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# Factors associated with unintended weight change in the UK Armed Forces: a cohort study

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## Abstract

**Objective:** To examine factors associated with self-reported unintended weight change in (ex-) military personnel of the UK Armed Forces.

**Design:** A cohort study whereby a self-report questionnaire was administered at baseline (2003–2005) and follow-up (2007–2009).

**Participants:** A total of 6352 former and serving military personnel of the UK Armed Forces.

**Setting:** United Kingdom.

**Main outcome measures:** Personnel were asked about socio-demographic, military and (mental) health characteristics, including screening measures for common mental health disorders. Further, participants were asked to report unintended weight fluctuations (none, < or > than 10 lbs in the past month). Multinomial regression analyses were used to identify factors associated with self-reported weight change at follow-up.

**Results:** Out of the 6352 former and serving military personnel, 123 (2.1%) reported unintended weight loss and 577 (9.0%) reported unintended weight gain in the past month. At follow-up, multivariable analyses indicated that unintended weight loss or weight gain was more likely to be reported by those who screened positive for mental health problems and those reporting weight changes at baseline. Reported weight loss was more common among smokers than non-smokers, whereas reported weight gain at follow-up was associated with having a higher BMI at baseline.

**Conclusions:** At follow-up, self-reported unintended weight changes in former and serving military personnel of the UK Armed Forces were found to be associated with mental health problems, body mass index, smoking and self-reported weight changes at baseline.

## Keywords

Body weight changes, cohort study, eating disorders, mental health, military personnel

large longitudinal study comprising US military personnel and veterans, suggested that a history of diagnosed mental health disorders was associated with new-onset disordered eating among Service personnel.<sup>3</sup> Further, new-onset eating disorders (EDs) and weight loss were more frequently reported in Service women who had experienced combat during their deployment.<sup>3</sup> Whether weight changes are associated with combat and/or mental health problems in UK (ex-) military personnel is unknown.

## Aims of the study

The current study examined factors predicting self-reported unintended weight change using baseline and follow-up data from 6352 UK (ex-) military personnel who participated in the King's Centre for Military Health Research Cohort Study.<sup>4,5</sup>

## Methods

The data for this study were collected during phase 1 (response rate 62%) and phase 2 (response rate 56%) of the King's Centre for Military Health Research cohort study looking into the health and well-being of (ex-) serving personnel of the UK Armed Forces.<sup>4,5</sup> This cohort was established in 2003 (phase 1: n = 10,272) and phase 2 data collection started in 2007.<sup>4,5</sup> During phase 2, personnel who participated in phase 1 were followed up (n = 6429), and two new samples were included, namely those who deployed to Afghanistan (n = 896) and a random sampled replenishment group of those who joined the Armed Forces since 2003 (n = 2665).<sup>4</sup>

Data for these two phases were gathered using a self-report questionnaire on various socio-demographic and military characteristics and (mental) health measures screening for common mental health disorders (using the general health questionnaire,<sup>6,7</sup> PTSD checklist civilian version (PTSD-checklist – Civilian version,<sup>8</sup> alcohol misuse (alcohol use disorders identification test<sup>9</sup>), smoking status and

## Introduction

Restrictive eating or overeating may be used as a way to cope with traumatic and/or stressful experiences.<sup>1,2</sup> Findings from the US Millennium Cohort Study, a

self-reported health. The civilian version of the PTSD checklist was used in the current study, as the military version asks questions referring to 'a stressful military experience' compared with 'a stressful experience from the past' in the civilian version; stressful experiences may have occurred outside the military context and otherwise these may have been omitted. The main components of the questionnaire were similar during both phases to enable longitudinal comparisons on various health and well-being outcomes of the cohort.

For the current study, personnel were selected if they participated in phase 1 and phase 2 of the study and responded to the questions asking whether they experienced 'unintended weight gain greater than 10lbs' or 'unintended weight loss greater than 10lbs' in the past month ( $n=6352$ ). The responses to these questions were combined into a single item identifying whether respondents reported unintended weight loss ( $<10$  lbs), no weight change or unintended weight gain ( $>10$  lbs) in the past month. Those who responded yes to both of the questions (e.g. weight gain and weight loss) were excluded ( $n=20$ ). The following cut-offs were used to identify whether participants screened positive for symptoms of common mental disorder (general health questionnaire  $\geq 4$ ),<sup>6,7</sup> probable PTSD checklist civilian version ( $\geq 50$ )<sup>8</sup> or alcohol misuse ( $>15$ )<sup>9</sup>. A binary 'caseness' variable was created combining those who screened positive for PTSD, common mental health disorders or both ( $n=1292$ ), as co-morbidity was identified in 198 cases. Height and weight of the participants were used to create a categorical body mass index (BMI) variable (BMI  $<18.5$ – $<25$ ;  $25$ – $<30$ ;  $\geq 30$ ).

