Mental health outcomes of male UK military personnel deployed to Afghanistan and the role of combat injury: analysis of baseline data from the ADVANCE cohort study

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Summary

Background The long-term psychosocial outcomes of UK armed forces personnel who sustained serious combat injuries during deployment to Afghanistan are largely unknown. We aimed to assess rates of probable post-traumatic stress disorder (PTSD), depression, anxiety, and mental health-associated multimorbidity in a representative sample of serving and ex-serving UK military personnel with combat injuries, compared with rates in a matched sample of uninjured personnel.

Methods This analysis used baseline data from the ADVANCE cohort study, in which injured individuals were recruited from a sample of UK armed forces personnel who were deployed to Afghanistan and had physical combat injuries, according to records provided by the UK Ministry of Defence. Participants from the uninjured group were frequency-matched by age, rank, regiment, deployment, and role on deployment. Participants were recruited through postal, email, and telephone invitations. Participants completed a comprehensive health assessment, including physical health assessment and self-reported mental health measures (PTSD Checklist, Patient Health Questionnaire-9, and Generalised Anxiety Disorder-7). The mental health outcomes were rates of PTSD, depression, anxiety, and mental health-associated multimorbidity in the injured and uninjured groups. The ADVANCE study is ongoing and is registered with the ISRCTN registry, ISRCTN57285353.

Findings 579 combat-injured participants (161 with amputation injuries and 418 with non-amputation injuries) and 565 uninjured participants were included in the analysis. Participants had a median age of 33 years (IQR 30–37 years) at the time of assessment. 90·3% identified as White and 9·7% were from all other ethnic groups. The rates of PTSD (16·9% [n=89] *vs* 10·5% [n=53]; adjusted odds ratio [AOR] 1·67 [95% CI 1·16–2·41], depression (23·6% [n=129] *vs* 16·8% [n=87]; AOR 1·46 [1·08–2·03]), anxiety (20·8% [n=111] *vs* 13·5% [n=71]; AOR 1·56 [1·13–2·24]) and mental health-associated multimorbidity (15·3% [n=81] *vs* 9·8% [n=49]; AOR 1·62 [1·12–2·49]) were greater in the injured group than the uninjured group. Minimal differences in odds of reporting any poor mental health outcome were noted between the amputation injury subgroup and the uninjured group (AOR range 0·77–0·97), whereas up to double the odds were noted for the non-amputation injury subgroup compared with the uninjured group (AOR range 1·74–2·02).

Interpretation Serious physical combat injuries were associated with poor mental health outcomes. However, the type of injury sustained influenced this relationship. Regardless of injury, this cohort represents a group who present with greater rates of PTSD than the general population, as well as increased psychological burden from multimorbidity.

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See **Comment** page 526

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Introduction

Military personnel who sustain a combat injury are at increased risk of poor mental health outcomes, but there is little evidence about the risk of such outcomes in the UK military.[1–4] UK military deployment to Afghanistan (Operation HERRICK, 2002–14) has represented a unique period in which the trauma management was advanced to the point that severely injured personnel were more likely to survive than at any other point in history.[5]

The mechanisms by which the UK military personnel sustained injuries in Afghanistan were primarily from improvised explosive devices, rocket-propelled grenades, and gunshots, which together accounted for over 90% of all UK military personnel injuries.[6] Lower limb injuries were the most prevalent, followed by upper limb injuries and head injuries. 265 UK military personnel sustained a major limb amputation as a result of their deployment to Afghanistan between 2003 and 2014.[7]

The mental health of military personnel who sustained a physical combat injury has been researched in the short-to-medium term. Much of this research is on US samples and suggests that sustaining a physical combat injury increases the risk of subsequent mental ill

Research in context

Evidence before this study

To investigate the mental health outcomes of physically injured military personnel who deployed to Afghanistan, we searched EMBASE, Global Health, PsycINFO, and OVID MEDLINE on Aug 29, 2021. Search terms included ([“ex-serving” OR “armed forces” OR “military” OR “soldier” OR “officer” OR “combat” OR “ex-military”) AND (“Afghanistan” OR “Herrick” OR “operation enduring freedom” OR “Iraq” OR “Telic” OR “operation Iraqi freedom” OR “operation new dawn”) AND (“PTSD” OR “PTSS” OR “mental illness*” OR “mental health” OR “mood disord*”) AND (“injur*” OR “disab*” OR “amputat*”)]. Included studies had to be published between Jan 1, 2001, and Aug 29, 2021), were original research articles, were human studies only, and reported on samples who deployed to Afghanistan. Studies were excluded if they had a primary sample population of severe traumatic brain injuries or female-only samples. No language restrictions were used.

