Prevalence of Delayed-Onset Posttraumatic Stress Disorder in Military Personnel: Is There Evidence for This Disorder?

Results of a Prospective UK Cohort Study

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Abstract: Delayed-onset posttraumatic stress disorder (PTSD) is defined as onset at least 6 months after a traumatic event. This study investigates the prevalence of delayed-onset PTSD in 1397 participants from a two-phase prospective cohort study of UK military personnel. Delayed-onset PTSD was categorized as participants who did not meet the criteria for probable PTSD (assessed using the PTSD Checklist Civilian version) at phase 1 but met the criteria by phase 2. Of the participants, 3.5% met the criteria for delayed-onset PTSD. Subthreshold PTSD, common mental disorder (CMD), poor/fair self-reported health, and multiple physical symptoms at phase 1 and the onset of alcohol misuse or CMD between phases 1 and 2 were associated with delayed-onset PTSD. Delayed-onset PTSD exists in this UK military sample. Military personnel who developed delayed-onset PTSD were more likely to have psychological ill-health at an earlier assessment, and clinicians should be aware of the potential comorbidity in these individuals, including alcohol misuse. Leaving the military or experiencing relationship breakdown was not associated.

Key Words: Posttraumatic stress disorder, delayed-onset, military, cohort study.

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Identification of delayed-onset posttraumatic stress disorder (PTSD) contributed to the development of the original diagnostic criteria of PTSD, initially termed "delayed-stress syndrome" (Jones and Wessely, 2007). Estimates of prevalence show considerable variation, and some studies have found no evidence for it at all (North et al., 2011). In a meta analysis across 11 countries, 25% of all PTSD cases were classified as delayed-onset PTSD (Smid et al., 2009), with some evidence for a higher prevalence in US studies (Adams and Boscarino, 2006; Berninger et al., 2010).

The diagnostic criteria of delayed-onset PTSD is that the onset of PTSD symptoms should occur at least 6 months after the traumatic event (*DSM-IV*; American Psychiatric Association, 2000). There is little guidance as to whether the onset of symptoms refers to any PTSD symptoms or if it only refers to the full PTSD diagnosis, but a recent review showed that delayed-onset PTSD with a lack of previous PTSD symptoms was uncommon (Andrews et al., 2007). Existing research on delayed-onset PTSD has predominantly used US data, with a dearth of prospective research in UK military samples. Some of the larger military studies have been anonymous, preventing longitudinal follow-up (Hoge et al., 2004, 2007). Methodological issues with existing research on delayed-onset PTSD include the use of retrospective data (Andrews et al., 2009; Prigerson et al., 2001), which is subject to recall bias (Raphael, 1987), and timing of PTSD assessments and the delayed-onset criteria; as in some studies, the first assessment occurred less than 6 months after trauma (American Psychiatric Association, 2000).

In this article, we use prospective data from a two-phase cohort study in a UK military sample to examine a) the prevalence of delayed-onset PTSD and the change in PTSD symptom score between phases, b) the sociodemographic, military, and psychological characteristics of delayed-onset PTSD, c) a cumulative measure of physical and psychological health as a predictive tool for delayed-onset PTSD, and d) whether a change in (psychological) health or marital status and leaving the military between phase 1 and phase 2 is associated with the development of delayed-onset PTSD.

METHODS

Study Design and Participants

Main Cohort

This cohort study included two phases of data collection, with the first phase taking place from 2004 to 2006 and the second taking place from 2007 to 2009 (Fear et al., 2010; Hotopf et al., 2006). The first phase of the cohort study recruited approximately 10% of UK military personnel who had been deployed to the first phase of the 2003 Iraq war (Operation TELIC: UK military codename for the Iraq deployment, with TELIC 1 from January 18 to June 28, 2003) and a further sample of military personnel who had not been deployed to Iraq at that time. Reservists were oversampled at a ratio of 2:1 and, in total, 10,272 participants responded (8,686 Regulars, 1,586 Reservists; 59% response rate; Hotopf et al., 2006). There were 9,395 participants from phase 1 who were available for follow-up at phase 2 (Fear et al., 2010), and 6,427 subsequently completed the phase 2 data collection (68% response rate). Response at phase 2 was associated with being older, female, an officer, and a regular at phase 1 but not with mental health status (Fear et al., 2010). Ethical approval was granted by the Ministry of Defence (Navy) personnel research ethics committee and the King's College Hospital local research ethics committee.

At phase 1, participants received the questionnaire by mail, or they received a visit to their military base, depending on the size of the military unit (Hotopf et al., 2006). The addresses used for the mail-outs were supplied by Defence Analytical Services and Advice (UK Ministry of Defence). There were three waves of data collection, and military tracing was undertaken with the assistance of the Ministry of Defence. At phase 2, there were two waves of data collection; the questionnaires were mailed out to the entire identified sample, and nonresponders were assigned a second mailing or a visit at their military base (Fear et al., 2010).