Univariable multinomial regression was used to identify socio-demographic, military and (mental) health factors associated with weight change in the past month. Factors that were associated with the outcome of interest during univariable analyses ( $p < 0.05$ ) were retained in the multivariable analyses. Multinomial odds ratios and 95% confidence intervals are reported. Sampling weights were generated to take into account the oversampling of reservists during phase 1 of the King's Centre for Military Health Research cohort study and to adjust for lower response rates among younger, lower ranked, male Service personnel during phase 2. Numbers presented are not weighted, whereas proportions are weighted. All the analyses were performed using STATA (version 11.0).

Ethical approval was granted by the Ministry of Defence's research ethics committee and the research ethics committee from King's College Hospital.

## Results

At phase 1, the mean age of the sample ( $n=6352$ ) was 35.3 years (SE 0.10), and the majority were male

(89.8%), regular instead of reserve military personnel (89.6%) who served in the Army (62.3%) and were non-commissioned officers (64.1%). Approximately one in three had been deployed (36.3%) and one in 10 (12.0%) had left Service at the time of questionnaire completion (Table 1).

Out of the 6352 (ex-) military personnel, 123 (2.1%) self-reported unintended weight loss and 577 (9.0%) self-reported unintended weight gain in the past month at follow-up (phase 2) (Table 1). Univariable analyses showed that self-reported unintended weight loss or weight gain at phase 2 of data collection was associated with various factors from phase 1, including mental health problems, smoking status, BMI, self-reported health and weight fluctuations (Table 2).

After adjustment, the following phase 1 variables remained statistically significantly associated with *self-reported unintended weight loss at phase 2*: screening positive for mental health problems, being a smoker, and self-reported unintended weight gain or weight loss. Personnel with a BMI of  $25$ – $<30$  were less likely to report unintended weight loss compared with those with a BMI below 25 (Table 2).

*Self-reported unintended weight gain at phase 2* was less likely to be reported among personnel serving in the RAF compared with Army personnel and officers compared with non-commissioned officers. Personnel who screened positive for common mental health disorders, PTSD or both were more likely to report weight gain compared with those who did not. Further, higher BMI at baseline was associated with unintended weight gain at follow-up. Self-reported unintended weight loss and weight gain (borderline significant) at phase 1 was found to be associated with reported unintended weight gain during phase 2 compared with those who did not report weight changes during phase 1 (Table 2).

## Discussion

The current study indicates that self-reported unintended weight fluctuations at follow-up were associated with mental health problems, BMI and self-reported weight fluctuations at baseline. Self-reported weight loss at follow up was more likely to be reported by smokers compared with personnel who never smoked.

A strength of the current study is its longitudinal nature, thereby providing the opportunity to follow up with a considerable number of (ex-) military personnel. No data were collected on the presence of eating disorders in the King's Centre for Military Health Research cohort study and, therefore, self-reported unintended weight fluctuation was used as the main outcome variable. However, this poses an

**Table 1.** Socio-demographic, military and (mental) health characteristics of UK (-ex) military personnel who had data for both Phase 1 and Phase 2.

Phase 1 variables	N (%)	Unintended weight fluctuations in the past month (at phase 2)			<i>p</i> <sup>a</sup>
		Unintended weight loss (<10 lbs)	No	Unintended weight gain (>10 lbs)	
Total	6352 (100.0)	123 (2.1)	5652 (88.9)	577 (9.0)	NA
Age group (years)					
≤24	728 (100.0)	21 (3.2)	636 (87.4)	71 (9.5)	
25–29	1064 (100.0)	18 (1.7)	947 (89.5)	99 (8.8)	
30–34	1454 (100.0)	38 (3.0)	1291 (88.2)	125 (8.8)	
35–39	1355 (100.0)	16 (1.2)	1197 (88.1)	142 (10.7)	
40+	1751 (100.0)	30 (1.7)	1581 (90.8)	140 (7.6)	0.01
Sex					
Male	5634 (100.0)	104 (2.0)	5015 (89.0)	515 (9.0)	
Female	718 (100.0)	19 (2.6)	637 (88.4)	62 (9.0)	0.67
Marital status <sup>b</sup>					
In a relationship	5001 (100.0)	87 (1.9)	4460 (89.3)	454 (8.8)	
Not in a relationship	1338 (100.0)	36 (2.8)	1180 (87.5)	122 (9.6)	0.11
Educational attainment <sup>b</sup>					
Low (O-levels or none)	2518 (100.0)	55 (2.3)	2199 (87.2)	264 (10.5)	
High (A-levels, degree and above)	3466 (100.0)	61 (2.0)	3188 (90.0)	287 (8.0)	0.01
Service branch					
Naval services	1047 (100.0)	14 (1.4)	958 (91.1)	75 (7.6)	<0.01
Army	4002 (100.0)	88 (2.3)	3501 (87.4)	413 (10.3)	
RAF	1303 (100.0)	21 (1.9)	1193 (91.9)	89 (6.2)	
Rank					
Officer	1496 (100.0)	19 (1.4)	1402 (94.1)	75 (4.4)	
Non-commissioned officer	3895 (100.0)	72 (1.9)	3416 (87.9)	407 (10.3)	
Other rank	851 (100.0)	30 (3.8)	742 (87.1)	79 (9.2)	<0.01
Engagement type					
Regular	5269 (100.0)	101 (2.1)	4693 (88.9)	475 (9.1)	
Reservist	1083 (100.0)	22 (1.6)	959 (90.2)	102 (8.2)	0.40