34 papers were included in this review. Almost all studies were from US military samples (n=31), with one study on UK, one study on French, and one study on Danish military samples. Rates of probable PTSD in physically injured personnel ranged from 4% to 58%, and rates of depression ranged from 3% to 38%. A third of papers focused on any combat injuries and the rest focused on specific injuries (eg, thermal injuries or amputations) or mechanism of injury (eg, explosive or gunshot wound). The majority of studies compared against a reference group of other injured personnel (eg, amputation-related injuries *vs* non-amputation injuries). Of those studies that compared the injured group with an uninjured reference group, combat injury was associated with poorer mental health outcomes. Several studies investigated pain and suggested that it was a mediating factor between injury status and mental health outcomes. Quality of evidence, as assessed by the UK National Heart, Lung, and Blood Institute’s quality assessment tools, was adequate.

Added value of this study

UK military personnel who sustained a physical combat injury during military deployments to Afghanistan had greater odds of reporting probable PTSD, depression, anxiety, and mental health multimorbidity compared with a frequency-matched uninjured group. This increase in poor mental health outcomes was noted among those with non-amputation-related injuries but was not evident among those who sustained amputation injuries. The study design allows for a more reliable estimate regarding the odds of reporting poor mental health outcomes than previous studies.

Implications of all the available evidence

It has been almost 20 years since the UK started Operation HERRICK (the military operations in Afghanistan between 2002 and 2014). Although combat injuries sustained during these operations are related to an increased reporting of poor mental health outcomes, the present findings suggest that the long-term mental health outcomes of combat casualties vary depending on the type of injury sustained during deployment. This study also directs attention to the potential psychological burden of those with mental health multimorbidity. These findings suggest that long-term follow-up of those deployed to a combat zone is essential and more attention to the mental health of those with less visible injuries, including pain, is warranted.

health.[1,3,4,8] To our knowledge, the only study on the UK military suggests that, during deployment to Iraq or Afghanistan, individuals who were medically evacuated were at increased risk of post-deployment probable post-traumatic stress disorder (PTSD) compared with individuals who were not medically evacuated.[2] Outcomes in injured personnel vary depending on the type and mechanism of the injury, as well as the mental health outcome investigated,[1,3,9] although many studies do not have data on an uninjured group for comparison.

The Armed Services Trauma Rehabilitation Outcome (ADVANCE) cohort study is investigating the long-term effect of sustaining a physical combat injury during deployment to Afghanistan (2002–14) on physical and psychosocial outcomes in serving and ex-serving UK armed forces personnel.[10] ADVANCE is a longitudinal study, with five follow-up visits planned at regular intervals across a 20-year period. The ADVANCE study hypothesises that combat casualties will have increased rates of adverse physical and psychosocial outcomes compared with a comparison group of uninjured Afghanistan-deployed armed forces personnel.

Here, we aimed to compare the rates of PTSD, depression, anxiety, and mental health-associated multimorbidity between injured and uninjured groups of Afghanistan-deployed UK armed forces personnel at baseline. A second aim was to examine whether subgroups of the injured group—namely, those with amputation-related and non-amputation-related injuries—exhibit differences in the rates of these outcomes. We hypothesised that the rates of poor mental health outcomes would be increased in the injured group compared with the uninjured group from the ADVANCE study cohort.