Measures

At phases 1 and 2, symptoms of PTSD in the "past month" were assessed using the National Centre for PTSD Checklist Civilian

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version (PCL-C; Weathers et al., 1994); cases were defined as individuals with a score of 50 or higher, referred to as probable PTSD (Fear et al., 2010; Weathers et al., 1994), and subthreshold PTSD was defined as individuals with a score of 40 to 49 (Mylle and Maes, 2004). Delayed-onset PTSD was defined as participants who did not meet the criteria for probable PTSD at phase 1 but met the criteria by phase 2. Normal-onset PTSD was defined as participants who met the criteria for probable PTSD at phase 1, regardless of PTSD status at phase 2. Symptoms of common mental disorder (CMD) in the "last few weeks" were measured using the General Health Questionnaire–12 (Goldberg et al., 1997), with cases defined as individuals with a score of 4 or higher (range of scores, 0–12). General health status was assessed using one item from the 36-item Short-Form Health Survey (Ware and Sherbourne, 1992), with individuals rating their current health as "poor" or "fair," compared with individuals rating their health as "good," "very good," or "excellent." Multiple physical symptoms (MPS) in the "past month" were assessed using a checklist of 53 symptoms, with cases defined as individuals reporting 18 or more symptoms (Hotopf et al., 2006). Typical alcohol use in the "past year" was measured by the 10-item World Health Organization Alcohol Use Disorders Identification Test (Babor et al., 2001). A score of 16 or higher was used to define alcohol misuse (range, 0–40; Fear et al., 2010).

At phase 1, childhood adversity was assessed using two measures (Iversen et al., 2007) adapted from the Adverse Childhood Exposure study scale (Felitti et al., 1998). The first assessed family relationship adversity: comprising four positive items that were reverse scored (*e.g.*, "I came from a close family") and four negative items (*e.g.*, "I used to be hit/hurt by a parent or caregiver regularly"; Iversen et al., 2007). These eight items were summed to form a cumulative measure and analyzed as 0, 1, and 2+ adversities. The second measure assessed childhood antisocial behavior, scored positively if participants answered true to "I used to get into physical fights at school" plus one of the following; "I often used to play truant at school" or "I was suspended or expelled from school" or "I did things that should have got me (or did get me) into trouble with the police" (MacManus et al., 2011).

Sample for This Study

Several exclusions were made to the follow-up sample (N = 6427) to ensure that the outcome group met the *DSM-IV* diagnostic criteria for delayed-onset PTSD (American Psychiatric Association, 2000). The inclusion criteria were a) participants must have PTSD data at both phases 1 and 2, b) participants must have a TELIC deployment before phase 1 data collection (conducted June 2004–March 2006) and the duration between the end of the TELIC deployment and phase 1 questionnaire completion should be greater than 6 months (delayed-onset is categorized as >6 months after trauma, and we measured this duration from the end of deployment) and cannot be longer than 5 years, c) participants should not have a deployment between the phase 1 and 2 data collections because it could provide an additional trauma exposure that introduces uncertainty on the time of onset of PTSD, and d) no history of PTSD reported at phase 1 (assessed by a self-report of "ever experienced" medical conditions) to ensure that PTSD had not developed after the TELIC deployment and then remitted by phase 1 data collection. One hundred thirty five participants were omitted from the follow-up sample as a result of the first criterion, with 3537 additional participants omitted using the second criterion, 1328 participants omitted using the third criterion, and 30 omitted using the fourth criterion. The final sample comprised 1397 participants.

Most of the sample (N = 1397) were male (89%), reported being married or in a long-term relationship (81%), were regulars (84%), and were holding lower ranks (81%). Two thirds of participants were serving in the Army (65%), with 18% in the Royal Air Force, and the rest, in the Naval services (17%). The characteristics for this sample are comparable with those for the original sample (N = 6427) (results not shown). The median time between the phase 1 and 2 assessments, in months, for this sample was 40.28 (interquartile range, 34.46–44.65).

Data Analysis

Sample weights were created to account for the oversampling of reservists at phase 1 and to account for response at phase 2. Analyses were conducted in STATA 11.0 (StataCorp, 2009). All the analyses presented here used the survey command, and weighted means, percentages, and odds ratios (ORs) are presented in the tables with unweighted cell counts, other than the diagnostic tests and receiver operating characteristics (ROC) curve, which are not.