(continued)

Table 1. Continued.

Phase I variables	N (%)	Unintended weight fluctuations in the past month (at phase 2)			p <sup>a</sup>
		Unintended weight loss (<10 lbs)	No	Unintended weight gain (>10 lbs)	
Serving status <sup>b</sup>					
Serving	5607 (100.0)	102 (1.9)	4987 (89.1)	518 (9.0)	
Left	721 (100.0)	20 (3.3)	642 (87.6)	59 (9.1)	0.09
Deployment status <sup>b</sup>					
No	2839 (100.0)	59 (2.2)	2557 (89.7)	223 (8.1)	
Yes	3498 (100.0)	63 (1.8)	3083 (87.8)	352 (10.5)	0.01
Unit role <sup>b</sup>					
Combat	1349 (100.0)	30 (2.5)	1171 (86.5)	148 (11.1)	
Combat support	696 (100.0)	13 (1.9)	622 (89.7)	61 (8.4)	
Combat service support	4250 (100.0)	79 (2.0)	3807 (89.6)	364 (8.4)	0.07
common mental health disorders, PTSD case <sup>b</sup>					
No	4968 (100.0)	68 (1.5)	4543 (91.6)	357 (7.0)	
common mental health disorders, PTSD or both	1292 (100.0)	53 (4.5)	1023 (78.6)	216 (16.9)	<0.01
alcohol misuse (>15) <sup>b</sup>					
Yes	831 (100.0)	32 (4.1)	687 (84.0)	112 (12.0)	
No	5454 (100.0)	87 (1.7)	4905 (89.7)	462 (8.6)	<0.01
Smoking <sup>b</sup>					
Never	3180 (100.0)	42 (1.3)	2881 (90.5)	257 (8.2)	
Ex-smoker	1522 (100.0)	23 (1.7)	1355 (89.0)	144 (9.3)	
Smoker	1650 (100.0)	58 (3.8)	1416 (86.1)	176 (10.0)	<0.01
Self-reported health <sup>b</sup>					
Excellent/very good/good	5580 (100.0)	95 (1.9)	5030 (90.1)	455 (8.0)	
Fair/poor	722 (100.0)	26 (3.8)	576 (80.0)	120 (16.3)	<0.01
BMI <sup>b</sup>					
<18.5–<25	2391 (100.0)	64 (2.8)	2212 (92.4)	115 (4.8)	
25–<30	2917 (100.0)	35 (1.2)	2583 (88.7)	299 (10.1)	
≥30	778 (100.0)	12 (1.9)	628 (81.2)	138 (16.9)	<0.01

(continued)

**Table 1.** Continued.

Phase I variables	N (%)	Unintended weight fluctuations in the past month (at phase 2)			p <sup>a</sup>
		Unintended weight loss (<10 lbs)	No	Unintended weight gain (>10 lbs)	
Unintended weight fluctuations <sup>b</sup>					
Unintended weight loss	124 (100.0)	11 (13.5)	96 (73.7)	17 (12.8)	
Neither	5505 (100.0)	87 (1.7)	5061 (92.0)	357 (6.4)	
Unintended weight gain	711 (100.0)	24 (3.3)	484 (65.7)	203 (31.0)	<0.01

Ph: phase.

<sup>a</sup>Pearson Chi square test.

<sup>b</sup>Missing data.

**Table 2.** Phase I factors associated with unintended weight loss and weight gain at phase 2 among UK (ex-) military personnel.