Methods

Study design and participants

This analysis reports on baseline data from the ADVANCE cohort. Full details of the ADVANCE cohort study, including the study protocol, are published elsewhere.[10] Injured individuals were recruited from a sample of UK armed forces personnel who were deployed to Afghanistan between 2002 and 2014 and had physical combat injuries, on the basis of records provided from the Ministry of Defence, Defence

Statistics (UK). Eligibility criteria for the injured group were: sustaining a physical combat injury while on deployment to Afghanistan; aeromedical evacuation as a result of the injury, resulting in admission to a UK hospital; and no history of cardiovascular, liver, or renal disease before injury. Uninjured personnel were recruited as a comparison group, consisting of individuals who were frequency-matched to the injured cohort on their age, rank, regiment, deployment during specific deployment periods (based on frequency of deployment periods from which the injured group sustained their injuries), and role on deployment. Eligibility criteria for the uninjured group were: deployment to Afghanistan and sustaining no physical combat injuries while on deployment; and no history of cardiovascular, liver, or renal disease before deployment. Details of potential participants from both groups and sampling characteristics were extracted from a combination of data sources, including the initial Notification of Casualty System (NOTICAS), the Defence Patient Tracking System, the Defence Medical Information Capability Programme, the Complex Trauma Database of the Defence Medical Rehabilitation Centre, the DRMC Prosthetic database, the UK Joint Theatre Trauma Registry, and the Joint Personnel Administration database. The ADVANCE study started data collection on Aug 5, 2015, and completed baseline data collection on Aug 28, 2020. The sample size was based on a sample size calculation for the primary hypothesis of the ADVANCE study using a primary composite cardiovascular disease endpoint.[10]

The ADVANCE study has approval from the Ministry of Defence Research Ethics Committee (protocol number 357/PPE/12). All participants gave written informed consent. Because there were only a very small number of female UK military combat casualties in Afghanistan and physiological differences between males and females that would confound the primary hypotheses of ADVANCE,[10] only male UK injured personnel were eligible for this cohort study.

Procedures

Between Aug 5, 2015, and Aug 28, 2020, participants were recruited through postal, email, and telephone invitations. For those who had left the military, efforts to trace them were made through electoral roll data, social media, and advertising through military charities. 2329 participants (1163 injured and 1166 uninjured) were invited to a study day at the Defence Medical Rehabilitation Centre at Headley Court (Surrey, UK) (between Aug 5, 2015 and Aug 30, 2018) or at Stanford Hall (Leicestershire, UK; from Oct 9, 2018, onwards). The study involved a comprehensive health investigation, including assessment of objective health measures (cardiovascular, respiratory, audiological, and musculoskeletal tests), a clinical interview with a research nurse (sociodemographic information and personal and family medical histories), and self-completion of participant questionnaires (musculoskeletal functioning, mental health, occupational history, and drug use).

The ADVANCE study has approval from the Ministry of Defence Research Ethics Committee (MODREC; protocol No:357/PPE/12). All participants gave written informed consent.

Outcomes

The mental health outcomes of this study were the rates of PTSD, depression, anxiety, and mental health-associated multimorbidity in each group. Military and sociodemographic information was collected via self-report questionnaire and clinical interview, supplemented by information provided by Defence Statistics (UK). This information included data on serving status, length of service, service branch, rank, number of deployments to Iraq and Afghanistan, engagement type (regular, reserve), and combat role.

Information on combat injury was collected from electronic medical records and supplemented by self-report in the clinical interview. This information included all types of injuries (eg, fragmentation injuries, gunshot wounds, fractures). New Injury Severity Scores (NISSs;[11] ranging from a score of 1 to 75) were extracted from the UK Joint Theatre Trauma Registry. The NISS was treated as a continuous variable and also categorised according to likely mortality from major trauma (NISS ≥13).[12]

Amputations were recorded as above, below, or through knee for the lower limb, and above or below elbow for the upper limb. Isolated partial amputations (eg, partial foot, partial hand, finger, or toe) were not included in the amputation injury group.

Depression was measured using Patient Health Questionnaire-9, a nine-item self-report questionnaire that records depressive symptoms over the previous 2 weeks.[13] Depression was defined as a score of 10 or higher (ranging from a score of 0 to 27). Anxiety was measured using Generalised Anxiety Disorder-7, a seven-item self-report questionnaire that records anxiety symptoms over the previous 2 weeks.[14] Anxiety was defined as a score of 10 or higher (ranging from a score of 0 to 21).