1. The weighted prevalence of delayed-onset PTSD was calculated, and *t*-tests were conducted to examine the difference between phase 1 and 2 symptom scores.
2. Logistic regression analyses were conducted to calculate unadjusted ORs for the associations between phase 1 variables and PTSD status in two sets of analyses (no PTSD [baseline] compared with delayed-onset PTSD; normal-onset PTSD [baseline] compared with delayed-onset PTSD). These analyses were adjusted for any significant variables from the unadjusted phase 1 analyses, other than the health measures (general health, CMD, MPS, and alcohol misuse), which were highly associated with each other.
3. A cumulative measure of physical/psychological morbidity at phase 1 was derived, comprising any phase 1 health measures that were significantly associated with delayed-onset PTSD: subthreshold PTSD, CMD, general health status, and MPS (range, 0–4). Alcohol misuse was not included in this measure because it was not significantly associated with the outcome. ROC was used to examine the sensitivity and specificity of this cumulative measure to predict delayed-onset PTSD, and positive and negative likelihood ratios were calculated (Attia, 2003).
4. Variables were created to reflect change in relationship and serving status and change in physical and mental health from phase 1 to 2. The change scores for CMD and MPS compared the negative change category (*i.e.*, decline in health) to the remaining three categories (baseline category), due to low power in the original baseline category. Logistic regression analyses were conducted to calculate ORs for the associations between each of the change variables and the outcome (no PTSD compared with delayed-onset PTSD). Further models are presented for significant associations, adjusting for service, rank, deployment characteristics ("in a combat role" and "thought might be killed on deployment"), history of depression and anxiety, both measures of childhood adversity, subthreshold PTSD at phase 1 (which were all associated with delayed-onset PTSD in the unadjusted models), and phase 1 health measures other than those that formed the change variable. The phase 1 MPS measure was not adjusted for in any of the models because of the high association with the phase 1 measure of CMD.

RESULTS

Prevalence of Delayed-Onset PTSD

Of those who did not meet the criteria for probable PTSD at phase 1, 3.5% (n = 44; 95% CI, 2.4%–4.6%) met the criteria for delayed-onset PTSD (Table 1), representing 46% of all PTSD cases assessed at both phases 1 and 2 in this restricted sample. Twelve (27%) had previously met the criteria for subthreshold PTSD at phase 1. Fifty-seven participants reported probable PTSD with a normal onset (*i.e.*, the onset occurred before phase 1 data collection), representing 54% of all PTSD cases at phases 1 and 2. Ninety-four percent of participants

TABLE 1. Prevalence of Subthreshold (PCL, 40–49) and Probable PTSD (PCL, ≥50) at Phases 1 and 2 (N = 1397)

	Phase 2		
	No PTSD (n = 1274)	**Subthreshold PTSD (n = 60)**	**Probable PTSD (n = 63)**
Phase 1			
No PTSD (n = 1282) (weighted % by row)	1213 (94.2)	37 (3.1)	32 (2.7) (delayed-onset PTSD)
Subthreshold PTSD (n = 58) (weighted % by row)	36 (60.3)	10 (18.3)	12 (21.4) (delayed-onset PTSD)
Probable PTSD (n = 57) (weighted % by row)	25 (46.3) (normal-onset PTSD)	13 (22.9) (normal-onset PTSD)	19 (30.8) (normal-onset PTSD)

PTSD indicates posttraumatic stress disorder; PCL, PTSD Checklist.

(n = 1213) who did not meet the criteria for probable PTSD at phase 1 still did not meet the criteria by phase 2.

Phase 1 and Phase 2 PTSD Symptom Profiles

At phase 1, the delayed-onset group reported a significantly higher mean PTSD symptom score than the no-PTSD group (weighted mean [SD]: No PTSD, 22.35 [6.82] *vs.* delayed-onset PTSD, 33.28 [9.23]; $t = -7.39$, $p < 0.001$). The mean PTSD symptom score remained stable at a low level for the no-PTSD group, decreased by approximately a third for the normal-onset PTSD group by phase 2, and approximately doubled in the delayed-onset PTSD group (Fig. 1). The overall symptom burden across the groups remained fairly stable from phases 1 to 2 as the new onset delayed cases are offset by the normal-onset cases improving. A similar pattern was seen for the re-experience, avoidance and numbing, and hyperarousal subscales (figures not shown but available from the authors).

Phase 1 Sociodemographic, Military, and Psychosocial Characteristics of Participants Reporting no PTSD, Normal-Onset and Delayed-Onset PTSD by Phase 2

Table 2 shows that participants with delayed-onset PTSD were more likely to hold a non-officer rank, to have been in a combat role, and to have thought that they might have been killed while on deployment compared with participants with no PTSD. Delayed-onset PTSD was highly associated with having a history of depression, reporting CMD and MPS, and meeting the criteria for subthreshold PTSD at phase 1. Participants with either subthreshold PTSD, CMD, MPS, or "poor"/"fair" general health at phase 1 had a threefold increase in odds for delayed-onset PTSD, with an eightfold increase for those reporting three or four of these conditions. Participants with normal onset PTSD were significantly more likely to report CMD and MPS at phase 1 compared with those with delayed-onset PTSD.

