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# Research Submission

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## Risk Factors for Headache in the UK Military: Cross-Sectional and Longitudinal Analyses

Roberto J. Rona, FFPH; Margaret Jones, BA; Laura Goodwin, PhD; Lisa Hull, MSc;  
Simon Wessely, FMedSci

**Aims.**—To assess the importance of service demographic, mental disorders, and deployment factors on headache severity and prevalence, and to assess the impact of headache on functional impairment.

**Background.**—There is no information on prevalence and risk factors of headache in the UK military. Recent US reports suggest that deployment, especially a combat role, is associated with headache. Such an association may have serious consequences on personnel during deployment.

**Methods.**—A survey was carried out between 2004 and 2006 (phase 1) and again between 2007 and 2009 (phase 2) of randomly selected UK military personnel to study the health consequences of the Iraq and Afghanistan wars. This study is based on those who participated in phase 2 and includes cross-sectional and longitudinal analyses. Headache severity in the last month and functional impairment at phase 2 were the main outcomes.

**Results.**—Forty-six percent complained of headache in phase 2, half of whom endorsed moderate or severe headache. Severe headache was strongly associated with probable post-traumatic stress disorder (multinomial odds ratio [MOR] 9.6, 95% confidence interval [CI] 6.4-14.2), psychological distress (MOR 6.15, 95% CI 4.8-7.9), multiple physical symptoms (MOR 18.2, 95% CI 13.4-24.6) and self-reported mild traumatic brain injury (MOR 3.5, 95% CI 1.4-8.6) after adjustment for service demographic factors. Mild headache was also associated with these variables but at a lower level. Moderate and severe headache were associated with functional impairment, but the association was partially explained by mental disorders. Mental ill health was also associated with reporting moderate and severe headache at both phase 1 and phase 2. Deployment and a combat role were not associated with headache.

**Conclusion.**—Moderate and severe headache are common in the military and have an impact on functional impairment. They are more strongly associated with mental disorders than with mild traumatic brain injury.

**Key words:** cohort study, functional impairment, psychological distress, post-traumatic stress disorder, traumatic brain injury

**Abbreviations:** AUDIT Alcohol Use Disorders Identification Test; CI confidence interval; GHQ General Health Questionnaire; MOR multinomial odds ratio; MPS multiple physical symptom; mTBI mild traumatic brain injury; PTSD post-traumatic stress disorder; SF-36 short-form 36 health survey

(*Headache* 2013;●●●●●●)

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From the King's Centre for Military Health Research, Department of Psychological Medicine, King's College, London, UK.

Address all correspondence to R. Rona, King's Centre for Military Health Research, Department of Psychological Medicine, King's College, Weston Education Centre, Cutcombe Road, London, SE5 9RJ, UK, email: Roberto.rona@kcl.ac.uk

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Headache is a common disorder<sup>1-3</sup> often resulting in limitation of working and social activities.<sup>4,5</sup> Recent studies from the US report that it is particularly common in deployed personnel<sup>6-8</sup> and is associated with long-term symptoms in those who have reported mild traumatic brain injury (mTBI) and head trauma.<sup>9-11</sup> Headache has been found to be associated with symptoms of depression, post-traumatic stress disorder (PTSD), and panic attack in civilian<sup>12,13</sup> and military populations<sup>2,7,8</sup> whether the diagnosis of headache is migraine or not,<sup>13,14</sup> although the direction of the association may differ according to type of headache.<sup>15</sup>

Most of the research on headache in the military comes from the US.<sup>2,7,8,16,17</sup> Headache has been found to be associated with female gender, younger age, lower ranks, and service in the army,<sup>8</sup> and has been found to be a cause of unit attrition during deployment.<sup>16</sup> The role of mental disorders in the persistence of headache is uncertain.<sup>18</sup>

This study of UK military personnel was carried out between 2004 and 2006 (phase 1) and again between 2007 and 2009 (phase 2).<sup>19,20</sup> The study was originally set up to assess the possible effects of deployment to Iraq and/or Afghanistan on mental and physical health. The aims of the current study were: to estimate the prevalence and severity of headache at phase 2; to assess the importance of social and service demographic factors, mental disorders, and deployment factors on headache; to assess the impact of headache on functional impairment; and to assess the factors associated with reporting moderate or severe headache at both phase 1 and phase 2 (repeated headache).

