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GENERAL MEDICINE

Upward trends in symptom reporting in the UK Armed Forces

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Abstract Several reports have shown increases in the prevalence of non-specific symptoms in the general population. Research in the military tends to focus on comparisons between deployed and non-deployed personnel and does not examine trends over time. 4,257 and 4,295 male participants of the Gulf war and Iraq war studies not deployed to either of these wars were randomly sampled and surveyed in 1997/1998 and 2004/2006 in two independent cross-sectional studies. Information was collected on 50 symptoms and the General Health Questionnaire (GHQ-12). Factor analysis was performed to identify an underlying pattern of symptom dimensions, and multivariate regressions were carried out to examine changes in symptom dimensions between the two surveys and the possible role of psychological morbidity. Factor analysis identified a robust pattern of eight symptom dimensions. An increase in the prevalence of symptoms was evident across all symptom dimensions. Adjustment for demographic and service characteristics revealed increases in the odds of scoring highly on symptom dimensions, varying from odds ratios 1.57, 95% CI 1.36–1.81 (cardio-respiratory dimension) to 2.24, 95% CI 1.93–2.60 (fatigue dimension). Unexpectedly, increases were even greater when adjusting for psychological morbidity. There is clear evidence of an increase in the reporting of non-specific symptoms over a 7 year period in the UK Armed Forces. It suggests that the threshold for reporting symptoms has decreased and cannot be explained by psychological distress. The possible implication of this trend for medical practice in the wider population deserves close scrutiny.

Keywords Factor analysis · Military · Non-specific symptoms · Psychological distress · Psychological symptoms

Abbreviations

GHQ	General Health Questionnaire
OR	Odds ratio
UK	United Kingdom

Introduction

There is good evidence of an increase in the prevalence of back pain, asthma, musculoskeletal pain, fibromyalgia and mental disorders over time [1–5], as well as studies demonstrating a steady increase in the reporting of long standing illness such as asthma and musculoskeletal problems [6]. Whether these increases in self-reported symptoms are indicative of greater levels of underlying pathology in the population is a matter of dispute. Systematic bias in reporting related to subjective perception of symptoms [7], greater willingness to report symptoms [2] and expectations that may affect the perception of health

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and symptoms may be responsible for the observed upward trends [4, 8]. Some commentators have talked of a "paradox of health", a phenomenon by which objective indices of health have improved but subjective measures of health have deteriorated [9]. However, at the same time in Western societies, material improvements have been blamed for the increase in some chronic conditions such as obesity and type 2 diabetes mellitus [10, 11], and there are reports showing an objective increase of bronchial-reactivity to challenge in asthmatics [12, 13].

Largely as a result of the aftermath of the 1991 Gulf war and the legacy of the so-called "Gulf War Syndrome", many studies have investigated the burden of symptoms in the Armed Forces. These studies have shown that deployment in the 1991 Gulf war was associated with an increased prevalence of non-specific symptoms [14] (although not representing a unique syndrome as such) [15]. However, a similar comparison between non-deployed and deployed personnel during the Iraq war failed to show a sharp contrast in the prevalence of non-specific symptoms [16]. So far, attention has focused on comparing deployed and non-deployed UK personnel in either the Gulf or Iraq wars. However, what has not been addressed is the possibility of changes over time, i.e. trends independent of deployment.

The aim of this study was to compare, using two cohorts, the prevalence of 50 non-specific symptoms, and to examine differences across time. The analysis included only personnel from studies of deployment to the Gulf and Iraq wars that did not deploy to these conflicts. This approach removed the influence of the very well documented but circumscribed increase in symptoms associated with service in the Gulf war [14]. The possible role of psychological morbidity in explaining trends over time was assessed.

Methods

Sample

We used data from two cross-sectional health studies of the UK Armed Forces. The 'Gulf war study' was carried out between 1997 and 1998 and had a 65.1% response rate ($n = 8{,}195$) [17]. The study comprised three randomly sampled groups: personnel who were deployed in the Gulf region between 1 September 1990, and 30 June 1991 (Gulf war group); and two comparison groups: personnel who were deployed in Bosnia between 1 April 1992, and 6 February 1997 (Bosnia group); and a group who were serving in the UK Armed Forced on 1 January 1991, but had not been deployed (Era group). It is the latter two groups ($n = 4{,}257$) which were used in this analysis.