PTSD was measured using the PTSD Checklist (PCL-C),[15] a 17-item self-report questionnaire examining the symptoms of PTSD according to DSM-IV over the past month. Probable PTSD was defined as a score of 50 or higher (ranging from a score of 17 to 85).

Mental health multimorbidity was defined as caseness on the PCL-C (score ≥50) in combination with caseness on either the Patient Health Questionnaire-9 (score ≥10) or Generalised Anxiety Disorder-7 (score ≥10).

Choice of primary measure

All outcome measures used in this study were brief, easily accessible, and psychometrically validated measures regularly used in UK military epidemiological research. Depression and anxiety are common mental

	Total cohort (n=1144)	Uninjured group (n=565)*	Injured group (n=579)	Amputation injury subgroup (n=161)	Non-amputation injury subgroup (n=418)
Age at sampled deployment, years	25 (22–29)	26 (23–29)	25 (22–29)	25 (22–28)	25 (22–29)
Age at assessment, years	33 (30–37)	34 (30–37)	33 (30–37)	32 (30–36)	33 (30–38)
Engagement type at time of sampled deployment					
Regular	1089 (95·2%)	545 (96·4%)	544 (94·0)%	157 (97·7%)	387 (92·8%)
Reserve	55 (4·9%)	20 (3·6%)	35 (6·0%)	4 (2·3%)	31 (7·2%)
Serving status at assessment					
Left service	520 (47·6%)	99 (17·8%)	421 (73·0%)	144 (89·7%)	277 (67·2%)
Still serving	624 (52·4%)	466 (82·2%)	158 (27·0%)	17 (10·3%)	141 (32·8%)
Ethnicity					
White	1036 (90·3%)	512 (90·4%)	524 (90·3%)	148 (91·6%)	376 (89·8%)
All other ethnic groups	108 (9·7%)	53 (9·6%)	55 (9·7%)	13 (8·4%)	42 (10·2%)
Rank at sampled deployment					
Lower rank	753 (72·0%)	339 (66·5%)	413 (76·6%)	128 (84·2%)	286 (74·0%)
Mid rank	253 (20·6%)	147 (24·7%)	106 (17·1%)	20 (10·9%)	86 (19·3%)
Officer rank	138 (7·4%)	79 (8·8%)	60 (6·3%)	13 (4·9%)	47 (6·7%)

Data are presented as n (%) and median (IQR). Weighted percentages are presented along with unweighted cell counts. *One participant was excluded from the uninjured comparison group due to having severe injuries outside of military service, leaving a total of 565 uninjured participants.

Table 1: **Sociodemographic and deployment characteristics overall and by injury status**

health disorders across both the UK general population[16] and armed forces.[17] PTSD, although not common, is seen more often within certain roles in the UK armed forces, including those who deploy in a combat role.[17] Multimorbidity represents an outcome with increased psychological burden beyond that of PTSD alone or depression alone.[18] Full details regarding the choice of primary measures are listed in the appendix (pp 1–2).

See Online for appendix

Statistical analysis

Data analysis was conducted using STATA MP 16.1. Ethnicity was recoded into two groups; White and all other ethnic groups combined. Rank at sampling was coded as a proxy for socioeconomic status—namely, lower rank (NATO OR2-OR4), mid rank (NATO OR5-OR9), and officer rank (NATO OF1-OF6).[19]

Sampling weights were applied to the injured group to take into account the undersampling of the less seriously injured group (NOTICAS system). Response weights were applied on the basis of age, rank, and service at time of injury and deployment of interest, to take into account that officers, royal marines, and slightly older participants (non-responder median age 24 years [IQR 21–27] *vs* responder median age 25 years [IQR 22–29]) were more represented in those who responded. Response weights were multiplied by sampling weights and applied by use of the svy command to all frequency tables. Weighted percentages are presented along with unweighted cell counts. Only a small number of data were missing (range n=2 to n=8); therefore these data were handled by use of casewise deletion.