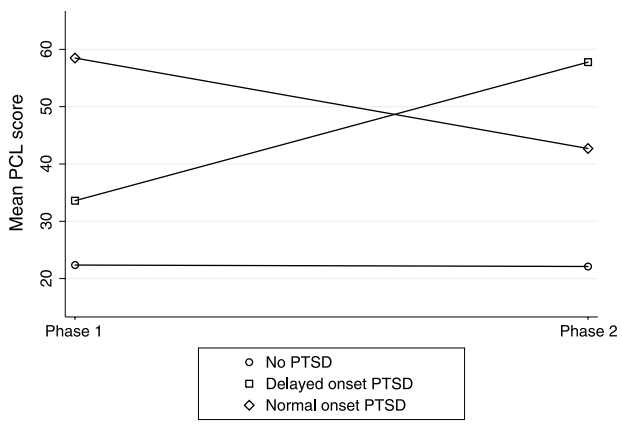

FIGURE 1. Graph displaying the mean PCL scores at phases 1 and 2 for the no-PTSD and normal- and delayed-onset PTSD groups. PTSD indicates posttraumatic stress disorder; PCL, PTSD Checklist.

Evaluating a Cumulative Measure of Physical/Psychological Morbidity at Phase 1 as a Diagnostic Test for Delayed-Onset PTSD

The ROC curve showed that the optimum threshold was achieved using a cutoff of 0 *vs.* 1+ conditions (sensitivity, 75.0%; specificity, 72.1%; Fig. 2). At this threshold, the positive likelihood ratio of 2.7 was relatively low, and with a negative likelihood ratio of 0.4, there was also little accuracy to predict the likelihood of delayed-onset PTSD if the test was negative. Using a higher cutoff resulted in a considerable reduction in sensitivity, with an expected increase in specificity (Table 3). The area under the curve was 0.77 (95% CI, 0.69–0.84), indicating that the cumulative measure overall has fair diagnostic accuracy (Fig. 2).

Associations Between Change in Psychosocial Factors and Physical and Psychological Health From Phases 1 to 2 and Delayed-Onset PTSD by Phase 2

Leaving the military between phases 1 and 2 was associated with delayed-onset PTSD (Table 4). However, this effect was no longer significant after adjustment for rank, deployment characteristics, history of depression, history of anxiety/panic disorder, childhood adversity, general health, alcohol misuse, CMD, and subthreshold PTSD at phase 1. After adjustment, self-reporting "poor" or 'fair' health at both phases 1 and 2 or reporting a decline in self-reported health from phase 1 to 2 was associated with an increase in the odds of delayed-onset PTSD. Participants who developed alcohol misuse also had increased odds of delayed-onset PTSD, and developing CMD or MPS between phases 1 and 2 was associated with approximately sevenfold increases in odds for delayed-onset PTSD after adjustment.

DISCUSSION

We found that delayed-onset PTSD, defined as the onset of probable PTSD at least 6 months after a traumatic event, exists in the UK military, representing nearly half of all PTSD cases assessed within our sample. Those who went on to develop delayed-onset PTSD already had more PTSD symptoms at an earlier assessment compared with those who did not develop probable PTSD, with evidence that delayed-onset PTSD was more likely if a subthreshold level of PTSD symptoms had previously been reported. Delayed-onset PTSD was shown to develop in military personnel who already have a degree of physical or psychological morbidity. Furthermore, delayed-onset PTSD paralleled the onset of CMD and alcohol misuse, suggesting that co-morbidity is

TABLE 2. Phase 1 Sociodemographic, Military, and Psychosocial Characteristics for Responders With No PTSD, Delayed-Onset PTSD, and Normal-Onset PTSD