The 'Iraq war study' was carried out between 2004 and 2006 and had a 61% response rate ($n = 10{,}272$) [18]. The study comprised two randomly sampled groups based on personnel who were deployed on the first phase of the Iraq war (Operation TELIC 1, the codename of the Iraq operation) between 18 January and 28 April 2003 (TELIC 1) and those who were serving at the time but were not deployed on this operation (Era group). Only the Era group ($n = 4{,}295$) was used in this analysis. The survey was carried out shortly after the completion of the first phase of the Iraq war (TELIC 1) although the conflict in Iraq continued throughout the data collection period. This meant that some personnel who had originally been designated to the Era group served on subsequent deployments to the conflict area (TELIC 2 or later). Special Forces were excluded from both studies for security reasons.

Both studies were based on randomly selected samples stratified by deployment status, and further stratified by Service (Naval Services, Army and Royal Air Force) and enlistment type (regular or reserve status). Analysis in the present investigation was restricted to male, regular, personnel from the two studies that did not deploy to the Gulf or Iraq wars. Reservists were excluded as they follow a civilian pattern of life most of the time and have been shown to have different patterns of health behaviours [19]. Women were excluded as their numbers were low and they have a different pattern of symptoms to men [20]. Personnel comprising the Bosnia group in the Gulf war study were included as they too constituted an era control group in the Gulf war study and deployment is a common feature in the Armed Forces [16]. Personnel comprising the Era group in the Iraq war study that served in Iraq on TELIC 2 or later at the time of questionnaire completion were also included as they conformed to the original criteria defined for sampling the era group in the Iraq war study [18]. However, we repeated the analysis excluding those who participated in TELIC 2 or later to assess the robustness of our findings.

Measures and procedures

Full details of the sampling, methods used to contact respondents, and measures employed in the two surveys, have been published before [17, 18]. Respondents indicated whether or not they had experienced any of 50 non-specific physical and psychological symptoms in the past month using a checklist. The checklist incorporated symptoms from the Hopkins Symptom Checklist [21], from symptom criteria for various functional disorders (such as chronic fatigue syndrome), and from symptoms reported in the pilot phase of the Gulf war study. The list of symptoms is given in the results section of this paper. Psychological morbidity was assessed using the 12-item version of the

General Health Questionnaire (GHQ-12) [22]. The continuous scoring method was employed as it was deemed more appropriate to the continuous nature of psychological morbidity in the population. Data were also available for age at completion of questionnaire, educational level, marital status, rank (commissioned officer or other), Service (Naval Services, Army or Royal Air Force) and whether the respondent was still in service at the time of questionnaire completion.

Analysis

Data for the Gulf Era and Iraq Era groups were combined. Age was categorised into bands (<25, 25–29, 30–34, 35–39, 40–49 and 50+ years) in line with previous research [17, 18]. Initially, the prevalence rates of the 50 symptoms in each of the cohorts were graphed to inspect their crude differences. A series of exploratory and confirmatory factor analyses were performed on the data to identify an underlying pattern of interrelations among the 50 symptoms. As traditional factor analysis methods are designed to handle continuous data, specialised techniques that can accommodate binary data were employed. The factor analytic models were based on a two-parameter probit ogive model as implemented in the Mplus software [23]. An exploratory factor analysis was performed on the 50 symptoms in the Gulf Era group and a factor structure was derived based on promax-rotated factor loadings of 0.3 and above, and substantive interpretation of the item-factor associations. The number of factors retained was determined iteratively by exploring factor structures with increasing numbers of factors. The last iteration, where each factor had at least two symptoms with factor loadings of at least 0.3 and meaningful substantive associations was retained. Confirmatory factor analysis was then used to validate the derived factor structure on the Iraq Era group, and the factor structure was then applied to both groups combined (full sample) in the calculation of standardised factor scores. All symptom dimensions were then dichotomised, with categories indicating a factor score in the upper quartile or in the remaining three. The derived binary indicators were then regressed on cohort membership in a series of logistic models in order to assess the relative impact of being in the Iraq Era group on the increase in type of symptom reported (time series effect). We ran three models for each dimension. The first model was unadjusted for any other variable. Model 2 was adjusted for demographic and service-related variables, entered categorically, as shown in Table 1. Model 3 controlled for the variables in model 2 as well as GHQ-12, to assess the impact of psychological morbidity on the trends. All regressions were estimated simultaneously in a complex multivariate model, in order to take account of the intercorrelations among the factors (an oblique-rotated factor structure allows for such intercorrelations by definition). The adjusted odds ratios (OR) for effects of cohort on odds of scoring in the top quartile of the respective symptom dimension scores were graphed for comparison. We also carried out the analysis excluding those of the Era sample deployed subsequently to the Iraq war to check the consistency of our findings. All analyses were carried out using either statistical package STATA 9.0 (Stata Corporation, College Station, TX, USA) or MPLUS v3 [23].