Sociodemographic and deployment characteristics were compared between the uninjured and injured groups, as well as between amputation injury and non-amputation injury subgroups. Logistic regression was used to assess the relationship between injury status and each mental health outcome. The unadjusted odds ratio (OR) is presented alongside an adjusted odds ratio (AOR) to show the effect of including confounders on the relationship between combat injury and the mental health-dependent variables. Conclusions on the aims and hypothesis of the study were based on the AOR. Adjustments for a-priori confounders (age at assessment[20] and socioeconomic status[21]) were made by including these variables in the model as covariates. To address the second aim of the study, separate regression models were constructed to compare the amputation injury subgroup to the uninjured group, the non-amputation injury subgroup to the uninjured group, and the amputation subgroup to the non-amputation injury subgroup.

Officers were excluded from the adjusted analyses owing to small numbers of poor mental health outcomes in this group (range n=1 to n=9). Because of the small number of poor mental health outcomes in the amputation injury group (range n=16 to n=25), bootstrapping by use of 1000 replications was used and bias-corrected 95% CIs are reported for all logistic regression analyses.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

579 injured participants and 566 uninjured participants were recruited for the ADVANCE study. The response rate, adjusted for deaths and potential participants with

	Total group n (%; 95% CI)	Uninjured group n (%; 95% CI)	Injured group n (%; 95% CI)	Amputation-related injury subgroup n (%; 95% CI)	Non-amputation-related injury subgroup n (%; 95%CI)
PTSD (PCL-C ≥50)	142 (13·9%; 11·9–16·2)	53 (10·5%; 8·1–13·5)	89 (16·9%; 13·9–20·4)	15 (9·9%; 6·0–16·0)	74 (19·3%; 15·6–23·7)
Depression (PHQ-9 ≥10)	216 (20·5%; 18·1–23·1)	87 (16·8%; 13·8–20·4)	129 (23·6%; 20·1–27·4)	25 (16·1%; 11·0–23·0)	104 (26·1%; 21·9–30·8)
Anxiety (GAD-7 ≥10)	182 (17·4%; 15·2–19·9)	71 (13·5%; 10·8–16·8)	111 (20·8%; 17·5–24·5)	21 (14·1%; 9·3–20·8)	90 (23·1%; 19·1–27·6)
Mental health multimorbidity (caseness on PCL-C and PHQ-9 or GAD-7)	130 (12·8%; 10·8–15·0)	49 (9·8%; 7·4–12·8)	81 (15·4%; 12·5–18·8)	12 (8·2%; 4·7–14·1)	69 (17·9%; 14·2–22·1)

Data are n (%, 95% CI). Weighted percentages are presented along with unweighted cell counts. GAD-7=Generalised Anxiety Disorder-7. PCL-C=PTSD Checklist. PHQ-9=Patient Health Questionnaire-9. PTSD=post-traumatic stress disorder.

Table 2: **Mental health outcomes by injury status**

no available contact details, was 59·6% (579 of 971 participants) for the injured group and 56·3% (566 of 1005 participants) for the uninjured group. 309 (55·1%) of 561 eligible participants with a very serious injury or serious injury NOTICAS classification and 161 (62·6%) of 257 eligible participants with amputation injuries took part in the ADVANCE study. For the purposes of this analysis, one participant was excluded from the uninjured comparison group owing to having severe injuries outside of military service, leaving a total of 565 uninjured participants.

Table 1 shows the sampling characteristics and the current sociodemographic and health characteristics of the study participants. The median number of Afghanistan deployments per participant was 2 (IQR 1–2). Participants were assessed for the ADVANCE study a median of 8 years (IQR 7–9) after their sampled deployment. Differences were noted in distribution of rank, with a greater proportion of higher ranks in the uninjured group compared with the injured group, and age, with the uninjured group being slightly older by approximately 1 year on average compared with the injured group.

The median NISS for the injured group was 13 (IQR 6–30). 292 (47·5%) of 579 injured participants had a score above the suggested cutoff for likely mortality from major trauma at the point of their aeromedical casualty evacuation (NISS ≥13).

