordinator

Anthony S David
professor

Simon Wessely
professor

Section of Social and Epidemiological Psychiatry, University of Leicester

Department of Psychiatry, Leicester General Hospital, Leicester LE5 4PW

Traolach Brugha
professor

Royal Defence Medical College, Fort Blockhouse, Gosport

Ian Palmer
military psychiatrist

Correspondence to: K Ismail
khalida.ismail@iop.kcl.ac.uk

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The cohort of interest was those deployed to the Gulf conflict between 1 September 1990 and 30 June 1991 (n=5 046). We chose two cohorts as controls: one comprised veterans who served in Bosnia as part of the United Nations peacekeeping forces between 1 April 1992 and 6 February 1997 (n=3450) to match for the experience of being in an international conflict, and the other comprised veterans who were in active service in the UK armed forces during the Gulf conflict but not deployed to the Gulf (Era veterans; n=4248) to match for military experience. The methods, response rates, and main findings of phase 1 have been published elsewhere.⁷ In phase 2, reported here, we compared Gulf veterans who screened positive at phase 1 for physical disability with Gulf veterans who screened negative and with Bosnia and Era veterans who screened positive (figure).

Population and sample

Individuals who returned completed questionnaires in phase 1 were defined as cohort members. They constituted the population from which groups were defined for phase 2.

Definition of ill health

In the absence of a clear definition of Gulf related ill health we used a generic measure of physical disability, the SF-36 physical functioning subscale, which was measured at phase 1 as our proxy measure for ill health.¹² We used the value of the first decile of the distribution of the SF-36 physical functioning subscale in the Era cohort (score 72.2) as the cut-off point below which we defined disability in all three cohorts. We considered the Era cohort the most representative of the military as it represented 80% of the UK armed forces. We chose a generic measure to allow a comparison between Gulf veterans and non-Gulf (Bosnia and Era) veterans that would be unbiased by different distributions of symptoms or assumptions about the nature of ill health in such veterans. This definition of ill health was designed to identify veterans whose disability was most likely to be clinically important. We defined Gulf veterans who reported impaired physical functioning below the cut-off point as disabled Gulf veterans, and those above as non-disabled Gulf veterans. We defined Bosnia and Era veterans who

reported impaired physical functioning below the cut-off point as disabled non-Gulf veterans. Bosnia and Era veterans were sampled separately from their respective cohorts but were grouped together in the statistical analysis (figure). The numbers of disabled and non-disabled Gulf and disabled Bosnia and Era veterans that were eligible to participate were 406, 3047, 138, and 278, respectively. We invited veterans to participate by using computer generated random numbers in batches of 100 for each group. We excluded those who after random selection had a disease or reported a currently diagnosed serious physical illness and replaced them by another randomly selected individual from the remaining eligible samples. Participants were invited to attend the Gulf War Illnesses Research Unit for a one day medical assessment between January 1999 and September 2000. Our study was approved by the local ethics committee, and we obtained informed consent.

Measures

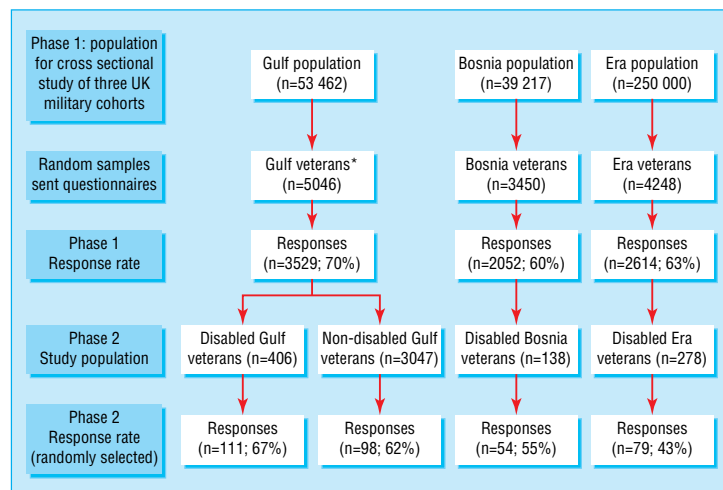
We asked participants about their sociodemographic and military history using a standardised format. We measured physical disability with the SF-36 physical functioning subscale to assess change in physical functioning between phase 1 and phase 2.