Results

Large differences were observed in all socio-demographic and service characteristics between the two cohorts ($P < .0005$ for all variables; Table 1). The Iraq Era group was older, more educated, had a higher percentage of servicemen in a long term relationship, more commissioned officers, and fewer Army personnel than the Gulf Era group. More personnel were still in service at the point of data collection in the Iraq Era group. The Iraq Era group had slightly lower median GHQ-12 scores, suggesting somewhat lower levels of psychological morbidity.

Figure 1 shows the prevalence of the 50 symptoms in the two cohorts by descending frequency in the Gulf Era group. Higher prevalence rates were observed for most symptoms in the Iraq Era group. The pattern of the Iraq Era group prevalence line indicates some differences in the rank-prevalence of symptoms between the cohorts, although the overall similarity in the slope of the lines suggests the overall pattern of symptoms is comparable. 22 of 50 symptoms had a prevalence of at least 10% in the Gulf Era group, and 28 of 50 in the Iraq Era group.

A series of exploratory factor analyses of symptoms in the Gulf Era group (using principal axis factoring) showed that factor structures with more than eight factors/dimensions resulted in promax-rotated factor loadings of <0.3 for the additional factors. The eight-factor solution yielded meaningful dimensions of symptoms following oblique rotation (Table 2), with moderate correlations ($rs = 0.25$–0.60) amongst the factors. A confirmatory factor analysis on the Iraq Era group showed the eight-factor solution to be a robust account of the clustering of these symptoms and yielded very good fit statistics, which were further improved by dropping some symptoms from the confirmatory factor analysis specifications following initial fitting (factor loadings in bold italics in Table 2). Table 3 lists the fit statistics for the re-specified confirmatory factor analysis, and for an analogous factor analysis on the entire sample (Gulf Era and Iraq Era groups). Comparative fit and Tucker-Lewis index value of 0.95 and above, and Root Mean Square Error of Approximation values of 0.06 and

Table 1 Comparison of cohort characteristics, Gulf Era group and Iraq Era group, and probability values for differences between cohorts

	Gulf Era group % (*n*) total 4,257	Iraq Era group % (*n*) total 4,295	X^2 probability
Age			
<25	12.4 (527)	15.1 (650)	<.0005
25–29	26.9 (1,143)	17.2 (737)	
30–34	29.4 (1,251)	20.6 (884)	
35–39	13.6 (579)	21.8 (938)	
40–49	15.1 (642)	20.7 (889)	
50+	2.7 (115)	4.6 (197)	
Educational status			
No qualifications	18.3 (753)	8.9 (361)	<.0005
O level/gcse	59.4 (2,446)	42.1 (1,705)	
A level	14.2 (586)	29.2 (1,180)	
Degree	8.2 (336)	19.8 (801)	
Relationship status			
In relationship	70.2 (2,940)	79.9 (3,420)	<.0005
Single	21.6 (906)	13.2 (567)	
Previous relationship	8.4 (353)	6.9 (295)	
Rank			
Other rank	88.5 (3,766)	80.7 (3,436)	<.0005
Officer (commissioned)	11.5 (491)	19.3 (821)	
Service			
Army	82.5 (3,509)	62.1 (2667)	<.0005
Royal air force	11.2 (475)	20.6 (884)	
Royal naval service	6.4 (272)	17.3 (744)	
Serving at data collection			
No	30.5 (1,280)	11.5 (489)	<.0005
Yes	69.5 (2,912)	88.6 (3,781)	
	Median (IQR)	*Median* (IQR)	
GHQ-12	12 (10–14)	11 (8–13)	NA

Note: Percentages are based on total valid responses (excluding missing data) for each variable