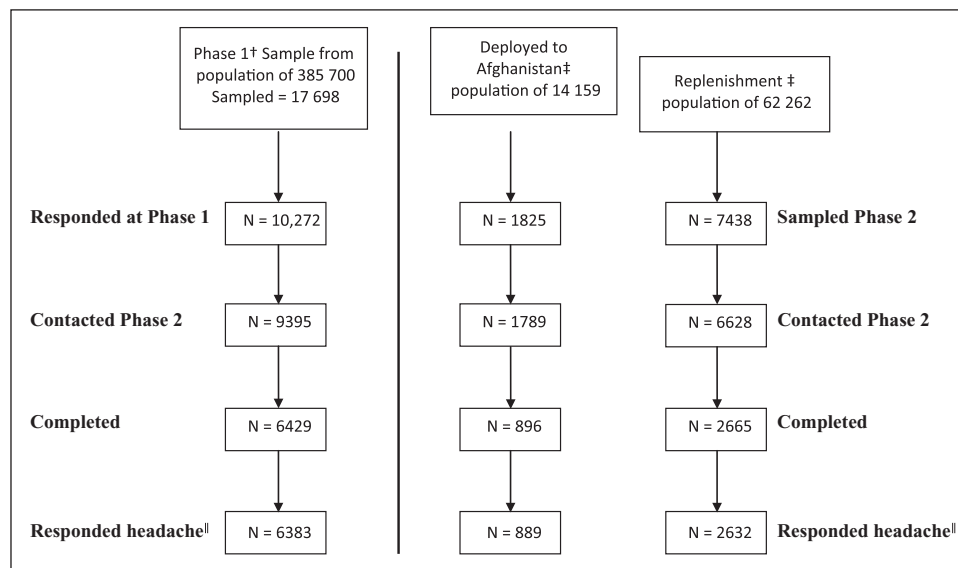
## METHODS

Participants were invited to complete a self-administered questionnaire between 2004 and 2006 (phase 1) and again between 2007 and 2009 (phase 2).<sup>19,20</sup> Phase 1 included a random sample of personnel deployed to Iraq in 2003 and another randomly selected group of those who had not deployed at that time.<sup>20</sup> The phase 2 sample included those who completed the questionnaire at phase 1 and who gave permission for future contact (the follow-up sample). Another 2 samples were added at phase 2: a random

sample of those deployed to Afghanistan between April 2006 and April 2007 to ensure sufficient statistical power to explore issues related to deployment to Afghanistan; a random sample of personnel who joined the military and were trained between April 2003 and April 2007 (Replenishment sample) to ensure that the demographic characteristics of the current UK Armed Forces were reflected in the study (Figure). Regular and reserve personnel were included. Participants were identified by the Defence Analytical Service and Advice, an agency of the UK Ministry of Defence. A random sample was selected from each of the appropriate subpopulations. The longitudinal sample comprised phase 1 participants who also participated at phase 2. Those who participated in phase 1 only were excluded. We have shown that mental health status and multiple physical symptom (MPS) status at phase 1 was not associated with participation at phase 2 of the study.<sup>19</sup> Further details are available elsewhere.<sup>19</sup>

**Measurements.**—The main outcome measure was the response to the question “have you had any of the following symptoms in the past month,” headache being one of the 53 symptoms, and if yes, the severity of the symptom. The 53-item symptom checklist has been part of our studies of the health of the UK armed forces since 1996.<sup>3</sup> The second outcome measure was functional impairment assessed from the short-form 36 health survey (SF-36) item: the extent to which physical or emotional problems interfered with normal social activities with family, friends, neighbors, or groups;<sup>21</sup> a 5-point response scale is given: not at all, slightly, moderately, quite a bit, extremely. Impaired were those who endorsed “quite a bit” or “extremely” from the 5 options response. We have demonstrated previously that this item of the SF-36 had the strongest association with both partial and full PTSD.<sup>22</sup>

The independent variables were PTSD-assessed using the PTSD Checklist – Civilian version, with probable PTSD defined as a score of 50 or above (range 17-85).<sup>23</sup> Symptoms of psychological distress were measured by the General Health Questionnaire 12 (GHQ-12),<sup>24</sup> with cases defined as individuals with a score of 4 or above (range 0-12). mTBI was assessed using a modified version of the Brief Traumatic Brain



**Figure.—Summary of sampling frames, sampling and response at each stage. †Cohort sampled at phase 1 in 2003. ‡Additional sample at phase 2 in 2007. ||Responded to the headache item on the symptom checklist.**

Injury Screen in those deployed to Iraq and/or Afghanistan.<sup>25</sup> The instrument explored possible cause of injury and symptoms associated with the injury including loss of consciousness and its duration.<sup>11</sup> MPSs were assessed using a checklist of 52 symptoms (excluding the headache item). This scale correspond in part to the instrument assessed by Derogatis and colleagues, and shown to have good psychometric properties,<sup>26</sup> with cases defined as individuals reporting 17 or more symptoms.<sup>20</sup>

A score of 16 or more (range 0-40) was used to define alcohol misuse using the 10-item World Health Organization Alcohol Use Disorders Identification Test (AUDIT);<sup>27</sup> smoking was categorized as non-smoker, ex-smoker, smoking fewer than 20 cigarettes per day, and smoking 20 or more cigarettes per day. As the assignment to conditions, including PTSD, was based on self-completed checklists rather than clinical assessment case<sup>11</sup> should be considered only as probable. Other variables collected were: sex, age, education level, marital status, service, rank, enlistment status (regular or reserve), deployment status (not deployed to Iraq or Afghanistan, deployed in a non-combat role, deployed in a combat role), and serving status (serving or discharged).