	No PTSD at Phases 1 and 2 (n = 1296[a]), n (Weighted %)	Delayed-Onset PTSD by Phase 2 (n = 44[a]), n (Weighted %)	No PTSD *vs.* Delayed-Onset PTSD, OR (95% CI) (Unadjusted Models)	No PTSD *vs.* Delayed-Onset PTSD, OR (95% CI) (Adjusted Models[b])	Normal-Onset PTSD (n = 57[a]), n (Weighted %)	Normal-Onset *vs.* Delayed-Onset PTSD, OR (95% CI) (Unadjusted Models)
Sex						
Male	1132 (89.3)	36 (85.1)	1.00	—	49 (86.2)	1.00
Female	164 (10.7)	8 (14.9)	1.46 (0.64–3.36)	—	8 (13.8)	1.09 (0.35–3.42)
Age, yrs						
<35	625 (55.0)	25 (63.3)	1.00	—	33 (66.2)	1.00
≥35	671 (45.0)	19 (36.7)	0.71 (0.38–1.34)	—	24 (33.8)	1.14 (0.49–2.65)
Marital status						
In a relationship	1050 (81.2)	36 (82.4)	1.00	—	41 (74.7)	1.00
Single, divorced, separated, widowed	244 (18.8)	7 (17.6)	0.92 (0.39–2.14)	—	16 (25.3)	0.63 (0.22–1.81)
Service						
Naval services	207 (17.3)	4 (9.2)	0.40 (0.14–1.19)	0.45 (0.16–1.28)	9 (17.9)	0.46 (0.12–1.72)
Army	850 (63.8)	37 (84.8)	1.00	1.00	44 (75.4)	1.00
Royal Air Force	239 (18.9)	3 (5.9)	0.23 (0.07–0.81)*	0.53 (0.15–1.87)	4 (6.7)	0.78 (0.15–4.07)
Rank						
Officer	304 (20.0)	3 (4.0)	0.17 (0.05–0.57)***	0.21 (0.06–0.72)*	5 (7.8)	0.49 (0.10–2.38)
Other rank	991 (80.0)	41 (96.0)	1.00	1.00	52 (92.2)	1.00
Engagement type						
Regular	936 (84.6)	33 (86.8)	1.00	—	34 (75.9)	1.00
Reservist	360 (15.4)	11 (13.2)	0.83 (0.42–1.68)	—	23 (24.1)	0.48 (0.20–1.16)
In a combat role on deployment						
No	1066 (80.4)	28 (57.7)	1.00	1.00	42 (71.0)	1.00
Yes	224 (19.6)	16 (42.3)	3.00 (1.57–5.75)***	2.61 (1.20–5.68)*	15 (29.0)	1.80 (0.73–4.44)
Thought might be killed						
No	564 (45.1)	7 (18.2)	1.00	1.00	5 (10.0)	1.00
Yes	721 (54.9)	37 (81.8)	3.69 (1.61–8.45)***	2.38 (1.03–5.46)*	52 (90.0)	0.50 (0.14–1.79)
Discharged weapon on deployment						
No	1153 (88.4)	38 (83.7)	1.00	—	44 (76.8)	1.00
Yes	132 (11.6)	6 (16.3)	1.48 (0.61–3.60)	—	12 (23.2)	0.64 (0.21–1.97)
Handled bodies on deployment						
No	1130 (87.8)	35 (78.1)	1.00	—	43 (77.8)	1.00
Yes	166 (12.2)	9 (21.9)	2.01 (0.93–4.35)	—	14 (22.2)	0.98 (0.36–2.68)
History of depression						
No	1158 (89.5)	29 (66.5)	1.00	1.00	30 (51.7)	1.00
Yes	138 (10.5)	15 (33.5)	4.31 (2.19–8.49)***	3.67 (1.75–7.67)***	27 (48.3)	0.54 (0.23–1.29)

History of anxiety/panic disorder						
No	1248 (96.6)	37 (85.7)	1.00	1.00	43 (75.0)	1.00
Yes	48 (3.4)	7 (14.3)	4.77 (1.92–11.82)***	2.85 (0.87–9.30)	14 (25.0)	0.50 (0.17–1.47)
Childhood adversity—antisocial behavior						
No	1123 (85.6)	30 (64.5)	1.00	1.00	38 (66.3)	1.00
Yes	166 (14.4)	14 (35.5)	3.26 (1.66–6.40)***	1.58 (0.73–3.43)	17 (33.7)	1.08 (0.44–2.68)
Childhood adversity—family relationship						
0 adversities	591 (46.7)	13 (27.6)	1.00	1.00	16 (31.2)	1.00
1 adversity	267 (21.2)	8 (17.0)	1.36 (0.53–3.48)	1.29 (0.46–3.63)	6 (8.7)	2.21 (0.56–8.72)
2 or more adversities	407 (32.1)	22 (55.4)	2.92 (1.41–6.04)***	2.18 (0.99–4.77)	31 (60.1)	1.04 (0.39–2.76)
General health status						
Fair/ poor	144 (10.7)	12 (26.9)	3.05 (1.49–6.23)***	1.84 (0.79–4.28)	20 (35.3)	0.67 (0.27–1.69)
Excellent/ good	1147 (89.3)	32 (73.1)	1.00	1.00	36 (64.7)	1.00
Common mental disorder (GHQ-12)						
Noncase	1059 (82.3)	19 (45.5)	1.00	1.00	4 (8.2)	1.00
Case	233 (17.7)	25 (54.5)	5.58 (2.94–10.58)***	2.47 (1.12–5.46)*	53 (91.8)	0.11 (0.03–0.37)***
Multiple physical symptoms						
Noncase	1178 (90.5)	25 (56.6)	1.00	1.00	18 (34.0)	1.00
Case	118 (9.5)	19 (43.4)	7.32 (3.81–14.07)***	3.40 (1.54–7.47)***	39 (66.0)	0.39 (0.16–0.95)*
Alcohol misuse (Case on AUDIT, >15)						
Noncase	1147 (87.6)	33 (76.3)	1.00	—	35 (59.6)	1.00
Case	140 (12.4)	9 (23.7)	2.18 (1.00–4.75)	—	21 (40.4)	0.46 (0.17–1.20)
Subthreshold PTSD reported at phase 1						
No	1250 (96.4)	32 (72.8)	1.00	1.00		
Yes	46 (3.6)	12 (27.2)	9.96 (4.67–21.20)***	4.87 (2.05–11.58)***		
Cumulative physical/psychological morbidity at phase 1[c,d]						
0 reports	928 (72.1)	11 (25.9)	1.00	1.00		
1 report	240 (18.9)	13 (29.8)	4.40 (1.88–10.33)***	3.37 (1.30–8.73)*		
2 reports	64 (4.8)	9 (18.4)	10.72 (4.09–28.08)***	6.56 (2.29–8.73)***		
3–4 reports	55 (4.2)	11 (25.9)	17.14 (6.84–42.97)***	8.14 (2.81–23.57)***		

