Post-traumatic growth among UK military personnel deployed to Iraq or Afghanistan: data from phase 3 of a military cohort study

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Background

Post-traumatic growth (PTG) refers to beneficial psychological change following trauma.

Aims

This study explores the sociodemographic, health and deployment-related factors associated with PTG in serving/ex-serving UK armed forces personnel deployed to military operations in Iraq or Afghanistan.

Method

Multinomial logistic regression analyses were applied to retrospective questionnaire data collected 2014–2016, stratified by gender. PTG scores were split into tertiles of no/very low PTG, low PTG and moderate/large PTG.

Results

A total of 1447/4610 male personnel (30.8%) and 198/570 female personnel (34.8%) reported moderate/large PTG. Male personnel were more likely to report moderate/large PTG compared with no/very low PTG if they reported a greater belief of being in serious danger (relative risk ratio (RRR) 2.47, 95% CI 1.68–3.64), were a reservist (RRR 2.37, 95% CI 1.80–3.11), reported good/excellent general health (fair/poor general health: RRR 0.33, 95% CI 0.24–0.46), a greater number of combat experiences, less alcohol use, better mental health, were of lower rank or were younger. Female personnel were more likely to report moderate/

large PTG if they were single (in a relationship: RRR 0.40, 95% CI 0.22–0.74), had left military service (RRR 2.34, 95% CI 1.31–4.17), reported better mental health (common mental disorder: RRR 0.37, 95% CI 0.17–0.84), were a reservist, reported a greater number of combat experiences or were younger. Post-traumatic stress disorder had a curvilinear relationship with PTG.

Conclusions

A moderate/large degree of PTG among the UK armed forces is associated with mostly positive health experiences, except for post-traumatic stress disorder.

Keywords

Trauma; military psychiatry; epidemiology; post-traumatic stress disorder; comorbidity.

Copyright and usage

Post-traumatic growth

Post-traumatic growth (PTG) refers to the phenomenon of beneficial psychological change as a result of experiencing a traumatic event.[1] The most used measure of PTG, the Post-Traumatic Growth Inventory (PTGI), defines PTG within the domains of being able to relate to others better, spiritual change, a new understanding of your own personal strength, perceiving new possibilities in your life or having a better appreciation of your life.[2] Along with the beneficial psychological changes involved with PTG, the construct has also been associated with other positive outcomes such as better mental health and positive health behaviours, such as lower alcohol and cigarette use.[3,4]

PTG and the armed forces

With an increased focus on building a more resilient, psychologically prepared military force[5,6] and the UK armed forces responsibilities during the COVID-19 pandemic,[7] it may be helpful to understand PTG in the UK military context and identify factors that might be associated with this beneficial psychological change. A systematic review on the topic suggested that military personnel experienced moderate PTG following deployment to Iraq/Afghanistan;[8] however, this was based almost entirely on samples from the USA. Among serving and ex-serving personnel in the USA, better mental health and physical health[9] were associated

with greater PTG, whereas greater anger problems[10] were associated with lower levels of PTG. Greater combat exposure,[11] being a reservist,[12] perceived threat during deployment,[12] being of junior rank[11] and a greater length of time since deployment[13] were associated with greater PTG. PTG and post-traumatic stress disorder (PTSD) have a more complicated relationship, with increasing PTSD symptoms being shown to have a curvilinear relationship with PTG (e.g. a bell-shaped curve, with PTG symptoms increasing along with PTSD symptoms up to a point, upon which as PTSD symptoms continue to increase, PTG symptoms decrease).[14] There are numerous differences in the way that the UK and USA deploy troops and manage their personnel, including variations in deployment length, greater number of reservists/national guard deployed and differences in regimental systems. There are also noted differences in mental health and behavioural outcomes between UK and US armed forces following deployment.[15] It may therefore be problematic to extrapolate USA findings to the UK context regarding PTG.

Aims

The only UK data on PTG in military personnel focuses on PTG as a result of seeking treatment for PTSD.[16] Given the paucity of UK military research into PTG, we aim to (a) examine deployment-related PTG among serving and ex-serving personnel in the UK

military who deployed to Iraq or Afghanistan; and (b) explore relationships between selected sociodemographic, health and deployment-related variables and PTG.

Method

Study design and participants

Data were drawn from the third phase of a representative longitudinal survey investigating the health and well-being of a cohort of Iraq or Afghanistan deployed and non-deployed UK military personnel since the UK deployed to Iraq in 2003.[17] At baseline, 10 272 participants took part (response rate 61.0%). At phase 3, 8093 participants took part (response rate 44.3%). Eligibility for the current study required participants to have deployed to either Iraq, Afghanistan or both. Only data collected at phase 3 is reported in this paper.