The questionnaire was extensively piloted to ensure that personnel, regardless of rank, understood

the questions. The study received ethical approval from the Ministry of Defence Research Ethics Committee and the King's College Hospital Local Research Ethics Committee. The nature of the study was fully explained to participants.

**Analysis.**—For the phase 2 cross-sectional analysis, multinomial logistic regressions were carried out to assess risk factors associated with severity of headache in 4 groups: no headache, mild headache, moderate headache, and severe headache in the last month. In unadjusted and adjusted models each level of headache was compared with no headache (reference group). The possible confounders in the adjusted model were: sex, age, marital status, education, service, rank, and enlistment status. Multiple logistic regressions were carried out to estimate whether severity of headache was related to functional impairment after adjustment first for service and demographic factors; second, adjusting additionally for PTSD, psychological distress, MPS, or mTBI separately; and third, adjusting for PTSD, psychological distress, and MPS. In the longitudinal analysis, risk factors for repeated headache were assessed in the group reporting moderate or severe headache at phase 1; the reference group was those no longer reporting moderate or severe headache at phase 2, and the repeated headache were those who reported

moderate or severe headache again at phase 2. The independent factors assessed at phase 1 were PTSD, psychological distress, MPS, AUDIT, functional impairment, and smoking status, and in a separate analysis for these variables at phase 2, also adjusting for the confounders included in the cross-sectional analysis. Information on mTBI was not collected at phase 1.

Sample weights were created to account for sampling fractions as 3 independent randomly selected samples were combined. Sample weights were calculated as the inverse probability of a participant from a specific subpopulation and specific engagement type (regular or reserve) being sampled. Response weights were created to account for response rate differences at phase 2, as younger service personnel, lower ranks, and males have a lower response rate. All data analyses were conducted in STATA v11.2 (Stata Corporation, College Station, TX, USA). Analyses presented here used the survey commands. Weighted percentages multinomial odds ratios (MORs) and odds ratios are presented in the tables with unweighted cell counts.

## RESULTS

The response rate at phase 2 was 6429 (68.4%) out of 9395 contacted personnel for the follow-up sample, 896 (50.1%) out of 1789 contacted personnel for the Afghanistan sample, and 2665 (40.2%) out of 6628 contacted personnel for the Replenishment samples, altogether 9990 (56%), but 96 were excluded as did not respond to the items on headache. The overall response rate of phase 1 of the study was 59% (Figure). Of the sample, 47.1% reported headache in the last month, 45.7% of males, and 59.4% of females. Severe and moderate headache were endorsed by 4.5% and 18.7%, respectively, by males, and 7.4% and 29.4%, respectively, by females. Headache had a lower prevalence in those with a degree, commissioned officers, reserves, those deployed to Iraq and/or Afghanistan, and those still serving. A trend across levels of headache severity was observed for most of these variables. Likewise, an increasing percentage of headache was associated with those case positive for PTSD, psychological distress (GHQ-12), MPS, those reporting mTBI, and those endorsing the statement that their health interfered with social

activities (Table 1). No apparent trend was observed between deployment status and headache.

**Cross-Sectional Analysis.**—Female gender, non-commissioned officer or other rank, older age, and having been discharged from service were positively associated with moderate or severe headache while being in the Royal Air Force, and being a reservist were negatively associated with moderate or severe headache compared with the reference group (no headaches) after adjustment for possible confounders (Table 2). Those deployed to Iraq only reported less headache, but not significantly, for mild (MOR = 0.91, 95% confidence interval [CI] 0.77-1.03) and moderate headache (MOR = 0.86, 95% CI 0.72-1.02). Those deployed to Afghanistan only reported less mild (MOR = 0.70, 95% CI 0.52-0.89) and moderate headache (MOR = 0.77, 95% CI 0.60-1.00). In the 20% that deployed both to Iraq and Afghanistan, no associations with headache were found. The association of PTSD, psychological distress, and MPS with headache increased with the level of severity of headache and was strong for severe headache, especially for MPS (Table 2). mTBI, smoking, and alcohol misuse were also associated with headache severity, but the effect sizes were small or intermediate (small effect size, an MOR less than 2; intermediate, an MOR between 2 and 4). Mild headache was positively associated with female gender, non-commissioned officer, and negatively associated with deployed status at phase 2 regardless of role. The effect sizes of the associations for service demographic variables were generally small, except for female gender and lower ranks that was intermediate in relation to moderate and severe headache.

Moderate and severe headache interfere with social functioning and the associations were intermediate or strong in the adjusted model (Table 3). PTSD, psychological distress, MPS, and mTBI separately reduced the level of association to a greater extent for severe headache. Even after adjustment for PTSD, psychological distress, and MPS, the association between severe and moderate headache and functional impairment remained significant, albeit reduced.