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.005$.
[a]Cell sizes differ because of missing data.
[b]Models adjusted for service, rank, deployment characteristics (in a combat role, and thought might be killed on deployment), history of depression, history of anxiety/panic disorder, childhood adversity (childhood antisocial behavior and family relationship adversities), and subthreshold PTSD at phase 1.
[c]Cumulative measure comprising GHQ caseness, MPS caseness, subthreshold PTSD, and general health status at phase 1.
[d]Model not adjusted for subthreshold PTSD which was included in the cumulative measure.
PTSD indicates posttraumatic stress disorder; GHQ, General Health Questionnaire; MPS, multiple physical symptoms; AUDIT, Alcohol Use Disorders Identification Test; OR, odds ratio.

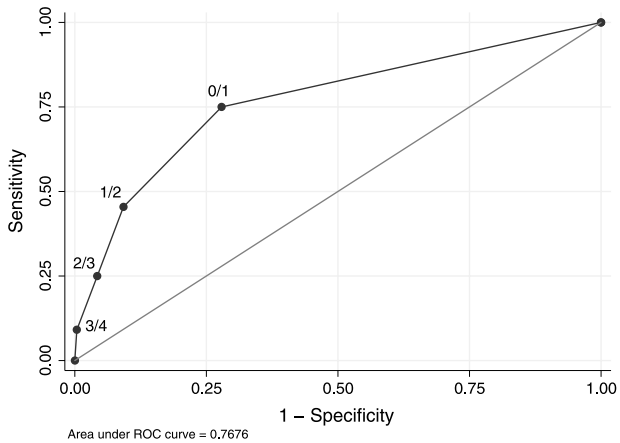

FIGURE 2. ROC curve for scores on the phase 1 cumulative measure predicting delayed-onset PTSD. PTSD indicates posttraumatic stress disorder; ROC, receiver operating characteristics.

likely in these individuals. We found little evidence that participants who left the military or experienced a change in their marital status were more likely to develop delayed-onset PTSD.

The results of this study supports existing literature that individuals with delayed-onset PTSD have a higher level of PTSD symptoms after the traumatic event compared with those who do not develop PTSD (Andrews et al., 2009; Dickstein et al., 2010). Subthreshold PTSD at baseline assessment was strongly associated with delayed-onset PTSD (Smid et al., 2009). In the current study, the prevalence of delayed-onset PTSD, of all PTSD cases, was higher than the 25% reported in a recent meta-analysis of international data (Smid et al., 2009) but is more similar to US data (Adams and Boscarino, 2006; Berninger et al., 2010; Dickstein et al., 2010). A longitudinal study in the US military assigned 3% of their total sample to a delayed-onset trajectory (Dickstein et al., 2010); 3% of the total sample reported delayed-onset PTSD in a US civilian study (Adams and Boscarino, 2006), and a US study of firefighters exposed to the World Trade Centre Disaster found that 45% of all PTSD cases have delayed onset (Berninger et al., 2010). In line with the general PTSD literature, there was evidence for a weak association between military rank and delayed-onset PTSD (Iversen et al., 2008; Riddle et al., 2007; Zohar et al., 2009). There was no evidence from the current study that reservists were more likely to develop delayed-onset PTSD, even though reservists are at a greater risk of CMD and PTSD after deployment compared with regulars (Fear et al., 2010; Hotopf et al., 2006). Military personnel who were in a combat role or thought they might be killed on deployment had a higher risk of delayed-onset PTSD, in agreement with previous research (Prigerson et al., 2001; Wolfe et al., 1999).

Research has shown that CMD (Andrews et al., 2009; Ehlers et al., 1998) and alcohol misuse (Andrews et al., 2009; Port et al., 2001) are risk factors for delayed-onset PTSD. There was further evidence from the current study that deterioration in self-reported physical health, CMD, and alcohol problems paralleled the development of delayed-onset PTSD. Depression may drive the development or persistence of PTSD after a traumatic event (Schindel-Allon et al., 2010), and there is evidence that depressive symptoms predict an increase in PTSD at a later assessment (Schindel-Allon et al., 2010). Although we used a broad assessment of CMD in the current study, which includes symptoms of depression, anxiety, social withdrawal, and somatic symptoms (Goldberg et al., 1997), we showed that CMD (in addition to subthreshold PTSD) at an earlier assessment was associated with delayed-onset PTSD. The current study also suggests that military personnel with delayed-onset PTSD are more likely to report alcohol misuse and psychological comorbidity (Kessler et al., 1995), which could result in a poorer prognosis and worse psychosocial functioning (Pietrzak et al., 2011).