The World Health Organization's schedule of clinical assessment in neuropsychiatry (version 2.1), a semi-structured interview, was administered by two psychiatrists (KI and SR) and a research nurse (KK) trained in its use. The presence and severity of current psychiatric symptoms was rated against a comprehensive list of precoded definitions for symptoms. Symptoms present within the past 4 weeks were rated. Symptoms that were rated covered alcohol related disorders, mood, anxiety, sleep, and somatoform disorders. We excluded psychotic disorders as they were expected to be of negligible frequency in this sample. A computer program, I-Shell SCAN (version 1 Win9x; WHO, Geneva), generated diagnoses based on the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV). Inter-rater reliability was assessed by each interviewer in turn rating taped interviews of study participants conducted by the other two interviewers.

Statistical analysis

We analysed our data with STATA 6. We defined non-participants as cohort members who refused, cancelled, or did not attend for interview. We used the χ^2 test to compare sociodemographic and health data of non-participants with participants based on information they had provided in the questionnaires in phase 1.⁷ We report separately the baseline demographic characteristics of disabled and non-disabled Gulf and disabled Bosnia and Era veterans with the χ^2 test. We measured the inter-rater reliability of the psychiatric interviews by comparing the agreement for depressive and anxiety disorders with the combined κ statistic for more than two raters.¹⁵ We present the distribution of psychiatric disorders for three groups: disabled Gulf veterans, non-disabled Gulf veterans, and disabled non-Gulf veterans (Bosnia and Era veterans combined). We present post-traumatic stress disorder separately from the other anxiety disorders because of its special relevance to a military population.

Our main analysis was the association between each of the main psychiatric disorders and disability



Study design. *Includes 800 Bosnia veterans from Bosnia sample who had also been deployed to the Gulf and for all subsequent analyses were taken as part of Gulf cohort

Table 1 Summary statistics of number of veterans in phase 1 and phase 2 in each category of SF-36 physical functioning subscale and its probability weight by cohort status

SF-36 group	Gulf veterans			Bosnia veterans			Era veterans		
	Stage 1	Stage 2	Probability weight	Stage 1	Stage 2	Probability weight	Stage 1	Stage 2	Probability weight
0 to <20.0	34	9	3.8				29	5	5.8
20.0 to <30.0	23	7	3.3	34*	19*	2.4*	26	6	4.3
30.0 to <40.0	30	7	4.3				43*	6*	7.2*
40.0 to <50.0	22	5	4.4						
50.0 to <60.0	79	18	4.4	22	9	2.4	58	20	2.9
60.0 to <72.2	216	64	3.4	79	28	2.8	120	41	2.9
72.2† to <80.0	131	5	26.2	47	—	—	—	—	—
80.0 to <90.0	515	19	27.1	161	—	—	—	—	—
90.0 to <100.0	320	10	32	145	—	—	—	—	—
100	2073	64	32.4	1500	—	—	—	—	—

Cells with no values are because no individuals with scores in these categories were selected for phase 2.

*Cells merged, as number in each was too small from which to calculate probability weight.

†Score <72.2=disabled.

status in the Gulf group, adjusting for potential confounding by age, sex, rank, and marital status with logistic regression. In our subsidiary analysis we adjusted for the same confounders with logistic regression to assess the association between each of the main psychiatric disorders and disability in the Gulf compared with non-Gulf group.

We report categorical data in percentage proportions and associations as either odds ratios or χ^2 (degrees of freedom). We chose 99% confidence intervals to report the estimate of the effect sizes to take account of multiple testing, but we also reported P values that were at or less than the 5% level. To take account of potential sampling bias—that is, the probability of being selected at phase 2 depending on the score on the SF-36 physical functioning subscale and cohort status at phase 1—we generated probability weights (table 1) and included them in the logistic regression.¹⁴ These are inversely proportional to the sampling fraction, which is the probability of a given observation in phase 1 being chosen for phase 2.