**Longitudinal Analysis.**—The Spearman correlation between headache severity at phase 1 and phase 2 for

Table 1.—Description of Participants by Headache Status at Phase 2 (N = 9904)

Characteristic	No Headache N = 5388 N (%)‡	Mild Headache N = 2215 N (%)‡	Moderate Headache N = 1864 N (%)‡	Severe Headache N = 437 N (%)‡	Total† N = 9904 N (%)‡
Sex					
Male	4904 (92.11)	1923 (89.65)	1540 (84.70)	358 (84.11)	8725 (89.70)
Female	484 (7.89)	292 (10.35)	324 (15.30)	79 (15.89)	1179 (10.30)
Age group (years)					
<25	941 (13.95)	391 (13.19)	266 (10.69)	62 (10.68)	1660 (12.98)
25-29	1062 (19.88)	458 (20.63)	360 (19.01)	87 (21.07)	1967 (19.93)
30-34	884 (16.00)	349 (16.90)	305 (17.10)	77 (18.38)	1615 (16.54)
35-39	899 (17.88)	385 (18.98)	377 (21.62)	81 (19.47)	1742 (18.94)
40 or more	1602 (32.29)	632 (30.30)	556 (31.58)	130 (30.40)	2920 (31.61)
Education level					
No qualifications or GCSE§	2167 (44.33)	884 (43.99)	801 (46.52)	208 (50.28)	4060 (44.97)
“A” level or degree§	2993 (55.67)	1254 (56.01)	981 (53.48)	207 (49.72)	5435 (55.03)
Marital status					
Relationship	4027 (77.48)	1689 (78.08)	1467 (81.35)	337 (80.09)	7520 (78.51)
Single or ex relationship	1337 (22.52)	514 (21.92)	388 (18.65)	97 (19.91)	2336 (21.49)
Service					
Naval services	834 (16.53)	359 (17.32)	270 (15.91)	65 (15.26)	1528 (16.52)
Army	3531 (63.93)	1364 (61.07)	1234 (65.52)	296 (66.99)	6425 (63.74)
RAF	1023 (19.55)	492 (21.61)	360 (18.57)	76 (17.75)	1951 (19.73)
Rank					
Commissioned officer	1302 (22.07)	497 (19.71)	338 (15.57)	63 (11.73)	2200 (19.76)
Non-commissioned officer	2862 (58.47)	1188 (60.62)	1119 (66.04)	266 (66.28)	5435 (60.83)
Other rank	1224 (19.46)	530 (19.67)	407 (18.39)	108 (21.98)	2269 (19.42)
Enlistment type					
Regular	4391 (87.93)	1862 (89.73)	1583 (90.93)	371 (92.88)	8207 (89.17)
Reserve	997 (12.07)	353 (10.27)	281 (9.07)	66 (7.12)	1697 (10.83)
Deployed role					
Not deployed	2578 (52.31)	1157 (57.04)	995 (57.67)	232 (54.65)	4962 (54.55)
Deployed in a support role	2010 (34.87)	815 (33.55)	621 (30.30)	155 (34.63)	3601 (33.66)
Deployed in a combat role	731 (12.81)	212 (9.40)	226 (12.04)	45 (10.71)	1214 (11.79)
Serving status					
Serving	4214 (74.45)	1730 (74.52)	1400 (71.67)	301 (64.49)	7645 (73.44)
Discharged	1163 (25.55)	483 (25.48)	458 (28.33)	132 (35.51)	2236 (26.56)
GHQ case (score 4 or more)					
No	4645 (87.27)	1778 (80.07)	1263 (68.82)	223 (53.24)	7909 (80.35)
Yes	679 (12.73)	421 (19.93)	587 (31.18)	211 (46.76)	1898 (19.65)
PCL case (score 50 or more)					
No	5252 (98.23)	2143 (96.87)	1706 (92.32)	362 (83.82)	9463 (96.06)
Yes	92 (1.77)	61 (3.13)	146 (7.68)	72 (16.18)	371 (3.94)
AUDIT case (score 16 or more)					
No	4680 (88.48)	1888 (87.23)	1550 (83.79)	355 (83.08)	8473 (87.01)
Yes	644 (11.52)	294 (12.77)	300 (16.21)	73 (16.92)	1311 (12.99)
Smoking status					
Non-smoker	2834 (51.46)	1125 (49.40)	855 (44.42)	190 (41.93)	5004 (49.15)
Ex-smoker	1312 (26.21)	568 (27.84)	474 (27.12)	105 (25.51)	2459 (26.73)
Smokes fewer than 20 cigarettes per day	811 (15.42)	325 (14.37)	340 (18.14)	69 (16.58)	1545 (15.78)
Smokes 20 or more cigarettes per day	356 (6.90)	175 (8.38)	177 (10.32)	63 (15.98)	771 (8.34)
MPS case (17 symptoms or more)					
No	5198 (96.55)	1960 (88.23)	1470 (79.65)	255 (59.26)	8883 (89.55)
Yes	165 (3.45)	243 (11.77)	377 (20.35)	180 (40.74)	965 (10.45)
mTBI					
No	25670 (96.88)	939 (94.97)	756 (93.74)	163 (90.81)	4425 (95.63)
Yes	88 (3.12)	51 (5.03)	50 (6.26)	17 (9.19)	206 (4.37)
Health interfered with social activity					
Not to moderately	5055 (93.98)	2057 (92.79)	1565 (83.96)	315 (71.92)	8992 (90.68)
Quite a bit to extremely	315 (6.02)	148 (7.21)	291 (16.04)	121 (28.08)	875 (9.32)