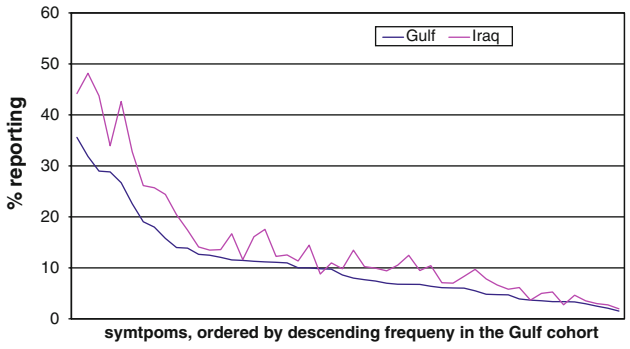

Fig. 1 Prevalence of reported symptoms by cohort

below are considered to indicate very good fit even by conservative standards [24]. In accordance with the factor structure specified in the confirmatory factor analyses, eight symptom dimensions/factors were defined: Cardio-respiratory (F1), Gastrointestinal (F2), Psychological (F3), Gastrointestinal infection (F4), Neurological (F5), Skeletal (F6), Other infection (F7), and Fatigue (F8) with the respective component symptoms detailed in bold in Table 2. Only 10 of the 50 symptoms did not form part of any of the factors/dimensions.

Consistent and statistically significant increases in ORs for the effect of being in the Iraq Era group relative to the Gulf Era group on scoring in the upper quartile of the respective factor scores were observed for all symptoms dimensions in the unadjusted Model 1 (Table 4). After adjusting for demographic and service-related variables the ORs increased for all factors, ranging from 1.57 to 2.24 (Model 2). Adjustment for GHQ-12 scores further increased the OR of each factor (Model 3), especially for the Psychological dimension, from 1.88 (95% CI 1.62–2.17) to 2.64 (2.21–315) and the Fatigue dimension, from 2.24 (1.93–2.60) to 3.09 (2.60–3.68). The estimates take account of the intercorrelations among the symptom dimensions as these were defined by an oblique-rotated solution. Analysis excluding personnel in the sample who subsequently deployed to Iraq did not change the interpretation of the results.

Table 2 Promax-rotated factor loadings (structure matrix of exploratory factor analysis on the Gulf Era group) of specific symptoms on symptom latent dimensions