Results

Overall, 740 cohort members were eligible for the study. Contact was made with 607. Non-participants were defined as those who refused to participate (n=176) and those who initially agreed to participate but did not attend (n=89). Table 2 compares the characteristics of participants with non-participants. The participation rate from phase 1 to phase 2 was 67% (n=111) for disabled Gulf veterans, 62% (n=98) for non-disabled Gulf veterans, 55% (n=54) for disabled Bosnia veterans, and 43% (n=79) for disabled Era veterans (figure).

Table 3 details the sociodemographic and military characteristics of participants in the four groups (Bosnia and Era reported separately). Distributions for sex and marital status were similar across the groups. Disabled veterans were more likely to be older than non-disabled veterans, to have left the armed forces, and to belong to a lower rank. Phase 2 scores on the SF-36 physical functioning subscale showed that between a third to a half of disabled veterans at phase 1 had improved whereas around 10% of non-disabled (Gulf only) veterans at phase 1 now met the criteria for disability.

The summary statistics for probability weights in table 1 show that the non-disabled Gulf veterans had the largest probability weights because there were relatively more of them in phase 1 than there were of disabled Gulf and non-Gulf veterans (figure). The combined inter-rater reliabilities for depressive disorders (α coefficient 0.83) and anxiety disorders (α coefficient 0.85) were high.

Table 4 shows the distribution of current DSM-IV categories and disorders. Most psychiatric disorders were 2-10 times more common in disabled Gulf veter-

Table 2 Sociodemographic and health characteristics of participants and non-participants in UK military personnel from phase 1 data. * Values are numbers (percentages) unless stated otherwise

	All participants (n=342)	All non-participants (n=265)	χ^2 test for heterogeneity (df), P value
Sex:			
Male	319 (93)	238 (90)	2.4 (1), 0.124
Female	23 (7)	27 (10)	
Age (years):			
20-39	259 (76)	195 (74)	0.4 (1), 0.546
≥40	83 (24)	70 (26)	
Marital status:			
Married or cohabiting	247 (73)	194 (74)	1.3 (2), 0.529
Divorced or separated	55 (16)	45 (17)	
Never married	38 (11)	22 (8)	
Qualifications:			
No qualifications	72 (23)	68 (27)	4.3 (2), 0.12
High school or college	229 (72)	179 (71)	
University	19 (6)	7 (3)	
Employment status:			
Employed	295 (88)	224 (87)	0.2 (1), 0.651
Not employed	40 (12)	34 (13)	
Service status:			
In service	138 (42)	152 (49)	3.5 (1), 0.061
Left service	204 (58)	113 (52)	
Psychological distress‡:			
Present	134 (41)	126 (50)	5.0 (1), 0.026
Not present	195 (59)	126 (50)	
Study group‡:			
Disabled Gulf veterans	111 (67)	55 (33)	28.0 (3), <0.0005
Non-disabled Gulf veterans	98 (52)	59 (38)	
Disabled Bosnia veterans	54 (55)	44 (45)	
Disabled Era veterans	79 (43)	107 (58)	

*Some categories do not add up to denominators because of missing data from phase 1.

†Measured by 12 general health questionnaires (score >3 when psychological distress present).

‡In each group denominator is participant plus non-participant.

Table 3 Distribution and univariate analysis of sociodemographic and military characteristics of disabled Gulf veterans, non-disabled Gulf veterans, disabled Bosnia veterans, and Era veterans. Values are numbers (percentages) unless stated otherwise