Previous research has considered the role of life stressors as a trigger for delayed-onset PTSD, in addition to the prime stressful/traumatic event that has resulted in PTSD (Andrews et al., 2009). The theory proposes that delayed-onset PTSD may result from a cumulative strain of multiple stressors (Andrews et al., 2009), similar to the stress-sensitivity hypothesis for depression (Hammen, 2005). In this study, we examined relationship breakdown between phases as a potential stressor, which was not associated with delayed-onset PTSD. Retrospective measures of family relationship adversity and childhood antisocial behavior were associated with delayed-onset PTSD (which has been previously seen [Horesh et al., 2011; Hyman, 2009]), but these effects diminished after adjusting for other phase 1 measures. Childhood adversity predicts psychopathology in adulthood (Clark et al., 2010), and adulthood psychopathology may have mediated the association between childhood adversity and delayed-onset PTSD in the current study.

A number of explanations as to why leaving the military might be associated with delayed-onset PTSD have previously been proposed: first, leaving the military could be considered a stressful event (Andrews et al., 2009); second, individuals may feel more able to report symptoms of PTSD after leaving the military (Frueh et al., 2000); and third, the association could be explained by a theory of "secondary gain," referring to the attention and benefits that the individual may receive as a consequence of PTSD (Jones and Wessely, 2007). The potential for financial gains as a result of compensation claims or disability benefit

TABLE 3. Sensitivity and Specificity of the Cumulative Measure to Predict Delayed-Onset PTSD

Cutoff	No PTSD (n = 1296), n (Weighted % by Column)	Delayed-Onset PTSD (n = 44), n (Weighted % by Column)	Sensitivity (95% CI)	Specificity (95% CI)	Positive Likelihood Ratios (95% CI)	Negative Likelihood Ratios (95% CI)
0/1	928 (72.1)	11 (25.9)	75.0% (59.7%–86.8%)	72.1% (69.6%–74.5%)	2.7 (2.2–3.3)	0.4 (0.2–0.6)
	359 (27.9)	33 (74.1)				
1/2	1168 (91.0)	24 (55.7)	45.5% (30.4%–61.2%)	90.8% (89.0%–92.3%)	4.92 (3.1–7.1)	0.6 (0.5–0.8)
	119 (9.0)	20 (44.3)				
2/3	1232 (95.8)	33 (74.1)	25.0% (13.2%–40.3%)	95.7% (94.5%–96.8%)	5.9 (3.3–10.4)	0.8 (0.7–0.9)
	55 (4.2)	11 (25.9)				
3/4	1282 (99.6)	40 (92.3)	9.1% (2.5%–21.7%)	99.6% (99.1%–99.9%)	23.4 (6.5–84.2)	0.91 (0.8–1.0)
	5 (0.4)	4 (7.7)				

PTSD indicates posttraumatic stress disorder.

TABLE 4. Associations Between Delayed-Onset PTSD and Change in Sociodemographic and Health Status From Phase 1 to Phase 2

Change Variables From Phase 1 to 2	No PTSD (n = 1296[a]), n (Weighted %)	Delayed-Onset PTSD (n = 44[a]), n (Weighted %)	OR (95% CI), Unadjusted Models	OR (95% CI), Adjusted Models[b]
Relationship status				
No change	1095 (83.8)	33 (76.5)	1.00	—
In a new relationship	115 (9.6)	4 (10.3)	1.17 (0.39–3.52)	—
End of a relationship	82 (6.6)	6 (13.2)	2.18 (0.84–5.62)	—
Serving status				
In service phases 1 and 2	769 (59.2)	19 (42.7)	1.00	1.00
Not in service phases 1 and 2	182 (15.0)	6 (16.2)	1.51 (0.58–3.89)	1.14 (0.40–3.29)
Left service	330 (25.4)	19 (41.1)	2.24 (1.13–4.42)*	1.46 (0.66–3.23)
Rejoined service	7 (0.5)	0	—	—
General health status[c]				
Good health stable	1059 (82.8)	21 (48.8)	1.00	1.00
Poor health stable	57 (4.4)	9 (20.5)	7.83 (3.33–18.44)***	3.72 (1.19–11.65)*
Decline in health	86 (6.4)	11 (24.4)	6.44 (2.89–14.35)***	3.74 (1.41–9.91)**
Improvement in health	87 (6.3)	3 (6.4)	1.71 (0.47–6.24)	0.88 (0.24–3.24)
Alcohol misuse (case on AUDIT, >15)[c]				
No change (no misuse)	1094 (83.4)	26 (60.2)	1.00	1.00
No change (misuse)	51 (4.4)	5 (12.3)	3.84 (1.37–10.77)*	1.29 (0.40–4.18)
Deterioration change	49 (4.2)	7 (18.3)	6.10 (2.45–15.17)***	6.15 (2.05–18.48)***
Improvement change	88 (8.0)	3 (9.2)	1.60 (0.47–5.47)	0.76 (0.21–2.71)
CMD (GHQ-12)[c,d]				
No change or positive change	1171 (90.4)	27 (60.0)	1.00	1.00
Negative change	119 (9.6)	17 (40.0)	6.29 (3.24–12.21)***	7.12 (3.07–16.52)***
Multiple physical symptoms[d]				
No change or improvement	1139 (95.1)	24 (66.5)	1.00	1.00
Decline in health	58 (4.9)	13 (33.5)	9.73 (4.56–20.76)***	7.85 (2.86–21.52)***