	F1	F2	F3	F4	F5	F6	F7	F8
Chest pain	**0.53**	0.06	0.13	0.00	0.18	−0.05	0.00	0.02
Headaches	0.18	0.25	0.13	0.04	0.04	−0.02	0.04	0.17
Rapid heartbeat	**0.49**	0.02	0.29	0.11	0.18	−0.07	−0.08	−0.06
Irritability/outbursts of anger	0.07	0.09	**0.77**	−0.02	−0.03	−0.03	−0.17	0.13
Inability to breathe deeply enough	**0.88**	−0.05	0.05	−0.03	0.03	−0.01	−0.02	0.02
Faster breathing than normal	**0.62**	0.09	0.29	0.18	0.01	0.04	−0.20	−0.06
Feeling short of breath at rest	**0.82**	−0.03	0.16	0.00	0.01	0.08	−0.08	−0.07
Wheezing	**0.83**	−0.05	−0.04	0.00	−0.05	0.03	0.04	0.01
Sleeping difficulties	−0.08	0.03	***0.41***	0.03	0.15	0.01	−0.08	**0.51**
Feeling jumpy/easily startled	0.05	−0.10	**0.76**	0.08	0.07	−0.08	−0.02	0.06
Feeling unrefreshed after sleep	−0.02	0.12	***0.41***	−0.16	0.04	0.01	−0.07	**0.74**
Fatigue	0.12	0.23	***0.34***	−0.08	0.01	−0.01	−0.04	**0.48**
Double vision	0.06	0.08	0.17	0.04	0.25	−0.11	0.24	0.02
Intolerance to alcohol	0.05	0.04	**0.53**	0.00	0.06	−0.06	0.01	0.06
Itchy or painful eyes	0.03	0.25	0.02	−0.06	0.12	0.08	0.14	0.26
Shaking	0.17	−0.07	**0.47**	0.17	0.09	−0.07	0.04	0.04
Tingling in fingers and arms	0.09	0.03	0.04	−0.10	**0.91**	−0.01	0.02	0.04
Tingling in legs and toes	0.02	−0.02	−0.08	0.04	**0.79**	0.09	0.14	0.05
Numbness in fingers and toes	0.02	0.03	0.00	0.00	**0.82**	0.09	0.00	0.02
Feeling distant or cut off from others	−0.02	−0.08	**0.91**	0.03	0.01	−0.10	−0.05	0.07
Constipation	−0.08	**0.57**	0.07	0.11	−0.04	−0.01	0.15	0.05
Flatulence or burping	0.03	**0.65**	0.06	−0.02	−0.03	0.03	−0.01	0.03
Stomach cramp	0.03	**0.57**	−0.02	0.27	0.04	0.03	0.07	0.00
Diarrhoea	−0.08	**0.72**	−0.09	***0.35***	0.03	−0.14	0.08	0.04
Dry mouth	0.18	**0.33**	0.15	0.08	0.03	0.01	0.16	0.04
Persistent cough	***0.44***	0.04	−0.20	−0.09	−0.11	−0.02	**0.46**	0.12
Lump in throat	0.28	−0.02	−0.04	0.01	0.03	−0.09	**0.64**	−0.03
Sore throat	0.20	0.21	−0.19	0.06	−0.15	−0.03	**0.61**	0.05
Forgetfulness	0.14	0.20	**0.75**	−0.22	−0.13	0.07	0.12	−0.11
Dizziness	0.15	0.04	0.24	0.08	0.18	0.02	***0.33***	−0.07
Feeling disoriented	0.08	−0.06	**0.67**	−0.04	0.09	−0.08	***0.38***	−0.14
Loss of concentration	0.14	0.18	**0.81**	−0.15	−0.13	0.02	0.08	−0.05
Pain on passing urine	−0.28	0.05	0.18	−0.11	0.12	−0.04	**0.81**	−0.05
Passing urine more often	−0.13	0.25	***0.35***	−0.07	0.00	0.07	0.27	0.02
Burning sensation in the sex organs	−0.23	0.18	0.16	−0.04	0.08	0.02	**0.70**	−0.12
Loss of interest in sex	−0.07	0.04	**0.55**	0.02	−0.01	0.03	0.16	0.08
Increased sensitivity to noise	0.06	0.01	**0.58**	−0.05	−0.01	0.06	0.20	−0.04
Increased sensitivity to light	0.10	0.07	0.27	−0.04	0.04	0.15	0.19	0.08
Ringing in the ears	−0.05	0.02	0.22	0.09	0.11	0.22	0.18	−0.11
Avoiding doing things/situations	0.02	0.05	**0.74**	0.06	−0.06	0.06	0.02	0.00
Pain without swelling/redness, several joints	0.06	−0.05	−0.01	0.04	0.07	**0.92**	−0.06	0.01
Joint stiffness	0.04	0.01	−0.03	0.06	0.09	**0.77**	0.00	0.00
Night sweats that soak the bed sheets	0.00	−0.15	0.29	0.22	−0.04	0.08	0.28	0.06
Feeling feverish	0.13	0.00	0.02	**0.47**	0.08	0.01	**0.39**	−0.04
Loss or decrease in appetite	0.05	−0.08	**0.36**	**0.37**	−0.17	0.04	0.18	0.18
Nausea	0.03	***0.34***	0.12	**0.82**	0.05	−0.01	−0.15	−0.14
Vomiting	0.04	0.26	−0.16	**0.94**	−0.05	0.05	−0.04	−0.10

Table 2 continued

	F1	F2	F3	F4	F5	F6	F7	F8
Distressing dreams	−0.08	−0.06	***0.70***	0.19	−0.02	0.00	−0.04	0.12
Unintended weight gain >10 lbs	0.13	0.12	0.31	−0.07	−0.05	0.15	−0.04	0.11
Unintended weight loss >10 lbs	−0.05	−0.12	0.22	**0.36**	−0.18	0.05	0.25	0.15

Loadings of .30 and above are in bold type

Loadings in bold italics were not retained in factor structure applied in subsequent confirmatory factor analysis

Symptom dimensions were significantly intercorrelated after oblique rotation ($rs = .25$–$.60$)

F1, Cardio-respiratory; F2, Gastrointestinal; F3, Psychological; F4, Gastrointestinal infection; F5, Neurological; F6, Skeletal; F7, Other infection; F8, Fatigue

$n = 4{,}257$

Table 3 Fit statistics for confirmatory factor analysis on Iraq Era group and full sample, respectively

Model	Comparative fit index	Tucker–Lewis index	RMSEA
Iraq Era group ($n = 4{,}295$)	.945	.981	.026
Full sample ($n = 8{,}552$)	.956	.987	.023

RMSEA root mean square error of approximation

Discussion

This study has shown a large and consistent increase in symptom reporting in the UK Armed Forces, which occurred over a 7 year period and was unrelated to deployments to the Gulf or Iraq. The increase in symptoms was general, although less marked for cardio-respiratory symptoms (F1) than for the other dimensions of symptoms, and very marked for fatigue symptoms (F8). Unexpectedly, the trends increased rather than decreased when adjusting for GHQ-12, indicating that psychological distress does not account for the increases, and that it may conceal their true magnitude.