Details on body region and mechanisms of injury, stratified by amputation injury status, are in the appendix (p 3). 442 (76·3%) of 579 injured participants had injuries because of blasts, 135 (23·3%) by gunshot wounds, and seven (1·2%) through other incidents (eg, vehicular accidents or falls). Participants could sustain multiple injury types, such as gunshot wound and explosion injuries. 161 (27·8%) of the 579 injured participants sustained at least one limb amputation and 76 (13·1%) had two or more limb amputations. Among the 161 participants in the amputation injury subgroup, the top three areas of injury were the lower limb (158 [98·1%]), head (80 [49·7%]), and torso (76 [47·2%]; appendix p 3). Among the 418 participants in the non-amputation-related injury subgroup, the top three areas of injury were the lower limb (258 [61·7%]), upper limb (208 [49·8%]), and head (188 [45·0%]; appendix p 3).

	OR (95% bias-corrected CI)	AOR* (95% bias-corrected CI)
Injury group (ref: uninjured group)		
PTSD (PCL-C ≥50)	1·77 (1·28–2·67)	1·67 (1·16–2·41)
Depression (PHQ-9 ≥10)	1·58 (1·18–2·16)	1·46 (1·08–2·03)
Anxiety (GAD-7 ≥10)	1·65 (1·22–2·30)	1·56 (1·13–2·24)
Mental health multimorbidity (caseness on PCL-C and PHQ-9 or GAD-7)	1·72 (1·24–2·64)	1·63 (1·14–2·48)
Amputation injury subgroup (ref: uninjured group)		
PTSD (PCL-C ≥50)	1·00 (0·48–1·68)	0·92 (0·46–1·70)
Depression (PHQ-9 ≥10)	1·02 (0·62–1·66)	0·87 (0·48–1·38)
Anxiety (GAD-7 ≥10)	1·05 (0·55–1·74)	0·97 (0·53–1·64)
Mental health multimorbidity (caseness on PCL-C and PHQ-9 or GAD-7)	0·85 (0·42–1·55)	0·77 (0·35–1·47)
Non-amputation injury subgroup (ref: uninjured group)		
PTSD (PCL-C ≥50)	2·09 (1·44–3·13)	2·01 (1·32–2·89)
Depression (PHQ-9 ≥10)	1·82 (1·27–2·45)	1·74 (1·24–2·38)
Anxiety (GAD-7 ≥10)	1·91 (1·39–2·71)	1·83 (1·27–2·59)
Mental health multimorbidity (caseness on PCL-C and PHQ-9 or GAD-7)	2·09 (1·44–3·20)	2·02 (1·29–2·92)
Amputation subgroup (ref: non-amputation injury subgroup)		
PTSD (PCL-C ≥50)	0·48 (0·25–0·85)	0·45 (0·23–0·87)
Depression (PHQ-9 ≥10)	0·56 (0·36–0·92)	0·49 (0·26–0·76)
Anxiety (GAD-7 ≥10)	0·55 (0·31–0·91)	0·52 (0·29–0·87)
Mental health multimorbidity (caseness on PCL-C and PHQ-9 or GAD-7)	0·41 (0·19–0·74)	0·38 (0·18–0·74)

AOR=adjusted odds ratio. GAD-7=Generalised Anxiety Disorder-7. OR=odds ratio. PCL-C=PTSD Checklist. PHQ-9=Patient Health Questionnaire-9. PTSD=post-traumatic stress disorder. *Adjusted for socioeconomic status and age; officers were excluded.

Table 3: **ORs and AORs from logistic regression of mental health outcomes by injury status**

Table 2 reports the rates of mental health outcomes stratified by injury status. 130 (91·5%) of 142 participants who reported PTSD also reported comorbid depression, anxiety, or both (mental health multimorbidity). Differences in the distribution of cases of all mental health outcomes between the injured and uninjured groups were noted, with higher rates seen in the injured group compared with the uninjured group on all outcome measures.

