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Mood Disturbances Endure After Completion of High-Altitude Military Training

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Abstract

Associations between physical and emotional stress and increases in mood symptoms have been documented in a variety of populations. In military personnel, more physical symptoms and decrements in ability to perform critical tasks have been shown to accompany such stress-induced dysphoria. Most research in this area has focused on the immediate effects of stress on mood. We wondered what immediate mood effects strenuous high-altitude training would have in male Marines, what mood effects would endure 30 and 90 days after completion of training, and how mood scores would compare with normative data. Sixty male Marines (mean age = 19 years, range = 18-28) completed the Profile of Mood States (POMS) at multiple time points before and after participating in a 30-day, cold-weather, high-altitude field training exercise. Detailed anthropometric measurements were taken at the same time points. The Marines reported significant increases in mood symptoms from baseline to completion of training, most of which endured for up to 90 days. In terms of anger and fatigue, the degree of mood symptoms reported by the Marines was elevated to levels comparable to normative data for adult male psychiatric outpatients. Rigorous military training in challenging environments may result in enduring mood symptoms that approach levels of clinical significance. Such dysphoria may have implications for readiness for duty and performance of critical tasks. Military populations may represent new opportunities for application of behavioral medicine techniques. Behavioral interventions such as stress coping techniques may be useful in military populations to reduce the impact of these mood symptoms.

Introduction

The literature is replete with observations of increased mood symptoms in a range of populations experiencing various forms of physical and emotional stress. Several studies have documented such adverse mood shifts in military and quasi-military populations undergoing stressful experiences involving rigorous training and challenging environments. (1-11) For example, in one study, mood symptoms in Army soldiers, as measured by the Profile of Mood States (POMS), were assessed shortly after beginning and immediately after completing a maximal effort 20-km road march while carrying a 46-kg load. The soldiers reported an 82% increase in fatigue and a 38% decrease in vigor between these two time points. (2) Another study examined mood in Navy special forces personnel engaged in basic training. Results showed increases in POMS anger and fatigue, and a decrease in POMS tension pre- to post-training for those who completed training. (7)

The assessment of changes in mood associated with strenuous training is of considerable interest in military populations for several reasons. In some studies, increases in mood symptoms have been associated with increases in physical symptoms (1-3,9,12), thus having potential implications for readiness for duty. For example, one study reported that POMS tension and fatigue were positively associated with a number of physical health symptoms in Navy personnel engaged in Persian Gulf operations. (6) In other studies, increases in mood symptoms have been associated with decrements in the execution of critical military or quasi-military functions, thus having possible implications for quality of performance of duties. For example, Army personnel reporting elevated POMS fatigue and diminished POMS vigor experienced a significant decrease in marksmanship accuracy. (2,4) Also, elevated levels of self-reported confusion accompanied augmented levels of fatigue in Air Force air traffic controllers working night shifts. (2) Specific to high-altitude training, a number of researchers have observed adverse changes in mood states at altitudes above 3050 m. (1,13-15)

Previous studies in this area have been generally limited to the documentation of mood changes during episodes of stressful training or other operations. Thus, pre-training baseline measurements and longitudinal designs that would include post-training follow-up assessments are often lacking in these studies. In addition, several of the cited studies involve sample sizes of 12 or less.

In this study, we were interested in assessing mood changes in young Marines participating in a strenuous, 30-day, high-altitude, cold-temperature field training exercise (FTX). Employing a longitudinal design that began with a pretraining baseline assessment, we were interested in determining whether mood symptoms would be increased at the completion of training, if they would remain elevated at 30 and 90 days after completion, and how mood scores would compare with normative data.

Methods

Study Participants

Sixty active-duty male Marines stationed at the Marine Corps Air Ground Combat Center at Twentynine Palms, CA, volunteered to participate in a 5-month longitudinal study. The study was approved by the Naval Health Research Center Institutional Review Board. Before admission into the study, each Marine read and signed an informed consent document. Prior to signing the informed consent, each Marine was polled individually as to his understanding of the study and was given ample opportunity to ask questions concerning his participation.

Table 1 shows characteristics of the participants at baseline. The Marines ranged in age from 18 to 28 years, with a mean age of 19.8 years (*SEM* = .26 years), height of 179.2 cm (*SEM* = .84 cm), and weight of 81.38 kg (*SEM* = 1.22). On average, the Marines had normal body mass index (BMI) but with relatively high fat-free mass and low ratio of body fat to lean body mass. All participants had been members of the Marine Corps for at least 6 months. Each Marine participating in the study was given a physical exam by the battalion medical officer and deemed to be in good health and free from taking any prescription medication.