Participants were asked to complete a questionnaire relating to sociodemographic, service information, deployment experiences, transitioning from deployment to home experiences, mental and physical health, relationships and lifestyle-related variables, either via paper survey or online. Data collection took place between 2014 and 2016. Access to a participant information sheet as well as specification that research was being conducted independently of the Ministry of Defence, and that participation was entirely confidential and voluntary was included in the questionnaire.

Materials

PTG

The PGTI is a validated 21-item measure of PTG.[2] A military deployment version of the PTGI (DPTGI) was administered (Supplementary File 1 available at https://doi.org/10.1192/bjo.2022.570). The stem question to the questionnaire was changed to 'As a result of my deployment(s) to Iraq/Afghanistan since 2002 … '. Because of concerns about readability for a UK armed forces audience, especially among those with low educational attainment, the language of some questions was altered minimally and responses were reduced from a six-point to a four-point Likert scale: 'no change for the better', 'a small change for the better', 'a medium change for the better' and 'a big change for the better'. The sum of all PTG items was used to generate a total PTG score (score range 0–63).

Sociodemographic and military factors

Data on age, service, rank, relationship status and engagement status (regular or reservist) were gathered from the questionnaire and supplemented by Defence Statistics, the Ministry of Defence's data and statistics branch.

Health factors

PTSD.   To measure PTSD, the 17-item Post-Traumatic Checklist – Civilian Version[18] was used. A score of ≥50 was used to define probable PTSD (score range 17–85).

Common mental disorders.   To measure common mental disorders (CMD), the 12-item General Health Questionnaire was used.[19] A score of ≥4 was used to define a probable CMD (score range 0–12).

Anger.   To measure anger, the Dimensions of Anger Responses (DAR-5) questionnaire was used.[20] A score of ≥12 was used to define a probable anger problem (score range 4–25).

General health.   A single question from the 36-item Short Form Survey was used as a measure of self-reported general health: 'In general, how do you rate your health now?'. Responses were given on a five-point Likert scale from poor to excellent. General health was recoded into three categories: 'excellent/very good', 'good' and 'fair/poor'.[21]

Smoking.   Two questions were asked in the survey regarding 'Do you currently smoke?' and 'If yes, how many cigarettes, cigars or rollups do you smoke a day?'. Total number of cigarettes smoked per day was used as a reflection of smoking behaviours.

Alcohol consumption.   Alcohol use was measured with the ten-item World Health Organization's Alcohol Use Disorders Identification Test (AUDIT).[22] To measure alcohol consumption, the sum of scores from the first three questions of the AUDIT (AUDIT-C) were used. Higher scores reflect greater alcohol consumption (score range 0–12).

Childhood adversity.   Childhood adversity was measured through use of a 16-item questionnaire used previously in UK military health research.[23] A score of ≥4 indicated greater childhood adversity (score range 0–16).

Recent life events.   To measure stressful life events, a post-deployment stressor measure was adapted[24] into an 11-item checklist with responses 'yes' or 'no', indicating whether the participant experienced a significant life event (e.g. divorce, death of a loved one) during the past 3 years.

Deployment-related factors

Combat exposure.   Combat exposure was assessed with a 14-item measure adapted from the Combat Experiences Scale,[25] which asked about exposure to potentially traumatic combat events such as exposure to an improvised explosive device or coming under small arms fire. Responses were given as either 0 (no reported experience) or 1 (experienced once or more on deployment) (score range 0–14). If the participant deployed to both Iraq and Afghanistan, the combat experience was counted if they experienced it on either deployment.

Belief of being in serious danger and length of time in hostile areas.   Belief that 'you were in serious danger of being injured or killed' and 'length of time in hostile areas during deployment' were derived from the Deployment Risk and Resilience Inventory.[26] Belief of being in serious danger had answers ranging from 'never', 'once or twice', 'sometimes' to 'many times'. Length of time participants were in hostile areas during their deployment had answers ranging from 'not at all', 'up to 1 week', '1 week to 1 month' to 'more than a month'.

Both questions were asked for Iraq as well as Afghanistan deployments. The maximum score on either deployment was used to generate a 'belief of being in serious danger' and 'length of time in hostile area' variable. Belief of being in serious danger was recoded into three categories: 1 (never), 2 (once or twice/sometimes) and 3 (many times). Length of time in hostile area was recoded into three categories: 1 (not at all), 2 (up to 1 week/1 week to 1 month) and 3 (more than a month).