Table 3 shows the unadjusted OR and AOR for probable PTSD, depression, anxiety, and mental health multimorbidity, comparing the injured group with the

uninjured group to address the primary hypothesis. The odds of reporting probable PTSD, depression, anxiety, and mental health multimorbidity were greater in the injured group compared with the uninjured group, with ORs ranging from 1·46 to 1·67. Details of the analysis on the sample with no bootstrap analysis are in the appendix (p 4).

The amputation injury and non-amputation injury subgroups were compared with the uninjured group, and also with one another, to address the second aim of the study (table 3). We observed minimal differences in the odds of reporting any poor mental health outcome between the amputation injury subgroup and the uninjured group, with ORs ranging from 0·77 to 0·97. The odds of reporting any poor mental health outcome were lower in the amputation-related injury subgroup compared with the non-amputation-related injury subgroup, with ORs ranging from 0·38 to 0·52. The odds of reporting any poor mental health outcome were greater in the non-amputation-related injury group compared with the uninjured group, with ORs ranging from 1·74 to 2·02.

Discussion

Overall, sustaining a combat injury was associated with a 46–67% increase in odds of reporting PTSD, depression, and anxiety symptoms compared with uninjured personnel. Planned subgroup analysis results suggest these differences were driven mostly by those with non-amputation injuries, and that individuals who had amputation injuries had minimal differences in the odds of reporting probable PTSD, anxiety, or depression compared with uninjured personnel and notably lower odds of reporting poor mental health outcomes compared with individuals who had non-amputation-related injuries.

Studies of US military personnel have reported that the rates of PTSD vary from 4·2% to 58·9% and that the rates of depression range from 3·0% to 38·3% in individuals who are physically injured in combat.[22–25] Data on UK combat-injured personnel have suggested rates of probable PTSD of 18·5% and rates of common mental disorders of 28·2% for those medically evacuated from Iraq or Afghanistan with a physical injury,[2] though these data were relating to outcomes in the short term (median time since deployment of 2 years [IQR 0·8–4·5]). Our data show similar rates of mental ill health at a median time since deployment of 8 years (IQR 7–9), suggesting that the increased risk of poor mental health outcomes among combat-injured personnel persists from the short term to the longer term.

Previous research has presented mixed results regarding amputation injury from combat and mental health outcomes. One study on short-term physical and mental health outcomes for individuals with combat injuries found that those with amputation injuries were significantly less likely to report PTSD, but significantly more likely to report mood disorders, than individuals with serious non-amputation injuries to the limbs.[9] In our ADVANCE study, individuals who had amputations reported no significant differences in mental health outcomes compared with individuals in the uninjured group, and significantly lower rates compared with personnel who had non-amputation injuries. Although all injured individuals received Defence Medical Service rehabilitation to return them to the highest level of function achievable, it is possible that those with amputation injuries had access to additional services or resources to help with mental health difficulties. Indeed, access to therapeutic services, either psychological or related to psychiatric medication, is worthy of further investigation. It remains to be seen whether increasing age, possible deterioration in mobility, and other factors, including possible age-related pain, might be associated with worsening mental health outcomes in this cohort.

Studies investigating media representation of injury have noted that, compared with injuries not sustained in a combat scenario, combat-related injuries have an associated greater positive worth among media and the UK population, with individuals with such injuries often being defined as heroic.[26] Minimal research has been done to investigate a possible hierarchy of type of combat injuries. Amputation is perceived as a signature injury from the British involvement in the Iraq and Afghanistan conflicts and is an easily visible injury. Events such as the INVICTUS games, a multi-national Olympic-style sporting event for injured service members, have also put these injuries front and centre of public perception. It is possible that such praise and perception has a positive effect on mental health.[27] Individuals with injuries that do not allow them to engage in such activities or perhaps are less obvious, such as those with chronic pain, might not benefit from such praise and attention, which might account for the increased likelihood of reporting poor mental health outcomes in our cohort. Further investigation is recommended into the hierarchy of wounding within those who sustained combat injuries.