Experimental Design

This study employed a prospective repeated measures design. Using the POMS, mood was evaluated on two occasions prior to and three occasions after completion of a deployment at the Marine Corps Mountain Warfare Training Center (MWTC), Bridgeport, CA, where the Marines participated in a 30-day high-altitude FTX. Data were collected at the Marines' home of record at Twentynine Palms, CA, 23 days prior to arrival at MWTC and within 1 day after the Marines arrived at the MWTC base camp. Because POMS scores did not differ significantly at these two time points, they were averaged to provide a single estimate of baseline functioning (baseline). The POMS was administered again at the conclusion of the FTX—1 day before the Marines returned to Twentynine Palms (post-FTX). In addition, participants completed the POMS at 30

(30-post-FTX) and 90 (90-post-FTX) days after completion of training to provide an estimate of mood recovery from the training episode. All POMS questionnaires were administered between 1300 and 1500 for each assessment period.

Various anthropometric measurements were taken at multiple time points using standard measurement techniques. At baseline, each Marine's height was measured in centimeters. At baseline and 30- and 90-days post-FTX, body weight was measured in kilograms, percent body fat was assessed using standard Navy circumference equations, and fat-free mass, fat-to-lean ratio, and BMI (kg/m^2) were calculated.

Military Training Activities

Winter military operations at MWTC consisted of continuous physical activities encompassing both night and day patrols using cross-country skiing, telemarking, and snowshoeing. Additional training included land navigation, acquiring survival skills, as well as live-fire training. Upon arrival at MWTC, the Marines received orientation on the military activities while at base-camp (altitude 2053 m) for approximately 3 days. At the conclusion of the base camp training, company size units hiked to their respective training ranges, which ranged in altitude from 2546 m to 3600 m. The initial military training exercises lasted approximately 9 days, at which time the Marines returned to base camp for 2 days. The Marines then hiked to different training ranges for the remainder of the FTX (~2 weeks). While in the field, the Marines typically bivouac in 4-man tents. The winter military operations took place between mid-February and mid-March. The average snow level during this time ranges from about 2 m to 4.5 m. Nighttime temperatures ranged from -2° C to -20° C and daytime temperatures ranged from 2° C to -7° C.

Mood Assessment

The POMS is a self-administered measure of current mood or affective states, consisting of 65 adjectives rated on a 0 to 4 scale. One of the most widely used mood scales, (16) this instrument is easily understood by persons having at least a 7th grade education. POMS data can be consolidated into 6 factor analytically derived mood variables (tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment) as well as a global distress variable (total mood disturbance). Higher scores indicate greater levels of mood

symptoms except for vigor, where lower scores indicate greater symptomatology. Internal consistency (Cronbach's α) ranges from .84 to .95, indicating excellent reliability. (17)

The POMS has been shown to be valid in studies of emotion-inducing conditions, sports, and exercise, (17) and studies assessing mood and fitness in military personnel before and after basic training (11) and other strenuous maneuvers and training (1-3,5-7,9,10). More specifically, the POMS has been used repeatedly to assess mood in military and quasi-military populations experiencing stressful situations involving high altitude and extreme cold temperatures. (1,3,9,10) At each administration of the scale, participants were instructed to indicate how they felt "right now."

Normative data for the POMS is available for many populations. We chose norms for adult males from the U.S. general population (ages 18-65), males attending college (because of the similarity to the Marines in terms of age range), and adult male psychiatric outpatients. The latter group was included to provide a rough estimate of whether any mood symptom elevations observed in the Marines approach a level of clinical significance.

Statistical Analysis

Data were analyzed using SPSS 11.0.1 (SPSS, Chicago, IL) *t* tests, Pearson's correlations, and repeated measures analysis of variance (ANOVA) and covariance (ANCOVA). *T* tests were used to compare the Marines' baseline POMS subscale scores with the norms. Repeated measures ANOVAs were conducted to determine the significance of changes in mood and anthropometric variables over time. Pearson's correlations were conducted to determine relationships between POMS subscale scores and anthropometric variables.