Role on last deployment.   Role was grouped based on types of role-in-theatre reported, 'combat' (e.g. infantry), 'combat support' (e.g. Royal Engineers) and 'combat service support' (e.g. medics).

Data analysis

Sample and response weights based on gender, age, rank, service, engagement type, serving status, sample and the interaction

between sample and engagement type were used to generate response weights, and sample weights were calculated as the inverse likelihood of a participant being sampled from a specific subgroup (e.g. deployment era).[17] The sample weights and response weights were multiplied together to make a single weight, and applied using the 'svy' function in Stata (version 16.1 for Windows). Weighted percentages and relative risk ratios (RRRs) are presented along with unweighted cell counts.

PTG tertiles based on total DPTGI score were used: no/a very low degree of PTG (0–7), a low degree of PTG (8–20) and a moderate/large degree of PTG (21–63). The statistical software package Stata was used for all statistical analyses. All sociodemographic (age, gender, service, rank), health (overall general health, anger, childhood adversity, common mental disorders, PTSD, alcohol use, smoking) and deployment-related (deployment, reservist status, ex-serving status, years since trauma, combat role, combat experiences, belief of being in serious in serious danger, length of time in hostile areas) variables investigated as part of this analysis have previously been shown to be associated with PTG (9–14).

For the purposes of this paper, PTSD scores were splined based on a clinically meaningful threshold of ≥50, indicating probable PTSD, because of the known curvilinear relationship between PTSD and PTG.[14] Two variables, one representing PTSD symptoms in the non-caseness group (<50) and one representing PTSD symptoms in the caseness group (≥50), were created. Visual inspection of plots of all variables investigated as part of this paper with PTG were conducted. Variables that appeared to have a curvilinear relationship with PTG were squared and entered into a univariable multinomial logistic regression model, and those with a significant association with PTG ($P < 0.05$) were defined as having a curvilinear relationship. Adverse childhood events and anger scores on the DAR-5 were found to have a curvilinear relationship with PTG, and subsequently, both were splined in a similar fashion to PTSD. Adverse childhood events were splined around four or more events,[23] and anger was splined around caseness (DAR-5 score ≥12). Because of the known correlations between anger and PTSD,[27] anger was only investigated at a univariable level.

Multinomial logistic regression was used to assess the sociodemographic, military, health and deployment-related factors associated with PTG. Univariable analysis was conducted on all variables of interest. As gender is a known predictor of PTG,[28] analysis was completed on the whole sample, then male personnel and female personnel separately. Variable selection procedures for the multivariable multinomial logistic regression model were based on recommendations in the literature.[29] The procedures were as follows: (a) all variables with a strong evidence base in the literature were selected for inclusion (this included age,[30] PTSD symptoms[14] and CMD[4]), (b) all variables with univariable RRRs >1.25 or <0.80 were selected for inclusion of model 1 and (c) all remaining variables were subject to best subset variable selection with the 'gvselect' Stata function. Variables in the model selected with the lowest Bayesian information criterion were selected for inclusion in model 1 (Supplementary File 2). Model stability analysis was conducted on model 1 by using bootstrap analysis ('mfpboot' function in Stata); 1000 replications were used. Bootstrap inclusion frequencies were generated, and variables that had scores >0.50 and $P < 05$ were included in the final model (model 2) (Supplementary File 3). Because of the small number of female personnel who scored over the clinical cut-off point on the PTSD Checklist, only PTSD symptoms in the non-probable PTSD group were included in the final model. Multicollinearity was assessed through variance inflation factors.

Ethical approval

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Ethical approval for the Health and Well-Being Study[17] was granted by the UK Ministry of Defence Research Ethics Committee (reference: 448/MODREC/13) and the King's College London Psychiatry Nursing and Midwifery Research Ethics Subcommittee (reference: PNM/12/13–169). Participants provided informed consent to take part in the study by completing and returning the questionnaire.

Results

Of the 8093 participants who took part in phase three of the cohort study, 5239 had deployed to Iraq and/or Afghanistan (64.7% of the total sample). This included participants from all branches of the armed forces (Royal Navy (including Royal Marines), army and Royal Air Force), as well as regulars and reservists. After excluding those with two or more missing answers on the DPTGI, 5180 out of 5239 (98.9%) participants were included for analysis. Cronbach's alpha for the 21-item DPTGI was excellent (α = 0.95), which indicates excellent internal validity.