Interpretation of the results

As the increases in prevalence of physical and psychological symptoms was across all symptoms, the most plausible interpretation of our results is that the trend is not a consequence of specific underlying pathologies, despite the variation in the magnitude of the increase between symptom dimensions. We have confidence in our findings because of the excellent fit of the symptom pattern derived from the Gulf Era group to the Iraq Era group, which provides strong evidence that the observed associations are robust, at least for the UK military population.

Unexplained symptoms are the defining feature of somatoform disorders, which are characterised by the experience of symptoms that suggest a medical condition, but where no underlying medical condition is found [25]. There is abundant evidence that somatoform disorders and

Table 4 Time-series effects on symptom dimension scores

	Model 1	Model 2	Model 3
F1Cardio-respiratory	1.37 (1.20–1.55)	1.57 (1.36–1.81)	1.81 (1.55–2.13)
F2 Gastrointestinal	1.76 (1.55–2.01)	1.91 (1.65–2.21)	2.21 (1.89–2.58)
F3 Psychological	1.61 (1.41–1.83)	1.88 (1.62–2.17)	2.64 (2.21–3.15)
F4 Gastrointestinal infection	1.60 (1.41–1.83)	1.84 (1.59–2.13)	2.24 (1.90–2.64)
F5 Neurological	1.71 (1.50–1.95)	1.98 (1.70–2.29)	2.33 (1.98–2.73)
F6 Skeletal	1.70 (1.49–1.94)	2.02 (1.74–2.34)	2.27 (1.94–2.66)
F7 Other infection	1.52 (1.33–1.73)	1.68 (1.45–1.94)	1.89 (1.61–2.20)
F8 Fatigue	2.00 (1.75–2.28)	2.24 (1.93–2.60)	3.09 (2.60–3.68)

Odds ratios are for upper quartile of symptom dimension scores in the Iraq Era group relative to the Gulf Era group

All estimates derived from one multivariate model (adjusted for intercorrelations among symptom dimensions)

Model 1 unadjusted

Model 2 adjusted for age, educational status, relationship status, rank, service, currently serving

Model 3 adjusted for age, educational status, relationship status, rank, service, currently serving, GHQ-12

unexplained symptoms are highly associated with anxiety and depressive disorders, and other symptoms of distress [26, 27]. Even in cases where symptom reporting is actually indicative of underlying organic pathology rather than of a somatoform disorder, some accompanying psychological morbidity would be expected [28, 29]. Instead, adjusting for psychological morbidity revealed a greater discrepancy in symptom reporting between the cohorts in our study. This finding is counterintuitive at first, but not unprecedented. Previous work has found no association between GHQ-12 scores and widespread pain [30], and adjustment for GHQ-12 only slightly decreased the association between work-related dissatisfaction and lower back pain [31].

Several explanations for trends of increasing symptom reporting in the general population have been suggested: that social, family and work life have become tougher and more competitive than before; the availability of more options and demands for personal choice in unpredictable circumstances; a greater awareness of health issues enhanced by the media and the internet, and within this context a greater concern about the health effects of modernity [3, 32]. It has also been proposed that willingness to report symptoms may be related to health reporting and health seeking behaviours, legal-financial incentives of benefits and compensation [4], and to a greater awareness of certain medical conditions. For example, the fast growing rates of chronic fatigue syndrome diagnoses [2, 3] have resulted in greater public awareness of this condition, and people may be more inclined to report related symptoms. As similar increases in symptoms to those observed in our study have also been observed in the general UK population [1–5], many of these arguments may explain the greater propensity to report non-specific symptoms in the UK Armed Forces as well.

Another way of explaining the increases in symptom reporting is within the paradigm of culture-driven disorders [33]. Petrie and colleagues assessed the hypothesis that worries about modernity in terms of traffic fumes, pesticides, antibiotics and additives in food, leakage from microwave ovens, cell phones and other technical advances would increase symptom reporting and medical health utilisation [32]. Although Petrie et al. [32] found some support for their hypothesis, the associations between "modern health worries" and symptoms were restricted to food intolerances and chronic fatigue syndrome and were too small to explain the marked increases in symptom reporting observed in our study over a 7 year period.