Results

Repeated measures ANOVAs indicated that there was a significant decrease from baseline to post-FTX in body weight ($p < .001$) and BMI ($p < .001$), which was maintained at 30-post-FTX, followed by return to baseline levels in body weight ($p = .012$) and BMI ($p = .013$) from 30- to 90-post-FTX (Table 1). The baseline to post-FTX body weight and BMI decrease can be explained by a significant decrease in fat-free mass ($p = .003$) during this period. In addition, there was a significant decrease in the fat-to-lean ratio from baseline to 30-post-FTX ($p = .047$). No significant changes in indices of fat or lean mass occurred after 30-post-FTX. Taken together,

these data suggest that the decrease in body weight and BMI was due to decreases in both fat and lean mass.

Table 2 shows mean POMS scores for the Marines at each time point and data for the three normative groups. *T* tests were used to compare the Marines' baseline POMS subscale scores with scores for each normative group. At baseline, the Marines reported 40% less tension ($p < .001$) and 23% less vigor ($p < .001$) than adult males, and 31% less tension ($p < .001$) and 23% less vigor ($p < .001$) than college males. No more differences emerged when using norms for adult males. Compared with norms for college males, at baseline the Marines had 33% less fatigue ($p < .001$), and 17% less confusion ($p = .016$). The Marines' baseline scores for depression, anger, and total mood disturbance levels were similar to those of both nonpatient normative groups. The Marines reported significantly lower baseline levels of mood symptoms on all POMS subscales compared with the adult male psychiatric outpatients ($p = .023$ for vigor; $p < .001$ for all other subscales).

Results of repeated measures ANOVAs revealed significant time effects for 5 of the 6 POMS subscales ($p < .001$ to .031) and POMS total mood disturbance ($p = .001$); however, only a trend was observed for vigor ($p = .079$). Post hoc analyses of these significant time effects revealed that the Marines reported significant increases in mood symptoms from baseline to post-FTX and, except for fatigue, these increased levels of symptoms were maintained at 30- and 90-post-FTX. Fatigue scores declined significantly from 30- to 90-post-FTX (10.53 to 7.91, $p = .022$), and were significantly lower than post-FTX scores (9.95 vs. 7.91, $p = .020$), but nonetheless remained significantly elevated above baseline (7.91 vs. 6.07, $p = .032$).

Of particular note are the levels of scores for POMS anger, fatigue, and vigor. As a reminder, at baseline, Marines' anger scores did not differ from either of the nonpatient norms, fatigue was significantly lower than college males, and vigor was significantly lower than both nonpatient norms. However, POMS anger scores were significantly higher than norms for college males at post-FTX (13.31 vs. 8.9, $p = .001$) and at 30-post-FTX (12.51 vs. 8.9, $p = .026$). Marines' anger scores did not differ from norms for adult male psychiatric outpatients at post-FTX, 30-post-FTX, and 90-post-FTX (13.31, 12.51, and 11.68 vs. 13.5; all nonsignificant (ns); see Figure 1). In addition, Marines' scores did not differ from male psychiatric outpatients at post-FTX and 30-post-FTX for vigor (14.29 and 12.82 vs. 11.3; both ns) and fatigue (9.95 and 10.53 vs. 10.1; both ns; see Figure 2).

We wondered if the anthropometric variables might be related to the POMS subscales. To this end, we examined baseline Pearson correlations between these sets of variables. With the exception of vigor, the POMS subscales were not significantly associated with any of the anthropometric variables. POMS vigor, however, was significantly negatively correlated with baseline weight (r = -.322, p = .012), fat mass (r = -.259, p = .045), and fat-free mass (r = -.299, p = .020). We also divided baseline anthropometric variables into high/low categories (using median splits), and used these as grouping variables in repeated measures ANOVAs with POMS subscales as the repeated variable. None of the time X anthropometrics group interactions were statistically significant.

Discussion

Because of potential implications for readiness for and performance of duty, understanding the mood effects of stressful activities and harsh environments is of particular importance in military populations. This study was designed to determine changes in mood symptoms associated with a rigorous, 1-month, cold-temperature, high-altitude FTX. This study is a significant addition to this literature in that it included pre-exercise baseline characterization of mood and anthropometrics and a longitudinal design that involved 30- and 90-day follow-up assessments of these variables and a larger sample size than many previous studies. Thus, we were able not only to report on the immediate effects of such rigorous training but on mood patterns up to 3 months after completion.