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.005$.
[a]Cell sizes differ because of missing data.
[b]Models adjusted for service, rank, deployment characteristics (in a combat role, and thought might be killed on deployment), history of depression, history of anxiety/panic disorder, childhood adversity (childhood antisocial behavior and family relationship adversities) and general health, alcohol misuse, CMD, and subthreshold PTSD all at phase 1.
[c]Model was not adjusted for the corresponding phase 1 health measure.
[d]Sample size in the baseline category for delayed-onset group is small, so the no-case, positive-change and case-stable categories have been combined.
PTSD indicates posttraumatic stress disorder; GHQ, General Health Questionnaire; AUDIT, Alcohol Use Disorders Identification Test; OR, odds ratio; CMD, common mental disorder.

could explain an increase in PTSD symptoms after an individual has left the military (Smid et al., 2009), although there is more research on secondary gain and recovery time (Jones and Wessely, 2007) than time of onset. In this study, there was only weak evidence for an association between leaving the military and delayed-onset PTSD; however, the sample of participants who left the military was small.

Strengths and Weaknesses of This Study

The strengths of this study include prospective data from a large UK military cohort, with a satisfactory response rate for a young, mobile, male population (Fear et al., 2010). There was minimal response bias at phase 2, and nonresponse was accounted for by weighting. For the assessment of delayed-onset PTSD, we used the *DSM-IV* definition in regard to the timescale from the trauma to PTSD onset (American Psychiatric Association, 2000); PTSD symptoms were initially assessed 6 months or more after deployment and again a number of years later. We have measured the duration from potential trauma to PTSD assessment as from the end of the deployment. This is a conservative approach given that we do not know the exact date of trauma; however, we acknowledge that a trauma may have occurred before this date. We tried to control for further military traumas in our sample by excluding participants who were deployed between the phase 1 and 2 assessments. We accept that other psychological traumas may have occurred between these phases, but these were not assessed in the current study. The measure of change in relationship status is also open to bias because there may have been additional changes in relationship status that could not be captured.

Weaknesses include the self-report nature of the data and a potential recall bias for measures that asked about events while on deployment (Wessely et al., 2003). The childhood adversity data was also collected retrospectively in adulthood. The sample in the current study was restricted by a range of exclusion criteria, resulting in a reduction in sample size from 6427 to 1397 participants. Because of these restrictions, there is uncertainty regarding the prevalence estimates of normal and delayed-onset PTSD. However, the original and restricted samples were found to be comparable in demographic and military characteristics, suggesting that the main findings from the regression analyses should be generalizable to the UK military. There was a wide window between deployment and phase 1 assessment, and a further limitation is that some of the participants who met the criteria for probable PTSD at phase 1 may have actually had delayed-onset PTSD, resulting in a potential underestimation of cases. We chose the current design to ensure that all cases defined as delayed-onset occurred at least 6 months after the potential trauma (as the conservative option), rather than classifying cases as delayed-onset when they were not.

Clinical Implications

Although we were able to find many meaningful risk factors of delayed PTSD, these risk factors considered separately or together were not powerful enough to detect, with a high degree of certainty, those who are at most risk of developing delayed-onset PTSD. Therefore, we are not in a position to offer an appropriate tool for screening for delayed PTSD. Delayed-onset PTSD also parallels the onset of CMD and alcohol misuse, and clinicians should be aware of potential comorbidity in these patients.

CONCLUSIONS

Delayed-onset PTSD exists in the UK military, representing nearly half of all PTSD cases assessed. This is in line with US military and civilian studies of delayed-onset PTSD. Ninety-three percent of the subjects in this restricted sample did not meet the criteria for normal- or delayed-onset PTSD. Military personnel who developed delayed-onset PTSD were more likely to have a history of depression, to meet the criteria for subthreshold PTSD, and to report CMD and MPS at an earlier assessment. There was little evidence that leaving the military or experiencing relationship breakdown were associated with delayed-onset PTSD. Clinicians should be aware of potential comorbidity in individuals with delayed-onset PTSD; the onset of the disorder was found to parallel the development of CMD, MPS, "poor" general health, and alcohol misuse.

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