Sample characteristics

The mean age of the sample was 40 years (standard deviation 9.35), 89.0% ($n = 4610$) were male and 11.0% ($n = 570$) were female. Further, 30.6% ($n = 1460$) of participants held combat roles, 13.0% ($n = 643$) held combat support roles and 56.4% ($n = 3072$) held combat service support roles. Regarding deployment, 35.7% ($n = 1773$) of participants were deployed to Iraq only, 29.6% ($n = 1604$) were deployed to Afghanistan only and 34.7% ($n = 1803$) were deployed to both Iraq and Afghanistan. Table 1 describes the sociodemographic and deployment characteristics of those included in the study overall and by PTG tertile (no/a very low degree of PTG, a low degree of PTG and a moderate/large degree PTG).

Table 2 describes the health characteristics of the sample; 22.3% (95% CI 20.9–23.7, $n = 1138$) of participants met the criteria for probable CMD and 6.6% (95% CI 5.8–7.6, $n = 281$) met the criteria for probable PTSD.

PTG

The median score for PTG in the whole sample was 13 (interquartile range (IQR) 5–24), with 35.1% (95% CI 33.5–36.7, $n = 1771$) scoring in the lowest tertile (no/a very low degree of PTG), 33.8% (95% CI 32.2–35.4, $n = 1764$) scoring in the middle tertile (a low degree of PTG) and 31.1% (95% CI 30.0–32.7, $n = 1645$) scoring in the top tertile (a moderate/large degree of PTG). For male personnel, the median score was 13 (IQR 5–24), with 35.1% (95% CI 33.4–36.9, $n = 1586$) scoring in the lowest tertile (no/a very low degree of PTG), 34.1% (95% CI 34.1–35.8, $n = 1577$) scoring in the middle tertile (a low degree of PTG) and 30.8% (95% CI 29.2–32.5, $n = 1447$) scoring in the top tertile (a moderate/large degree of PTG). For female personnel, the median score was 13 (IQR 5–26), with 34.2% (95% CI 29.5–39.2, $n = 185$) scoring in the lowest tertile (no/a very low degree of PTG), 31.0% (95% CI 26.6–35.9, $n = 187$) scoring in the middle tertile (a low degree of PTG) and 34.8% (95% CI 30.1–39.8, $n = 198$) scoring in the top tertile (a moderate/large degree of PTG).

Subscale scores for PTG, stratified by gender, can be found in Supplementary File 4.

Table 1 Description of study participants (sociodemographic factors) overall and by post-traumatic growth tertiles (N = 5180)