Strengths and weaknesses

This study used data from two large epidemiological surveys based on representative samples of the UK Armed Forces, with satisfactory response rates and identical measures. However, as with all observational studies, it is possible that sampled individuals who completed the questionnaires were different to those who did not and this may have biased the results. We have shown previously that young males, especially lower ranks, are more reluctant to complete questionnaires. However, we have also shown that non-response in our cohorts is unlikely to cause bias as non-response in military cohorts are largely due to practical difficulties in finding people or to participant inertia [34]. Some of the personnel in the Era sample of the Iraq war study did deploy to Iraq on operations subsequent to TELIC 1, but findings from the Iraq war survey suggest only a small deployment effect associated with multiple physical symptoms [18], which could not have explained the marked increase in symptoms observed here over 7 years. Similarly, a "healthy warrior effect", a greater chance to be deployed if healthy, would have had minimal impact in our results if our results related to psychological distress (GHQ-12) and posttraumatic stress disorder are also applicable to multiple physical symptoms [35]. Furthermore, the results did not change when we repeated the analysis, excluding those who participated in TELIC 2 or later.

Implications

These findings present challenges to healthcare professionals as the increased willingness to report non-specific symptoms may affect health-care utilisation. It may also become increasingly difficult for practitioners to evaluate the meaning of symptoms as the positive likelihood ratio for a single symptom as part of a known condition may decrease when more patients are presenting with non-specific symptoms. Healthcare professionals may need to adapt the way medicine is practiced to include strategies to ease communication with patients that are more prone to report symptoms, and learn approaches to manage their ailments [33]. The rapid changes in symptom reporting demonstrated in this study suggest the need to monitor trends of symptoms over time in order to gauge the changing pattern of illness reporting in military and civilian populations.

This study reports a large increment in general non-specific symptom reporting over a relatively short time period (7 years) in the UK Armed Forces. It suggests that personnel are more willing to report symptoms than previously. The impact of this trend on medical practice deserves close scrutiny.