	Disabled Gulf veterans (n=111)	Non-disabled Gulf veterans (n=98)	Disabled Bosnia veterans (n=54)	Disabled Era veterans (n=79)	Disabled Gulf veterans v non-disabled Gulf veterans (χ^2 (df), P value)	Disabled Gulf veterans v disabled Bosnia and Era veterans combined (χ^2 (df), P value)
Sex:						
Male	105 (95)	93 (95)	50 (93)	71 (90)	0.01 (1), 0.922	1.16 (1), 0.282
Female	6 (5)	5 (5)	4 (7)	8 (10)		
Age (years):						
21-30	25 (23)	33 (34)	29 (54)	12 (15)	11.35 (2), 0.003	2.25 (2), 0.325
31-40	53 (48)	54 (55)	21 (39)	34 (43)		
>40	33 (30)	11 (11)	4 (7)	33 (42)		
Marital status:						
Married or cohabiting	71 (64)	77 (79)	41 (76)	56 (71)	8.29 (2), 0.016	4.18 (2), 0.124
Divorced or separated	17 (15)	14 (14)	9 (17)	12 (15)		
Never married	23 (21)	7 (7)	4 (7)	11 (14)		
Service status:						
In service	33 (30)	52 (53)	32 (59)	24 (30)	11.74 (1), 0.001	3.99 (1), 0.046
Left service	78 (70)	46 (47)	22 (41)	55 (70)		
Rank:						
Private	28 (25)	16 (16)	16 (30)	8 (10)	7.92 (2), 0.019	6.04 (2), 0.049
Non-commissioned officer	79 (71)	69 (70)	34 (63)	60 (76)		
Commissioned officer	4 (4)	13 (13)	4 (7)	11 (14)		
Current disability status:						
Disabled*	65 (60)	11 (11)	36 (67)	39 (50)	52.1 (2), <0.005	241.0 (5), <0.0005
Not disabled	44 (40)	87 (89)	18 (33)	39 (50)		

*Score <72.2 on SF-36 physical functioning subscale at phase 2: missing observations in two disabled Gulf veterans and one disabled Era veteran owing to lack of data at phase 2.

ans than they were in non-disabled Gulf veterans except for alcohol related disorders, which were less common. The rates for most psychiatric disorders were similar between disabled Gulf veterans and disabled non-Gulf veterans (Bosnia and Era veterans combined) except for somatoform disorders, which were twice as common in the disabled Gulf group. The rates for

post-traumatic stress disorder were similarly low in all three groups.

The likelihood of having any psychiatric disorder in each DSM-IV category was assessed by logistic regression (table 5). Disabled Gulf veterans were significantly more likely to have depressive, anxiety, somatoform, and sleep disorders than were non-

Table 4 Prevalence of DSM-IV disorders in disabled Gulf veterans, non-disabled Gulf veterans, and disabled Bosnia and Era veterans combined. Values are numbers (percentages)

	Disabled Gulf veterans (n=111)	Non-disabled Gulf veterans (n=98)	Disabled Bosnia and Era veterans (n=133)
Any alcohol related disorder	8 (7)	10 (10)	5 (4)
Alcohol dependence	5 (5)	7 (7)	3 (2)
Alcohol misuse	3 (3)	3 (3)	2 (2)
Substance induced anxiety disorder	0	1 (1)	0
Any mood disorder	13 (12)	3 (3)	14 (11)
Major depressive disorder, single episode	13 (12)	3 (3)	14 (11)
Any anxiety disorder	16 (14)	3 (3)	14 (11)
Panic disorder without agoraphobia	4 (4)	0	1 (1)
Panic disorder with agoraphobia	0	1 (1)	0
Agoraphobia without panic disorder	3 (3)	1 (1)	1 (1)
Specific phobia	3 (3)	1 (1)	4 (3)
Social phobia	2 (2)	0 (0)	2 (2)
Generalised anxiety disorder	13 (12)	1 (1)	9 (7)
Any post-traumatic stress disorder	3 (3)	1 (1)	4 (3)
Any somatoform disorder	18 (16)	6 (6)	9 (7)
Somatisation disorder	2 (2)	0	0
Undifferentiated disorder	18 (16)	6 (6)	9 (7)
Any sleep disorder	20 (18)	7 (7)	19 (14)
Primary insomnia	12 (11)	6 (6)	9 (7)
Primary hyperinsomnia	0	0	1 (0.8)
Circadian rhythm sleep disorder	2 (2)	4 (4)	4 (3)
Nightmare disorder	7 (6)	1 (1)	6 (5)
Sleep terror disorder	4 (4)	0	4 (3)
Sleepwalking disorder	2 (2)	0	1 (1)
Any psychiatric disorder*	27 (24)	12 (12)	25 (19)

DSM-IV=Diagnostic and Statistical Manual of Mental Disorders, fourth edition.