†Not all totals add to 9904 because some participants did not complete all questions.

‡Percentages are weighted to account for sampling fractions and response rate differences.

§GCSEs are examinations usually taken at age 16. A-levels are usually taken at age 18 and are required for entry to university.

AUDIT = Alcohol Use Disorders Identification Test; GCSE = General Certificate of Secondary Education; GHQ = General Health Questionnaire; MPS = multiple physical symptom; mTBI = mild traumatic brain injury; PCL = post-traumatic stress disorder checklist; RAF = Royal Air Force.

Table 2.—Association of Headache With Demographic, Service Variables, and Health Variables in Whole Sample (N = 9904)

Covariate	Mild Headache MOR (95% CI)		Moderate Headache MOR (95% CI)		Severe Headache MOR (95% CI)	
	Unadjusted	Adjusted†	Unadjusted	Adjusted†	Unadjusted	Adjusted†
Sex (female)	1.35 (1.12-1.62)	1.39 (1.14-1.68)	2.11 (1.76-2.53)	2.64 (2.17-3.21)	2.20 (1.61-3.01)	2.95 (2.12-4.09)
Age per 10 years‡	0.96 (0.90-1.02)	0.97 (0.89-1.05)	1.01 (0.95-1.07)	1.15 (1.06-1.26)	0.98 (0.87-1.10)	1.33 (1.12-1.57)
Service						
Naval services	1.10 (0.93-1.29)	1.10 (0.94-1.32)	0.93 (0.79-1.12)	0.89 (0.74-1.08)	0.88 (0.64-1.22)	0.74 (0.53-1.04)
Army	1.0	1.0	1.0	1.0	1.0	1.0
RAF	1.16 (1.00-1.34)	1.14 (0.97-1.34)	0.93 (0.79-1.09)	0.82 (0.69-0.98)	0.87 (0.64-1.18)	0.69 (0.50-0.95)
Rank						
Commissioned officer	1.0	1.0	1.0	1.0	1.0	1.0
Non-commissioned officer	1.16 (1.00-1.34)	1.19 (1.01-1.40)	1.60 (1.36-1.88)	1.81 (1.51-2.18)	2.13 (1.53-2.97)	2.54 (1.73-3.73)
Other rank	1.13 (0.95-1.34)	1.13 (0.90-1.40)	1.34 (1.10-1.63)	1.81 (1.40-2.33)	2.13 (1.45-3.11)	3.59 (2.14-6.01)
Enlistment type						
Regular	1.0	1.0	1.0	1.0	1.0	1.0
Reserve	0.83 (0.71-0.97)	0.88 (0.74-1.04)	0.73 (0.61-0.86)	0.62 (0.51-0.76)	0.56 (0.40-0.78)	0.41 (0.28-0.62)
Deployed at phase 2						
No	1.0	1.0	1.0	1.0	1.0	1.0
Yes	0.84 (0.74-0.94)	0.79 (0.69-0.90)	0.81 (0.71-0.92)	0.80 (0.70-0.92)	0.90 (0.71-1.13)	0.89 (0.69-1.15)
Role on deployment						
Not deployed	1.0	1.0	1.0	1.0	1.0	1.0
Deployed in a support role	0.88 (0.78-1.00)	0.83 (0.72-0.95)	0.79 (0.69-0.90)	0.77 (0.66-0.89)	0.95 (0.74-1.22)	0.95 (0.72-1.24)
Deployed in a combat role	0.67 (0.55-0.82)	0.62 (0.50-0.77)	0.85 (0.70-1.04)	0.89 (0.71-1.10)	0.80 (0.54-1.18)	0.74 (0.48-1.14)
Serving status						
Serving	1.0	1.0	1.0	1.0	1.0	1.0
Discharged	1.00 (0.87-1.14)	1.01 (0.87-1.18)	1.15 (1.00-1.33)	1.09 (0.93-1.28)	1.60 (1.25-2.06)	1.42 (1.07-1.89)
PCL case (score 50 or more)	1.80 (1.22-2.65)	1.78 (1.20-2.64)	4.62 (3.36-6.36)	4.44 (3.20-6.16)	10.72 (7.27-15.82)	9.60 (6.39-14.23)
GHQ case (score 4 or more)	1.71 (1.46-2.00)	1.70 (1.44-2.00)	3.10 (2.67-3.61)	3.16 (2.70-3.69)	6.02 (4.72-7.67)	6.15 (4.78-7.91)
MPS (17 or more symptoms)	3.74 (2.94-4.76)	3.89 (3.03-4.98)	7.16 (5.71-8.98)	7.28 (5.74-9.22)	19.25 (14.40-25.75)	18.15 (13.38-24.62)
AUDIT (score 16 or more)	1.12 (0.94-1.34)	1.14 (0.95-1.38)	1.49 (1.25-1.77)	1.65 (1.37-2.00)	1.56 (1.14-2.15)	1.56 (1.11-2.19)
Smoking status						
Non-smoker	1.0	1.0	1.0	1.0	1.0	1.0
Ex-smoker	1.11 (0.96-1.27)	1.12 (0.97-1.29)	1.20 (1.03-1.40)	1.09 (0.93-1.28)	1.19 (0.89-1.60)	1.11 (0.82-1.51)
Smokes fewer than 20 cigarettes per day	0.97 (0.82-1.15)	1.00 (0.83-1.19)	1.36 (1.14-1.62)	1.34 (1.12-1.62)	1.32 (0.94-1.86)	1.29 (0.90-1.84)
Smokes 20 or more cigarettes per day	1.27 (1.01-1.59)	1.21 (0.95-1.54)	1.73 (1.38-2.18)	1.63 (1.28-2.08)	2.84 (1.99-4.06)	2.60 (1.76-3.84)
mTBI	1.64 (1.07-2.52)	1.74 (1.13-2.69)	2.07 (1.33-3.23)	2.17 (1.35-3.47)	3.14 (1.62-6.09)	3.37 (1.69-6.45)