Phase I variables	Univariable		Multivariable	
	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)
Age group (years)	Odds ratio (95% confidence interval)	Odds ratio (95% confidence interval)	Odds ratio (95% confidence interval)	Odds ratio (95% confidence interval)
≤24	1.96 (1.03–3.73)*	1.30 (0.92–1.84)	0.69 (0.25–1.90)	1.19 (0.73–1.94)
25–29	1.04 (0.52–2.07)	1.18 (0.86–1.62)	0.71 (0.28–1.78)	1.07 (0.73–1.57)
30–34	1.87 (1.08–3.24)*	1.20 (0.90–1.60)	1.56 (0.84–2.92)	0.94 (0.67–1.32)
35–39	0.74 (0.37–1.48)	1.46 (1.10–1.93) **	0.75 (0.34–1.64)	1.15 (0.83–1.61)
40+				
Sex				
Male			nr	nr
Female	1.30 (0.72–2.34)	1.00 (0.74–1.37)		
Marital status <sup>a</sup>				
In a relationship				
Not in a relationship	1.54 (0.98–2.42)	1.12 (0.88–1.42)	1.10 (0.59–2.03)	1.15 (0.87–1.54)
Educational attainment <sup>a</sup>				
Low (O-levels or none)	1.21 (0.80–1.85)	1.35 (1.10–1.65)**	0.85 (0.52–1.41)	1.02 (0.80–1.29)
High (A-levels, degree and above)				

(continued)

Table 2. Continued.

Phase I variables	Univariable		Multivariable	
	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)
Service branch				
Naval services	0.57 (0.30–1.08)	0.71 (0.53–0.94)**	0.64 (0.30–1.36)	0.83 (0.60–1.16)
Army				
RAF	0.78 (0.46–1.33)	0.58 (0.44–0.76)***	0.98 (0.51–1.86)	0.66 (0.48–0.90)**
Rank				
Officer	0.71 (0.40–1.24)	0.40 (0.30–0.54)***	1.12 (0.57–2.21)	0.65 (0.47–0.91)**
NCO				
Other rank	2.00 (1.22–3.28)**	0.90 (0.67–1.21)	1.70 (0.78–3.71)	0.93 (0.63–1.39)
Engagement type				
Regular			nr	nr
Reservist	0.72 (0.41–1.28)	0.90 (0.69–1.17)		
Serving status <sup>a</sup>				
Serving				
Left	1.79 (1.04–3.09)*	1.03 (0.76–1.41)	1.30 (0.62–2.72)	0.91 (0.64–1.32)
Deployment status <sup>a</sup>				
No				
Yes	0.82 (0.54–1.23)	1.32 (1.09–1.60)**	0.83 (0.52–1.32)	1.18 (0.93–1.48)
Unit role <sup>a</sup>				
Combat	1.29 (0.79–2.10)	1.37 (1.08–1.73)**	1.07 (0.58–1.99)	1.21 (0.92–1.61)
Combat support	0.94 (0.49–1.81)	1.00 (0.72–1.39)	1.29 (0.61–2.72)	1.14 (0.80–1.65)
Combat service support				
common mental health disorders, PTSD case <sup>a</sup>				
No				
common mental health disorders, PTSD or both	3.56 (2.35–5.39)***	2.82 (2.29–3.48)***	2.45 (1.44–4.14)***	2.17 (1.69–2.79)***
alcohol misuse (>15) <sup>a</sup>				
No				
Yes	2.51 (1.57–4.03)***	1.50 (1.15–1.94)***	1.53 (0.86–2.75)	1.04 (0.77–1.41)
Smoking <sup>a</sup>				
Never				

(continued)

Table 2. Continued.

Phase 1 variables	Univariable		Multivariable	
	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)	Unintended weight loss at phase 2 (<10 lbs)	Unintended weight gain at phase 2 (>10 lbs)
Ex-smoker	1.32 (0.74 - 2.35)	1.15 (0.90–1.46)	1.25 (0.63–2.47)	1.05 (0.79–1.38)
Smoker	3.05 (1.92 - 4.87)***	1.28 (1.02–1.62)*	2.48 (1.45–4.26)***	1.20 (0.91–1.58)
Self-reported health <sup>a</sup>				
Excellent/very good/good	1	1	1	1
Fair/poor	2.31 (1.39–3.84)***	2.29 (1.79 - 2.95)***	0.94 (0.47–1.87)	1.12 (0.81–1.53)
BMI <sup>a</sup>				
<18.5–<25	1	1	1	1
25–<30	0.47 (0.29–0.76)**	2.19 (1.69–2.83)***	0.52 (0.30–0.88)**	2.20 (1.63–2.99)***
≥30	0.82 (0.42–1.62)	3.99 (2.95–5.40)***	0.81 (0.35–1.90)	3.10 (2.15–4.47)***
Unintended weight fluctuations <sup>a</sup>				
Unintended weight loss	2.72 (1.59–4.66)***	6.82 (5.43–8.55)***	2.34 (1.10–4.97)**	4.48 (3.43–5.87)***
Neither	1	1	1	1
Unintended weight gain	10.10 (5.03–20.26)***	2.51 (1.37–4.61)***	5.71 (2.32–14.00)***	1.88 (0.98–3.59) <sup>b</sup>

Total n = 6352.