Variable	Overall	No/very low PTG (DPTGI score 0–7)	Low PTG (DPTGI score 8–20)	Moderate/large PTG (DPTGI score 21–63)
Overall, n (%)	5180 (100.00)	1771 (35.1)	1764 (33.8)	1645 (31.1)
Gender				
Male, n (%)	4610 (89.0)	1586 (35.1)	1577 (34.1)	1447 (30.8)
Female, n (%)	570 (11.0)	185 (34.2)	187 (31.0)	198 (34.8)
Age at assessment (years)				
20–29, n (%)	686 (11.2)	173 (27.2)	210 (30.0)	303 (42.8)
30–39, n (%)	1872 (41.7)	572 (30.1)	634 (33.7)	666 (36.2)
≥40, n (%)	2622 (47.1)	1026 (41.3)	920 (34.8)	676 (23.9)
Service				
Royal Marines, n (%)	185 (3.6)	57 (30.8)	62 (33.5)	66 (35.7)
Navy, n (%)	370 (7.1)	161 (43.5)	111 (30.0)	98 (26.5)
Army, n (%)	3586 (69.2)	1107 (32.1)	1225 (34.5)	1254 (33.4)
Royal Air Force, n (%)	1039 (20.1)	446 (44.0)	366 (32.2)	227 (23.8)
Regular/reservist				
Regular, n (%)	4316 (92.0)	1519 (35.9)	1471 (33.5)	1326 (30.6)
Reservist, n (%)	864 (8.0)	252 (25.6)	293 (36.9)	319 (37.5)
Serving status				
Serving, n (%)	3098 (50.2)	1033 (35.0)	1060 (34.5)	1005 (30.5)
Ex-serving, n (%)	2082 (49.8)	738 (35.1)	704 (33.2)	640 (32.7)
Rank				
Other rank, n (%)	572 (12.6)	153 (25.4)	174 (32.6)	245 (42.0)
Non-commissioned officer, n (%)	3104 (67.0)	1057 (35.8)	1046 (33.5)	1001 (30.7)
Commissioned officer, n (%)	1504 (20.4)	561 (38.6)	544 (35.5)	399 (25.9)
Deployment				
Iraq only, n (%)	1773 (35.7)	693 (39.6)	573 (31.7)	507 (28.6)
Afghanistan only, n (%)	1604 (29.6)	511 (35.4)	537 (33.3)	556 (31.3)
Iraq and Afghanistan, n (%)	1803 (34.7)	567 (31.4)	654 (36.3)	582 (32.3)
Years since last deployment to Iraq/Afghanistan				
Reported years since last deployment, median (IQR)	6 (3–10)	7 (3–11)	6 (3–10)	5 (3–9)
Role during last deployment				
Combat, n (%)	1460 (30.6)	363 (25.0)	495 (34.6)	615 (40.4)
Combat support, n (%)	643 (13.0)	242 (38.2)	218 (32.4)	185 (29.4)
Combat service support, n (%)	3072 (56.4)	1174 (39.8)	1063 (33.7)	852 (26.5)
Combat experiences				
No combat experiences, n (%)	536 (10.6)	290 (55.3)	142 (26.4)	104 (18.3)
One or more combat experiences, n (%)	4644 (89.4)	1481 (32.7)	1622 (34.7)	1541 (32.6)
Number of combat experiences reported, median (IQR)	4 (2–8)	3 (2–7)	4 (2–8)	6 (3–10)
Belief of being in serious danger				
Never, n (%)	720 (13.6)	362 (51.8)	227 (30.3)	131 (17.9)
Once or twice/sometimes, n (%)	3076 (56.5)	1072 (34.9)	1074 (34.9)	930 (30.2)
Many times, n (%)	1379 (29.9)	336 (24.9)	461 (33.5)	582 (41.6)
Length of time in a hostile area				
Not at all, n (%)	1296 (24.6)	553 (43.8)	428 (32.9)	315 (23.3)
Up to 1 week/1 week to 1 month, n (%)	2083 (40.4)	739 (35.5)	715 (34.3)	629 (30.2)
More than a month, n (%)	1771 (35.0)	467 (26.6)	612 (34.0)	692 (39.4)

Numbers may not add up to 5180 because of missing data. Weighted percentages are presenting alongside unweighted cell counts. PTG, post-traumatic growth; DPTGI, military deployment version of the Post-Traumatic Growth Inventory; IQR, interquartile range.

Sociodemographic, military, health and deployment factors associated with PTG

The results from the univariable multinomial logistic regressions for the whole, male-only and female-only samples can be found in Supplementary File 5.

The results from the multivariable multinomial logistic regression model for the whole sample can be found in Supplementary File 6. Table 3 describes the multinomial logistic regression models created to investigate the relationships between sociodemographic, military, health and deployment variables with PTG in male personnel, and Table 4 describes the same models for female personnel.

In the final model for male personnel, reservists, those who reported a greater belief of being in danger of injury/death on deployment, those who reported a greater number of different combat experiences, those of lower rank and those that reported more PTSD symptoms in the non-probable PTSD group were significantly more likely to report a moderate/large degree of PTG compared with those who reported no/a very low degree of PTG.

Those with fair/poor general health, probable CMD, those who were older, those who reported greater alcohol consumption and those who reported more PTSD symptoms in the probable PTSD group were significantly less likely to report moderate/large growth and more likely to report no/a very low degree PTG.

In the final model for female personnel, reservists, those who had left service and those who had reported a greater number of different combat experiences were significantly more likely to report a moderate/large degree of PTG compared with those who reported no/a very low degree of PTG. Those with probable CMD, who were in a relationship and were older were significantly less likely to report moderate/large growth and more likely to report no/a very low degree of PTG.

Discussion

This study aimed to examine the prevalence of PTG among UK military serving and ex-serving personnel as a result of deployment to

Table 2 Description of study participants (health and deployment factors) overall and by post-traumatic growth tertiles (N = 5180)