†Adjusted for sex, age (continuous), education, marital status, service, rank, enlistment status.

‡Age is a continuous variable divided by 10.

The associations for education and marital status are not included.

AUDIT = Alcohol Use Disorders Identification Test; CI = confidence interval; GHQ = General Health Questionnaire; MOR = multinomial odds ratio; MPS = multiple physical symptom; mTBI = mild traumatic brain injury; PCL = post-traumatic stress disorder checklist; RAF = Royal Air Force.

Table 3.—Association Between Emotional Health Interfering With Social Functioning (Outcome) and Headache Severity

N (%)	Unadjusted		Adjusted†		Adjusted† and GHQ‡		Adjusted† and PCL‡		Adjusted† and GHQ§		Adjusted† and PCL‡ and GHQ§ and MPS¶					
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)				
Mild headache 148 (7.21%)	1.21	(0.95-1.54)	1.15	(0.90-1.47)	1.06	(0.82-1.36)	0.93	(0.72-1.21)	0.88	(0.69-1.14)	1.39	(0.97-1.97)	0.90	(0.68-1.17)	0.80	(0.61-1.05)
Moderate headache 291 (16.04%)	2.98	(2.44-3.64)	2.68	(2.18-3.28)	2.22	(1.80-2.75)	1.78	(1.43-2.22)	1.76	(1.41-2.20)	2.26	(1.61-3.18)	1.67	(1.33-2.09)	1.41	(1.11-1.79)
Severe headache 121 (28.08%)	6.10	(4.60-8.09)	5.11	(3.80-6.87)	3.56	(2.55-4.97)	2.64	(1.93-3.60)	2.51	(1.84-3.44)	3.80	(2.25-6.29)	2.27	(1.62-3.19)	1.71	(1.21-2.42)

†Adjusted for sex, age (continuous), education, marital status, service, rank, enlistment status.

‡Adjusted for social and service demographic variables and additionally for PCL case status, GHQ case status, MPS status, or mTBI status.

§Adjusted for social and service demographic variables and additionally for PCL case status and GHQ case status.

¶Adjusted for social and service demographic variables and additionally for PCL case status, GHQ case status, and MPS status.

CI = confidence interval; GHQ = General Health Questionnaire; MPS = multiple physical symptom; mTBI = mild traumatic brain injury; OR = odds ratio; PCL = post-traumatic stress disorder checklist.

the follow-up sample of our study (n = 6376) was 0.42. Fifty-three percent of the 1465 service personnel with moderate or severe headache at phase 1 of the study reported moderate or severe headache at phase 2, but only 17% of 4911 with mild or no headache at phase 1 reported moderate or severe headache at phase 2.

PTSD, psychological distress, and MPS at phase 1 and phase 2 were associated with repeated moderate or severe headache regardless of level of adjustment (Table 4). The level of association was intermediate at phase 1 or 2 for PTSD, but the association was greater for psychological distress and MPS at phase 2. High AUDIT score at phase 2 was associated with repeated headache. Smoking was not associated with repeated headache.