<sup>a</sup>Missing data borderline significant ( $p < 0.06$ ) and therefore included in the multivariate model.

<sup>b</sup>Borderline ( $p < 0.06$ ).

Reference category for the equation is no unintended weight change.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$  (two-tailed tests).

important limitation. Studies suggest that there is a high correlation between self-reported weight and true weight; however, these estimates have found to be influenced by gender, age, education, socio-economic status and BMI.<sup>10–12</sup> Further, the presence of mental illness might also impact on the accuracy of the weight estimate. A study done by Minsky et al.<sup>13</sup> suggested that people affected by a mental disorder often underestimate their actual weight. Another limitation is that not all the members of the cohort answered the self-reported unintended weight question at baseline as well as follow-up ( $\pm 5\%$ ). These were excluded from the analyses. Therefore, the results should be interpreted cautiously.

The findings of the Millennium Cohort Study suggested that a history of mental health problems was associated with (new-onset) eating disorders and weight loss in military personnel.<sup>3</sup> Specifically for PTSD, the Millennium Cohort Study results indicated that a history of PTSD, new on-set or persistent PTSD was associated with weight fluctuations in US

(ex-) serving personnel compared with those without PTSD.<sup>14</sup> In the current study, (ex-) military personnel who screened positive for probable PTSD and/or common mental health disorders were more likely to report unintended weight fluctuations. In contrast to that study, no association was found between combat exposure and reported unintended weight fluctuations in Service women. A possible explanation may include the use of a proxy for combat exposure namely unit role. Service personnel indicating to be a member of combat unit may, once deployed, operate in a different role. Further, only a small number of women ( $n=81$  out of  $n=718$  women) reported weight fluctuations in our study.

Several other studies suggest co-morbidity in (ex-) service personnel who present with eating disorders or emotional eating such as PTSD and depressive symptomatology.<sup>15–17</sup> A change in eating behaviour may encompass a way to cope with stress due to traumatic events.<sup>1</sup> In addition, the pressure to achieve and maintain the set fitness standard and the constant



competition between personnel are factors that may facilitate changes in eating behaviour, and these may, in some cases, continue to develop in an eating disorder.<sup>18,19</sup> The impact of weight fluctuations and eating disorders, potentially in co-morbidity with other mental health disorders, on mission readiness (both on a personal and unit level) is unclear and should be examined.

To the best of our knowledge, no prevalence data are available on eating disorders in the UK Armed Forces, and this warrants future research. A systematic review accumulating evidence about the prevalence of eating disorders in US Armed Forces personnel suggested that for female Service members, the weighted prevalence of anorexia nervosa ranged from 0.2% to 1.6% and 0.71% to 9.7% for bulimia nervosa.<sup>18</sup> Prevalence rates fluctuated depending on how the prevalence of eating disorders was established, e.g. self-reported by the participant, using a diagnostic interview done by a clinician or data extraction from medical records.<sup>18</sup> Weighted prevalence data for men were only available from medical records studies; 0.008% (anorexia nervosa) and 0.015% (bulimia nervosa).<sup>18</sup>

As can be derived from the review above, the proportion of female military personnel suffering from eating disorders might be higher than male military personnel, while the absolute numbers of male military personnel with eating disorders will outnumber female personnel. Therefore, it is important that research studies should include the Armed Forces population as a whole.

This study indicates that various baseline factors were associated with self-reported unintended weight fluctuations at follow-up in UK Service personnel including mental health problems, BMI, smoking status and self-reported weight fluctuations.

#### Declarations

**Competing interests:** None declared.

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**Ethical approval:** Ethical approval was granted by the Ministry of Defence's research ethics committee and the research ethics committee from King's College Hospital.

**Guarantor:** NTF.

**Contributorship:** SAMS developed the analytical strategy for this paper, undertook the data analyses presented here and wrote the paper. NTF was involved in the design and planning of the study and commented extensively on the paper.

**Provenance:** Not commissioned; peer-reviewed by Simon Howard.

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