Variable	Overall	No/very low PTG (DPTGI score 0–7)	Low PTG (DPTGI score 8–20)	Moderate/large PTG (DPTGI score 21–63)
Probable CMD (GHQ score ≥4)				
Non-case, n (%)	4015 (77.7)	1351 (34.6)	1349 (33.2)	1315 (32.2)
Probable CMD, n (%)	1138 (22.3)	415 (37.1)	406 (35.7)	317 (27.2)
Probable PTSD (PCL-C score ≥50)				
Non-case, n (%)	4865 (93.4)	1669 (35.3)	1649 (33.3)	1547 (31.4)
Probable PTSD, n (%)	281 (6.6)	94 (32.5)	105 (41.0)	82 (26.5)
Anger (DAR-5 score ≥12)				
Non-case, n (%)	3896 (72.2)	1348 (36.0)	1304 (32.8)	1244 (31.2)
Problematic anger, n (%)	1272 (27.8)	419 (32.6)	459 (36.8)	394 (30.6)
Self-reported general health				
Excellent/very good, n (%)	2791 (52.7)	852 (31.7)	939 (32.3)	1000 (35.9)
Good, n (%)	1577 (30.9)	557 (35.2)	565 (36.4)	455 (28.4)
Fair/poor, n (%)	786 (16.4)	350 (45.0)	258 (34.5)	178 (20.5)
Smoking				
Non-smoker, n (%)	4445 (84.5)	1532 (35.1)	1527 (34.1)	1386 (30.7)
Smoker, n (%)	702 (15.5)	228 (34.7)	227 (32.2)	247 (33.1)
Median number of cigarettes smoked (IQR)	13 (10–20)	15 (10–20)	13 (8–20)	10 (8–15)
Alcohol consumption (AUDIT)				
Non-drinker, n (%)	214 (4.0)	77 (41.0)	43 (21.8)	94 (37.2)
Drinker, n (%)	4966 (96.0)	1694 (34.8)	1721 (34.3)	1551 (30.9)
Median AUDIT alcohol consumption score (IQR)	6 (4–8)	6 (5–9)	6 (5–9)	6 (4–8)
Childhood adversity (four or more events reported)				
No, n (%)	3404 (64.4)	1191 (65.7)	1154 (63.7)	1059 (63.8)
Yes, n (%)	1644 (35.6)	546 (34.3)	561 (36.3)	537 (36.2)
Recent life events				
Number of recent life events, median (IQR)	1 (0–2)	1 (0–2)	1 (0–2)	1 (0–2)

Numbers may not add up to 5180 because of missing data. Weighted percentages are presenting alongside unweighted cell counts. PTG, post-traumatic growth; DPTGI, military deployment version of the Post-Traumatic Growth Inventory; CMD, common mental disorders; GHQ, General Health Questionnaire; PTSD, post-traumatic stress disorder; PCL-C, Post-traumatic stress disorder CheckList – Civilian version; DAR-5, Dimensions of Anger Responses; IQR, interquartile range; AUDIT, Alcohol Use Disorders Identification Test.

Iraq/Afghanistan, and identify the sociodemographic, military, health and deployment-related factors associated with PTG. Our results showed that 30.8% of male personnel and 34.8% of female personnel reported a moderate/large degree of PTG after an operational deployment. Our results are in keeping with known associations previously found in research of PTG, such as that female personnel and those of younger age experienced greater rates of PTG, those with current probable CMD experienced less PTG, and the noted curvilinear relationship between PTSD symptoms and PTG.[4,8,28] This study extends the literature on military/deployment-related factors associated with PTG, including that reservists, those with a greater number of different combat experiences and those who report a greater belief of being in danger on deployment are more likely to report a moderate/large degree of PTG; and health factors associated with PTG, including that those who report better general health and less alcohol use are more likely to report a moderate/large degree of PTG. We also found that health-related factors were associated with male, but not female, serving and ex-serving

Table 3 Multivariable multinomial logistic regression model of sociodemographic, health and deployment factors and post-traumatic growth in male personnel (n = 4610)

Variables			No/very low PTG (DPTGI score 0–7)	Low PTG (DPTGI score 8–20)		Moderate/large PTG (DPTGI score 21–63)	
				RRR (95% CI)	P-value	RRR (95% CI)	P-value
Sociodemographic and military	Age		(base)	0.99 (0.98–1.00)	0.02	0.96 (0.95–0.97)	<0.01
	Engagement status (reference: regular)	Reservist	(base)	1.71 (1.32–2.22)	<0.01	2.37 (1.80–3.11)	<0.01
	Rank (reference: non-commissioned officer)	Other rank	(base)	1.20 (0.87–1.66)	0.27	1.53 (1.12–2.11)	<0.01
		Officer	(base)	1.09 (0.89–1.34)	0.38	1.04 (0.83–1.29)	0.75
Deployment	Number of combat experiences		(base)	1.05 (1.02–1.07)	<0.01	1.08 (1.05–1.11)	<0.01
	Belief of being in danger of injury/death (reference: not at all)	Once or twice/sometimes	(base)	1.30 (0.99–1.69)	0.06	1.84 (1.33–2.53)	<0.01
		Many times	(base)	1.41 (1.00–1.98)	0.05	2.47 (1.68–3.64)	<0.01
Health	General health (reference: very good/excellent)	Good	(base)	0.93 (0.76–1.14)	0.47	0.66 (0.53–0.83)	<0.01
		Fair/poor	(base)	0.59 (0.45–0.79)	<0.01	0.33 (0.24–0.46)	<0.01
	PTSD symptoms	Non-probable PTSD	(base)	1.03 (1.02–1.05)	<0.01	1.04 (1.02–1.06)	<0.01
		Probable PTSD	(base)	0.98 (0.95–1.01)	0.15	0.94 (0.90–0.98)	<0.01
	CMD (reference: non-probable CMD)	Probable CMD	(base)	0.71 (0.55–0.92)	0.01	0.58 (0.43–0.80)	<0.01
	AUDIT-C score		(base)	1.01 (0.98–1.04)	0.52	0.95 (0.92–0.98)	<0.01