*Depression, anxiety, and alcohol related disorders only.

Table 5 Univariate and multivariate analysis of association between having a DSM-IV disorder and group status. Values are odds ratios (99% confidence intervals)

Disorder	Disabled Gulf veterans (n=111) v non-disabled Gulf veterans (n=98)				Disabled Gulf veterans (n=111) v disabled Bosnia and Era veterans combined (n=133)			
	Unadjusted	P value	Adjusted*	P value	Unadjusted	P value	Adjusted*	P value
Alcohol related disorder	0.7 (0.2 to 2.5)	0.44	0.5 (0.1 to 2.4)	0.28	2.0 (0.4 to 9.0)	0.24	1.9 (0.4 to 9.1)	0.32
Mood disorder	4.2 (0.8 to 22.8)	0.029	4.1 (0.8 to 21.0)	0.025	1.1 (0.4 to 3.2)	0.77	1.0 (0.3 to 3.2)	0.97
Anxiety disorder	5.3 (1.0 to 28.1)	0.01	6.8 (1.4 to 33.4)	0.002	1.4 (0.5 to 3.9)	0.36	1.4 (0.4 to 4.3)	0.47
Post-traumatic stress disorder	2.7 (0.1 to 53.9)	0.39	8.4 (0.3 to 223.2)	0.09	0.9 (0.1 to 6.6)	0.89	1.1 (0.1 to 9.1)	0.88
Somatoform disorder	3.0 (0.8 to 10.6)	0.028	3.3 (0.8 to 13.8)	0.035	2.7 (0.9 to 8.1)	0.023	3.1 (1.0 to 9.6)	0.01
Sleep disorder	2.9 (0.9 to 9.4)	0.02	2.8 (0.8 to 9.7)	0.03	1.3 (0.5 to 3.3)	0.43	1.1 (0.4 to 3.2)	0.78
Any psychiatric disorder†	2.3 (0.9 to 6.1)	0.028	2.4 (0.8 to 7.2)	0.036	1.4 (0.6 to 3.1)	0.30	1.3 (0.5 to 3.4)	0.44

DSM-IV=Diagnostic and Statistical Manual of Mental Disorders, fourth edition.

*Adjusted for age, sex, rank, and marital status using probability weights.

†Depression, anxiety, and alcohol related disorders only.

disabled Gulf veterans. Any common psychiatric disorder (depression, anxiety, and alcohol related disorders) was around two and half times more common in disabled Gulf veterans than it was in non-disabled Gulf veterans.

Comparing the risk of psychiatric disorders between disabled Gulf veterans and disabled non-Gulf veterans (Bosnia and Era veterans combined) showed no significant differences after adjusting for confounding except for somatoform disorders, which were three times more likely in the disabled Gulf veterans (table 5). The relative rate for any common psychiatric disorder (depression, anxiety, and alcohol related disorders) was not significantly greater in disabled Gulf veterans compared with disabled non-Gulf veterans.

Discussion

The validity of previous research into the nature of ill health of Gulf veterans has been questioned because of the lack of appropriate controls and the use of self reported measures. In this observational study we used standardised clinician ratings to measure psychiatric disorder in randomly selected samples of Gulf veterans and non-Gulf veterans (Bosnia and Era veterans combined). We found a negative association: three quarters of Gulf veterans with disability do not have formal psychiatric disorders, such as depression, anxiety, or alcohol related problems, although the prevalence was more than double that of Gulf veterans with no (or minimal) disability. We also found that disabled Gulf veterans are not much different in their pattern of mental health problems to similarly disabled non-Gulf veterans except that they have a threefold increase in somatoform disorders. The prevalence of post-traumatic stress disorder was no different in the three groups, suggesting that whatever the nature of ill health in Gulf veterans, it was not explained by events or exposures conventionally understood to be psychologically traumatic.