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References

1. Barraclough R, Devereux G, Hendrick DJ, Stenton SC. Apparent but not real increases in asthma prevalence during the 1990s. Eur Respir J. 2002;20:826–33.
2. Gallagher AM, Thomas JM, Hamilton WT, White PD. Incidence of fatigue symptoms and diagnoses presenting in UK primary care from 1990 to 2001. J Royal Soc Med. 2004;97:571–5.
3. Hallsten L, Lundberg I, Waldenstrom P. Chapter 6. Low mental well-being—trends in and outside the labour market. In: Gustafsson RA, Lundberg I, editors. Worklife and health in Sweden 2004. Sweden: National Institute for Working Life Stockholm; 2005. p. 159–81.
4. Harkness EF, Macfarlane GJ, Silman AJ, McBeth J. Is musculoskeletal pain more common now than 40 years ago? two population-based cross-sectional studies. Rheumatology. 2005;44:890–5.
5. Palmer KT, Walsh K, Bendall H, Cooper C, Coggon D. Back pain in Britain: comparison of two prevalence surveys at an interval of 10 years. Br Med J. 2000;320:1577–8.
6. Stewart-Brown S, Evans J, Patterson J, Petersen S, Doll H, Balding J, et al. The health of students in institutes of higher education: an important and neglected public health problem? J Public Health Med. 2000;22:492–9.
7. Magnus P, Jaakkola JJK. Secular trend in the occurrence of asthma among children and young adults: critical appraisal of repeated cross sectional surveys. Br Med J. 1997;314:1795–9.
8. Wessely S, Hotopf M. Are some public-health problems better neglected? Lancet. 2001;357:976–7.
9. Barsky A. The paradox of health. N Engl J Med. 1988;318:414–8.
10. Hirani V. Anthropometric measures, overweight and obesity. In: Sporston K, Primatesta P, editors. The Health Survey for England 2003, Cardiovascular Disease. London: The Stationery Office; 1990.
11. Passa P. Diabetes trends in Europe. Diabetes Metab Res Rev. 2002;18:S3–8.
12. Burr ML, Butland BK, King S, Vaughan Williams E. Changes in asthma prevalence: two surveys 15 years apart. Arch Dis Child. 1989;64:1452–6.
13. Peat JK, van den Berg RH, Gree WF, Mellis CM, Leeder SR, Woolcock AJ. Changing prevalence of asthma in Australian children. BMJ. 1994;308:1591–6.
14. Barrett DH, Gray GC, Doebbeling BN, Clauw DJ, William C. Prevalence of Symptoms and Symptom-based Conditions among Gulf War Veterans: Current Status of Research Findings. Epidemiol Rev. 2002;24:218–27.
15. Ismail K, Everitt B, Blatchley N, Hull L, Unwin C, David A, et al. Is there a Gulf War syndrome? Lancet. 1999;353:179–82.
16. Horn O, Hull L, Jones M, Murphy D, Browne T, Fear NT, et al. Is there an Iraq war syndrome? comparison of the health of UK service personnel after the Gulf and Iraq wars. Lancet. 2006;367:1742–6.
17. Unwin C, Blatchley N, Coker W, Ferry S, Hotopf M, Hull L, et al. Health of UK servicemen who served in Persian Gulf War. Lancet. 1999;353:169–78.
18. Hotopf M, Hull L, Fear NT, Browne T, Horn O, Iversen A, et al. The health of UK military personnel who deployed to the 2003 Iraq war: a cohort study. Lancet. 2006;367:1731–41.
19. Browne T, Hull L, Horn O, Jones M, Murphy D, Fear NT, et al. Explanations for the increases in mental health problems in UK reserve forces who have served in Iraq. Br J Psychiatry. 2007;190:484–9.
20. Rona RJ, Fear NT, Hull L, Wessely S. Women in novel occupational roles: mental health trends in the UK Armed Forces. Int J Epidemiol. 2007;36:319–26.
21. Derogatis LR, Lipman RS, Rickels K, Uhlenhuth EH, Covi L. The Hopkins symptom checklist (HSCL): a self-report symptom inventory. Behav Sci. 1974;19:1–15.
22. Goldberg DP, Gater R, Sartorius N, Ustun TB, Piccinelli M, Gureje O, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. Psychol Med. 1997;27:191–7.
23. Muthen LK, Muthen BO. Mplus User's Guide. 4th ed. Los Angeles, CA; 1998–2007.
24. Hu LT, Bentler P. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Model. 1999;6:1–55.
25. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Arlington, VA: American Psychiatric Publishing Inc; 2000.
26. Creed F, Barsky A. A systematic review of the epidemiology of somatisation disorder and hypochondriasis. J Psychosom Res. 2004;56:391–408.
27. Wessely S. Introduction. The health of Gulf War veterans. Philos Trans R Soc B. 2006;361:531–2.
28. Benjamin S, Morris S, McBeth J, Macfarlane GJ, Silman AJ. The association between chronic widespread pain and mental disorder. Arthritis Rheum. 2000;43:561–7.
29. Magni G, Moreschi C, Rigatt-Luchini S, Merskey H. Prospective study on the relationship between depressive symptoms and chronic musculoskeletal pain. Pain. 1994;56:289–97.
30. McBeth J, Macfarlane GJ, Benjamin S, Silman AJ. Features of somatisation predict the onset of chronic widespread pain. Arthritis Rheum. 2001;44:940–6.
31. Papageorgiou AC, Macfarlane GJ, Thomas E, Croft PR, Jayson MIV, Silman AJ. Psychosocial factors in the workplace—do they predict new episodes of low back pain?: evidence from the South Manchester Back Pain Study. Spine. 1997;22:1137–42.
32. Petrie KJ, Sivertsen B, Hysing M, Broadbent E, Moss-Morris R, Eriksen HR, et al. Thoroughly modern worries. The relationship of worries about modernity to report symptoms, health and medical care utilization. J Psychosom Res. 2001;51:395–401.
33. Aceves-Avila FJ, Ferrari R, Ramos-Remus C. New insights into culture driven disorders. Best Pract Res Clin Rheumatol. 2004;18:155–71.
34. Iversen A, Liddell K, Fear N, Hotopf M, Wessely S. Consent, confidentiality, and data protection act. BMJ. 2006;332:165–9.
35. Wilson J, Jones M, Fear NT, Hull L, Hotopf M, Wessely S, et al. Is previous psychological health associated with the likelihood of Iraq War deployment? an investigation of the "healthy warrior effect". Am J Epidemiol. 2009;169:1362–9.