Sampling/response weights have been applied to analyses in this table. PTG, post-traumatic growth; DPTGI, military deployment version of the Post-Traumatic Growth Inventory; RRR, relative risk ratio; PTSD, post-traumatic stress disorder; CMD, common mental disorder; AUDIT, Alcohol Use Disorders Identification Test – alcohol consumption.

Table 4 Multivariable multinomial logistic regression model of sociodemographic, health and deployment factors and post-traumatic growth in female personnel (*n* = 570)

Variables			No/very low PTG (DPTGI score 0–7)	Low PTG (DPTGI score 8–20)		Moderate/large PTG (DPTGI score 21–63)	
				RRR (95% CI)	*P*-value	RRR (95% CI)	*P*-value
Sociodemographic and military	Age		(base)	0.98 (0.95–1.02)	0.34	0.93 (0.90–0.97)	<0.01
	Engagement status (reference: regular)	Reservist	(base)	1.95 (1.00–3.80)	0.05	2.31 (1.18–4.52)	0.02
	Serving status (reference: serving)	Ex-serving	(base)	1.38 (0.80–2.37)	0.25	2.34 (1.31–4.17)	<0.01
	Relationship status (reference: single)	In a relationship	(base)	0.51 (0.28–0.92)	0.03	0.40 (0.22–0.74)	<0.01
Deployment	Number of combat experiences		(base)	1.28 (1.16–1.42)	<0.01	1.29 (1.16–1.43)	<0.01
Health	PTSD symptoms	Non-probable PTSD	(base)	0.99 (0.96–1.03)	0.77	1.04 (1.00–1.08)	0.08
	CMD (reference: non-probable CMD)	Probable CMD	(base)	0.92 (0.45–1.87)	0.81	0.37 (0.17–0.84)	0.02

Sampling/response weights have been applied to analyses in this table. PTG, post-traumatic growth; DPTGI, military deployment version of the Post-Traumatic Growth Inventory; RRR, relative risk ratio; PTSD, post-traumatic stress disorder; CMD, common mental disorder.

personnel's experience of PTG; other factors such as having left the service and being single were associated with female, but not male, serving and ex-serving personnel's experience of PTG.

Deployment factors and PTG

We identified that a number of combat/deployment factors are associated with PTG. Greater combat exposure has been reported to be associated with PTG previously,[11] and it is suggested that stress inoculation and adaptive coping mechanisms might explain this association. However, we also find that reservists, when compared with regular serving personnel, were more likely to report a moderate/large degree of PTG compared with no/very low PTG. Stress inoculation therefore has limited applicability to reservists, who are less likely to deploy frequently compared with regular serving personnel.[17] It might be more beneficial to understand combat exposure as traumatic events that have the potential to change the basic schemas in the survivor's psyche by restructuring basic assumptions about the world around them or themselves that result in either positive, negative or both positive and negative psychological change.[14,30] Belief of being in serious danger when on deployment has, to our knowledge, only been investigated among those serving during the 1991 Gulf War.[12] Rumination on the traumatic event has previously been shown to be related to PTG,[4,8] which might increase a person's appraisal of the potential danger associated with the event.

Gender-related differences in PTG

The gender-related differences noted in this study may, in part at least, be related to differences in the lived experience of military deployment between the gender. In the UK, female personnel have only been employed in close combat roles since 2018, roles that traditionally comprised junior rank male personnel. Ex-serving status was a unique aspect associated with PTG for female personnel in our sample. It has been reported in US military veterans that there is a large amount of heterogeneity with regards to experiences of PTG over time,[31,32] meaning that different subgroups of trauma-exposed military serving and ex-serving personnel might have different trajectories of growth.