This study has implications for clinical practice. Both civilian and military clinicians should be encouraged to routinely enquire about mental health in their serving and veteran patients who have served in conflicts such as Afghanistan and Iraq. Patients do not have to present with obvious injuries to experience poor mental health outcomes. Stigma around mental health in the military might discourage patients from seeking help.[28] Although our amputation injury group appeared to have similar mental health outcomes to our uninjured group, both injured and uninjured groups reported greater rates of PTSD compared with the general population estimates from UK national surveys, such as the Adult Psychiatric Morbidity Survey.[16] Additionally, over 90% of both the uninjured and injured groups with PTSD had comorbid depression or anxiety (mental health multimorbidity). The psychological burden of comorbid PTSD and depression has been found to be considerably greater than that of

PTSD or depression alone[18] and is associated with poorer quality of life and increased suicidality. Injured personnel without amputation were significantly more likely to report mental health multimorbidity compared with both the uninjured group and the amputation-related injury subgroup. The psychological burden of these non-amputation-related injuries is worthy of further investigation, along with other notable comorbidities, such as traumatic brain injury, pain, and PTSD (often labelled together as the polytrauma clinical triad).[29]

Of the UK Armed Forces personnel injured in Afghanistan who met our study criteria, more than 55% of those with a very serious injury NOTICAS classification took part in the ADVANCE study. We made great efforts to have a comparison group as similar to the injured group as possible, based on age, rank, role on deployment, regiment, and deployment era. Weighting based on differences between responders and non-responders was also implemented. Participants of the ADVANCE study completed a comprehensive health assessment with validated health measures.

To attempt to ensure the study was accessible to participants with a range of difficulties, accommodation was provided and travel expenses were paid. Attempts were made to include participants who had left the military, including investigating electoral roll data, working with charities, and social media recruitment. For those in service, participants were invited in person from unit visits as well as via email and postal invitations. Despite these efforts, it is still possible that the hardest to reach or those who declined to take part, both in the uninjured and injured groups, might represent a group with worse physical or mental health, and this is a limitation of the study. Additionally, this cohort was limited to only male injured service personnel. Female injured personnel might have different outcomes.

Another limitation of this study is the use of the PCL-C, which lists only DSM-IV symptoms of PTSD. Future follow-up appointments for the ADVANCE study will use the PCL-5, which assesses the DSM-5 symptoms of PTSD. Traumatic brain injury was also not investigated. Future follow-up appointments for the ADVANCE study will implement the Ohio-State Traumatic Brain Injury Screener questionnaire[30] to address this limitation. This screener includes information on loss of consciousness (including length of time unconscious) as well as symptoms such as dizziness and memory loss. Mediation analysis was beyond the scope of this current paper; however, mediating factors, such as current or chronic pain, psychiatric medication use, and access to therapeutic services will be explored within the ADVANCE study cohort in the future.

Adverse mental health outcomes were more prevalent among injured UK military personnel compared with those who were uninjured in our study. However, mental health outcomes appear to vary depending on the type of injury sustained, with those who experienced non-amputation injuries having greater odds of poor mental health outcomes compared with those who sustained amputation injuries. This study also emphasises the potential psychological burden of multiple mental health problems among injured and uninjured groups. Long-term follow-up of this cohort conducted by the ADVANCE study over the next 20 years will give insight into some of the reasons for the different mental health outcomes between these groups and observe whether the outcomes are maintained with reduced mobility, age-related pain, or other factors associated with increased age.

Contributors

DD completed the literature search, designed the figure in the appendix, collected and curated data, and was involved in data interpretation, writing the original draft, and editing the manuscript. DD and SS contributed to the formal analysis. ANB, CJB, and SW contributed to conceptualisation of the study. ANB, CJB, PC, AMJB, SW, and NTF contributed to funding acquisition. ANB, PC, CJB, AMJB, and NTF contributed to the methodology of the study. DD completed this work as part of his PhD thesis. ANB, SAMS, and NTF are DD's PhD supervisors. ANB, SS, PC, CJB, AMJB, SW, SAMS, and NTF contributed to reviewing the manuscript. DD and SS had full access to all the data in the study. All authors had final responsibility for the decision to submit for publication.

Declaration of interests

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Data sharing

Given the sensitive nature of the participants, data have not been made widely available. Requests for data will be considered on a case-by-case basis and subject to UK Ministry of Defence clearance.

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