Several potential limitations to our study need to be considered. Firstly, we used a two phase cohort design as an efficient method of identifying the most ill and most healthy veterans when there is no case definition for ill health in Gulf veterans.¹⁵ Using a screening questionnaire alone would be prone to reporting bias. A clinical interview of thousands of veterans would have been too costly. The limitation of a two phase design is that conclusions are made on a small proportion of the population being studied so that the overall estimate of

the associations are less precise. We used sampling weights to take account of different probabilities for being selected based on cohort status and physical functioning, but this would not have corrected for response rates at phases 1 and 2.

Secondly, a sizeable proportion of disabled veterans at phase 1 had improved physical functioning by the time they participated in the clinical interview at phase 2, whereas a smaller proportion of healthy Gulf veterans became worse. This may have led to an underestimation of current psychiatric disorders in disabled Gulf veterans. By using a physical functioning measure to define ill health we may have overidentified people with physical symptoms and underidentified people with psychological symptoms. However, using psychiatric screening measures such as the general health questionnaire would have biased the study to overestimating psychiatric disorders.¹⁶

The prevalence of common psychiatric disorders are not increased in Gulf veterans who report no physical disability, and it is reassuring that even in those selected by their level of disability the rates are not substantially increased. These findings contrast with most previous research, which has used self report measures.¹ The increase in somatoform disorders that we found should be treated cautiously. Although it confirms that there is an increase in symptomatic distress in Gulf veterans, redefining medically unexplained symptoms as somatoform disorders may to some extent be tautological and is anyhow a controversial psychiatric disorder. Most somatoform disorders were of the undifferentiated type, a diagnosis that falls short of somatisation disorder, which is the more severe and rare form. Undifferentiated somatoform disorder described here represents multiple unexplained symptoms that are distressing but not so severe that Gulf veterans are seeking multiple medical advice or reassurance to establish their cause.

We found low rates of post-traumatic stress disorder, which contrasts with most other studies. Several studies have used self reported measures, which may have overestimated post-traumatic stress, or have used selected samples.^{11 17} Our findings also contrast with studies that found a positive association between symptoms of post-traumatic stress and ill health in Gulf veterans.¹⁷ One interpretation is that a simple association between ill health and the conventional diagnosis of post-traumatic stress disorder is not necessarily found in modern military populations, especially in conflicts such as the Gulf war in which tra-

What is already known on this topic

Gulf veterans report medically unexplained symptoms more often than non-Gulf veterans

The clinical characteristics of ill health in Gulf veterans are not well known, and factors associated with ill health in Gulf veterans are poorly understood

What this study adds

Most ill Gulf veterans do not have a formal psychiatric disorder

The rates for post-traumatic stress disorder are low

Psychiatric morbidity is not strongly associated with ill health in Gulf veterans

The rates for somatoform disorders are three times greater in disabled Gulf veterans than they are in disabled non-Gulf veterans

ditional military combat trauma was rare. We suggest that current models of psychological distress based solely on discrete traumatic events may have limited explanatory function in Gulf related ill health and that other vulnerability factors such as the effects of premorbid health, media reporting, and communication of risk may have a more important role in explaining anxiety and somatic symptoms in Gulf veterans. Other methodological explanations may exist for the low rates of post-traumatic stress disorder. In our study non-participants in phase 2 had more psychological distress at phase 1, and it is possible that some veterans with post-traumatic stress disorder were too ill to attend for phase 2.

We continue to find an effect of the Gulf conflict manifested as increased symptomatic distress. In our study, the modest increase in psychiatric disorders do not fully explain ill health in Gulf veterans.

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Contributors: KI contributed to the study hypotheses and design, collected the data, performed the statistical analysis, and drafted the manuscript. KK collected the data. SR conducted some of the psychiatric interviews. CU and LH coordinated the study. TB assisted with the measurement of the psychiatric data and analysis plan. PS calculated the probability weights and was the statistical adviser. MH contributed to the statistical analysis. All authors contributed to the preparation of the manuscript. ASD and SW are the principal investigators and will act as guarantors for the paper.

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