Other factors

Several potential variables of interest were not included in our final multivariable models because of our rigorous variable selection

procedures (e.g. service, combat role, length of time in a hostile area and length of time since last deployment). It is likely that these variables may have acted as indicators of the type of experiences a servicemember would have during deployment, and it makes sense that they would be superseded by deployment-related factors such as number of combat experiences and belief of being in serious danger of injury or death. Greater time since traumatic event is largely seen as being associated with greater PTG,[4,8] but in our study, PTG was investigated as a result of any Iraq/Afghanistan deployment.

Implications for clinical practice

In our study, reservists, when compared with regular serving personnel, and those who experienced a greater number of different combat experiences were more likely to report moderate/large PTG compared with no/very low PTG. Combat exposure and reservist status have been linked to both positive and negative mental health consequences in previous literature.[8,17] Although the UK armed forces already aims to promote good mental health through Medical Force Protection (i.e. actions taken to promote healthy behaviours or minimise risks regarding ill-heath where possible), it may be beneficial for military leaders to target individuals with high combat exposure and reservists for interventions promoting psychological growth following deployment. Although screening procedures for mental illness have been shown to be ineffective in the armed forces,[33] screening for combat exposure may identify individuals who (a) might be at increased risk of poor mental health outcomes and (b) might be targeted for interventions that elicit positive psychological growth. Such an approach may be less stigmatising than trying to identify personnel at risk of mental health difficulties.[34] However, further research is required to understand whether repeated combat exposure, specific types of combat exposure or increased severity of combat experiences have differing effects on psychological well-being. Intervention post-deployment is a possible avenue for exploration in future research.[5] Increasing severity of PTSD symptoms among those with probable PTSD, as well as probable CMD, were associated with a lower likelihood of reporting moderate/large PTG; however, evidence does suggest that those with mental health difficulties can experience psychological growth after mental health treatment.[16] It is important to note that PTG is beneficial psychological change following a trauma and traditionally includes one or many of the following factors: better appreciation of life, seeing new possibilities in your

future, understanding your own personal strength, being better able to relate to others and spiritual change.[1,2] As such, interventions that encourage aspects of positive psychology, such as optimism and gratitude, may offer pathways to positive growth similar those who experience PTG.[35]

Strengths and limitations

The cross-sectional study design and small sample size of female personnel are notable limitations of our study. Additionally, our representation of combat experiences limited combat scenarios to either experienced or not experienced, and did not investigate the effect of multiple, repeated experiences of those scenarios. This relationship is worthy of separate investigation and beyond the scope of this study. The question used in this study relating to general health does not provide details regarding the physical well-being of our sample, and unique factors such as battlefield injury[36] or long-term serious illness[4] might also affect PTG or even form an independent domain of PTG not currently measured in the DPTGI or PTGI. Further research investigating physical injury and factors of physical health related to PTG is recommended. This study relies on self-report data regarding PTG, and data on external sources assessment of the participants experience of PTG was not available. Tertiles were used as part of this study because no clinical cut-off points were available for the DPTGI or PTGI that were applicable to armed forces personnel.[31] As such, inferences from this sample may not be generalisable to other non-UK military samples. Finally, there was a notable floor effect in our measure. This may be reflective of post-traumatic depreciation; negative changes as a result of deployment to Iraq/Afghanistan,[37] which the DPTGI/PTGI do not measure. Future studies might benefit from using a bi-directional measure of post-traumatic change, which allows participants to report beneficial change (PTG), negative change (post-traumatic deprecation) or no change as a result of their trauma/deployment. Strengths of our study include a robust statistical approach to variable selection; inclusion of pertinent and informative sociodemographic, health and deployment-related variables; and a breakdown of both male and female PTG, which is lacking in the general literature.

In conclusion, this paper identified that a moderate/large degree of PTG is associated with military/deployment-related factors as well as sociodemographic and health-related factors. We also found gender-related differences in the factors associated with experiencing a moderate/large degree of PTG, most notably that health-related factors were associated with PTG in male, but not female, serving/ex-serving military personnel; and relationship and serving status were associated with PTG in female, but not male, serving/ex-serving military personnel. These results will hopefully inform future interventions designed to increase the likelihood of armed forces personnel experiencing beneficial psychological growth over negative mental health outcomes as a result of deployment.

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First received 6 Dec 2021, final revision 3 Aug 2022, accepted 8 Aug 2022

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