## DISCUSSION

Headache is common (47%) in the UK Armed Forces, and approximately half of all headaches are perceived as moderate or severe. The severity of headache is associated with service demographic factors, especially gender and rank, but deployment to Iraq or Afghanistan was not associated or was negatively associated with headache. Probable mental ill health and previous mTBI were associated with the level of headache severity. Reporting MPS was most strongly associated with severity of headache, while mTBI, although associated with headache, had an MOR lower than PTSD, psychological distress, or MPS. Moderate and severe headache have a strong association with functional impairment that greatly decreases after adjusting for mental ill health and mTBI. Mental ill health is associated with repeated moderate or severe headache.

The prevalence of headache in our study cannot be easily compared with other military studies because the wording of questions and length of period explored were not the same. However, a consistent finding in all studies has been that headache is a common complaint in military personnel<sup>2,6,8</sup> as well as in civilians.<sup>14,28</sup>

We were able to study only generic headache in our study in contrast to US military studies that have been able to separate migraine from other types of headache<sup>8</sup> or focus on migraine.<sup>2,6</sup> This limitation is not necessarily problematic because in the Millennium

**Table 4.—Outcome Is Severe/Moderate Headache at Both Phase 1 and Phase 2 Compared With Severe/Moderate Headache at Phase 1 But No or Mild Headache at Phase 2, N = 1465**

Covariate	Phase 1 Health and Smoking Status			Phase 2 Health and Smoking Status		
	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)	Adjusted ‡ OR (95% CI)	Unadjusted OR (95% CI)	Adjusted† OR (95% CI)	Adjusted‡ OR (95% CI)
PTSD	2.44 (1.60-3.71)	2.40 (1.56-3.69)	2.40 (1.56-3.69)	2.82 (1.81-4.39)	2.58 (1.63-4.07)	2.58 (1.63-4.07)
GHQ	1.59 (1.27-1.99)	1.58 (1.25-2.00)	1.58 (1.25-2.00)	2.21 (1.73-2.82)	2.27 (1.75-2.94)	2.27 (1.75-2.94)
MPS	1.68 (1.31-2.14)	1.57 (1.22-2.03)	1.57 (1.21-2.03)	3.97 (2.95-5.35)	3.98 (2.92-5.42)	3.98 (2.92-5.42)
AUDIT	0.76 (0.57-1.02)	0.80 (0.59-1.09)	0.80 (0.59-1.09)	1.49 (1.07-2.08)	1.63 (1.14-2.32)	1.63 (1.14-2.32)
Emotional health interfered with normal social activities	1.58 (1.16-2.14)	1.58 (1.15-2.16)	1.58 (1.16-2.16)	3.31 (2.38-4.59)	3.09 (2.19-4.36)	3.09 (2.19-4.36)
Smoking status						
Non-smoker	1.0	1.0	1.0	1.0	1.0	1.0
Ex-smoker	0.94 (0.72-1.23)	0.93 (0.70-1.24)	0.93 (0.70-1.24)	1.01 (0.78-1.30)	0.96 (0.73-1.26)	0.96 (0.73-1.26)
Smokes less than 20 per day	1.07 (0.79-1.44)	1.07 (0.77-1.47)	1.06 (0.77-1.47)	1.01 (0.73-1.38)	1.04 (0.75-1.46)	1.05 (0.75-1.46)
Smokes 20 or more per day	1.34 (0.97-1.86)	1.36 (0.96-1.93)	1.36 (0.96-1.93)	1.33 (0.93-1.90)	1.38 (0.95-2.01)	1.38 (0.95-2.02)

†Sex, age, education, marital status, service, rank, enlistment status.

‡Sex, age, education, marital status, service, rank, enlistment status + deployment (at phase 1 for phase 1 health outcomes, at phase 2 for phase 2 outcomes).

AUDIT = Alcohol Use Disorders Identification Test; CI = confidence interval; GHQ = General Health Questionnaire; MPS = multiple physical symptom; mTBI = mild traumatic brain injury; OR = odds ratio; PCL = post-traumatic stress disorder checklist; PTSD = post-traumatic stress disorder.



Cohort study migraine, severe headache and “headache that bothered a lot” were each associated with the same covariates and the strength of the associations were similar.<sup>8</sup>

The most striking finding in our study was the strong association of moderate and severe headache with PTSD, psychological distress, and multiple somatic symptoms.<sup>20</sup> These findings are consistent with those reported in US military studies<sup>6,8,12</sup> and in civilian studies.<sup>13,14,29</sup> However, the strength of the associations, especially in those reporting severe headache, was noteworthy. Other studies have not included MPS as a possible covariate in their analysis, but in the Millennium Cohort, a high level of “bodily pain” reporting was highly associated with all measures of headache.<sup>8</sup> It is possible that “bodily pain” represents a similar psychological issue to our measure of MPS. Another study using a cross-sectional design concluded that migraine and other headaches have an effect on major depression and panic attacks, but there was also an effect in the other direction, except between major depression and other headache.<sup>14,15</sup> Our study demonstrated that mental health problems are also important factors in repeated moderate and severe headache, and suggests that clinicians should explore possible mental illnesses in patients who complain of moderate and severe headache. In contrast, the association between alcohol misuse and headache was only mild in our study. Our study, although documenting a mild association between headache and alcohol, reinforces findings reported by others who found that those with an alcohol-related problem were less likely to report headache than the rest.<sup>2,8</sup> We found that smoking was associated with headache, as has been shown in another study,<sup>30</sup> but did not contribute to repeated headache.

We found a relationship between headache and mTBI, as has been reported by others.<sup>2,7,9</sup> We have reported an association between mTBI and headache previously,<sup>11</sup> but the current paper adds to that report by showing an increasing effect with headache severity. The level of the association with mTBI was lower than those for PTSD, psychological distress, and MPS.

Our study is the first to demonstrate that moderate and severe headaches, but not mild headache, are

associated with impaired social functioning in the military. The association remained significant even after adjusting for service demographic factors and possible mental health problems. Another study assessed impaired duty days among those with headache, but the study did not include a control group.<sup>6</sup> Civilian studies have shown that migraine is associated with functional impairment.<sup>4,5</sup> Our results are consistent with another study demonstrating that headache pain severity was a major factor influencing impairment<sup>4</sup> and a previous report that depression and headache contribute independently to increased functional impairment.<sup>5</sup>

Unlike the Millennium Cohort, we did not find that deployment increased the risk of moderate or severe headache whether deployed in a combat or a support role.<sup>8,31</sup> In the Millennium Cohort, the association was restricted to those deployed with a combat role. Another study based on hospitalized and ambulatory patients showed that after deployment to Iraq or Afghanistan, there was a greater increase in migraine in those with concussion, anxiety, or depression,<sup>7</sup> but clinical samples may be problematic for studying etiologic factors.<sup>32</sup> In the Millennium Cohort, it is unclear that deployment per se increased the rate of headaches because the increase in relative frequency of new headaches was marginal except for those complaining of recurrent severe headache.

As expected, we found headache to be more common in females, lower ranks, and regulars compared with reservists.<sup>8,31,33,34</sup> Those who exited the services reported more headaches than those who continue in service. It is possible that services leavers felt freer to report health complaints than those in the services who may show a high level of hardiness or are less inclined to report their health problems. Secondary gains or financial incentives are less plausible explanations for this result in UK personnel because access to free health care is available both during service and after leaving service, and financial compensation is unlikely to be given for this type of condition in the UK.

**Strengths and Weaknesses.**—The strengths of this study are the large sample size to make statistical inference from the data, the large range of covariates available for analysis, and the ability to assess the

contribution of mental ill health to repeated headache using a longitudinal design.

The main problem with our study is that the questions on headache are not based on any of the validated questionnaires on headache and migraine. This is a concern in relation to comparison of the prevalence of headache with other studies, and we recommend caution in doing so. The items of headache in our questionnaire are unlikely to have biased the reported statistical inferences because many of the associations have been found in studies that used validated instruments of headache. In spite of its limitations, our questions on headache have the advantage that they are inclusive, whereas validated questionnaires exclude those with head injury. It is possible that the inability to distinguish between headache types may err on the side of blurring associations, but the associations found in our study were very strong, especially those representing possible mental disorders. Our results are not based on clinical assessment so due care should be taken in interpreting them. However, most of the covariates in the analyses are based in validated instruments or correspond to commonly used definitions of service demographic variables. As in all population studies, attrition in the follow-up sample and non-response in the Afghanistan and the replenishment samples limit statistical inference. These limitations are mitigated in our study by demonstrating no association between mental health status at phase 1 and probability of participation in phase 2 and by the use of response weights in the analyses. A causal relationships of results based on cross-sectional analysis should be interpreted with caution.

**Implications.**—The most important implication from our study is that health care staff should be aware of the contribution of mental illnesses to symptoms of headache. It is also important to evaluate whether headache is an additional symptom in those who seek health care for mental illness. As barriers to health care including stigma are a frequent finding in surveys exploring mental health problems,<sup>35,36</sup> it is possibly more likely that a mental health issue may be uncovered in those who seek help for a headache. Intractable headache may provide the opportunity to explore possible mental health issues in those seeking

health care. This is especially important because mental health issues studies may influence the prognosis of headache, as shown for repeated headache in our study, but not found in another longitudinal study.<sup>18</sup>

Moderate and severe headache should be properly managed because it may have an impact on functional impairment independent of any concomitant mental health problem. Severity and frequency of headache are independent contributors of functional impairment<sup>4</sup> so they need to be explored, as they may have an effect on the ability to cope with duties, including deployment.

In conclusion, headache is common, and its severity has implications for the ability of service personnel to cope with service demands. Headache is highly associated with MPS, PTSD, and psychological distress, and these conditions are worth exploring and managing to improve the prognosis of headache, as well as the quality of life and preparedness of service personnel.

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