The Marines reported significant increases in mood symptoms from baseline to post-FTX, which were generally maintained through 90-post-FTX. Overall, the Marines reported fewer mood symptoms at baseline than were reported for male college students and males from the general population. However, immediately after the exercise, the Marines reported levels of depression, anger, fatigue, and total mood disturbance that exceeded levels reported for these two normative groups. In addition, levels of anger, vigor, and fatigue equaled normative values for male psychiatric outpatients, and, thus, could be of potential clinical concern.

The strenuousness of the exercise is suggested by the significant anthropometric changes observed in these Marines. BMI and percent body fat decreased an average of 2% from baseline to the end of the exercise. BMI continued to decrease to an average of 3% and 6%, respectively, by the 30-days-post time point. Fat-free mass declined 1%, and overall BMI was reduced by 3%

by 30-days post-FTX. However, because anthropometric variables were associated with only one POMS subscale—vigor, which was the only POMS subscale not to show significant changes over time—the observed mood changes cannot be explained by changes in body habitus as a result of the exercise.

These findings are in agreement with previous studies that observed elevated fatigue and anger symptoms along with decreased vigor immediately after experiencing stressful activities or environments. It is of significant interest that these augmentations in mood symptoms remained elevated—some at levels observed in psychiatric outpatients—well beyond the completion of the stressful exercise. Rigorous military training in challenging environments may result in enduring mood symptoms that approach levels of clinical significance. Such symptoms have been previously associated with increased physical symptoms and decrements in performance of critical tasks. Thus, military populations may represent new opportunities for further application of behavioral medicine techniques. Behavioral interventions involving stress coping techniques could conceivably have a positive impact on readiness for duty and quality of performance during and after the execution of strenuous activities in stressful environments.

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Table 1. Participant Characteristics by Time Point: Mean (*SEM*)

	Baseline	Post	30 Post	90 Post
Age	19.80 (.26)	---	---	---
Body mass index	25.33 (.33) [a**; b**]	24.85 (.30) [a**; c**]	24.69 (.39) [b**; d*]	25.86 (.40) [c**; d*]
% body fat	16.52 (.56)	16.23 (.48)	15.57 (.56)	17.29 (.64)
Fat-free mass	67.66 (.78) [a**]	67.07 (.77) [a**]	67.14 (.86)	68.84 (1.20)
Ratio: fat/lean	.20 (.01) [b*]	.20 (.01)	.19 (.01) [b*]	.21 (.01)

[a]Significant baseline to post-FTX differences.
[b]Significant baseline to 30-post-FTX differences.
[c]Significant post-FTX to 90-post-FTX differences.
[d]Significant 30-post-FTX to 90-post-FTX differences.
** $p < .01$; * $p < .05$.

Table 2. Profile of Mood States (POMS) Subscale Norms and Scores by Time Point: Mean (*SEM*)

	Norms [f]			Marines			
	College Males	Adult Males (age 18-65)	Male Psychiatric Outpatients [h]	Baseline	Post	30 Post	90 Post
Tension	10.70 [g**]	12.30 [g**]	18.4	7.42 (.57) [a**; b**; c*]	9.55 (.73) [a**]	9.80 (.93) [b**]	9.77 (.94) [c*]
Depression	8.60	8.30	22.3	7.24 (1.08) [a**; b*; c**]	10.41 (1.30) [a**]	10.67 (1.63) [b*]	11.61 (1.57) [c**]
Anger	8.90	9.20	13.5	9.11 (.96) [a**; b**]	13.31 (1.20) [a**; i]	12.51 (1.57) [b**; i]	11.68 (1.47) [i]
Vigor	16.90 [g**]	16.30 [g**]	11.3	13.08 (.77)	14.29 (.85) [i]	12.82 (1.07) [i]	14.73 (.80)
Fatigue	9.00 [g**]	7.00	10.1	6.07 (.64) [a**; b**; c*]	9.95 (.74) [a**; d*; i]	10.53 (1.06) [b**; e*; i]	7.91 (.84) [c*; d*; e*]
Confusion	7.10 [g*]	6.70	12.4	5.91 (.48) [a*; b**; c*]	6.79 (.58) [a*]	7.64 (.73) [b**]	7.09 (.69) [c*]
Total	27.50	27.20	65.4	22.66 (3.42) [a**; b**; c*]	35.72 (4.10) [a**]	38.33 (5.59) [b**]	33.34 (5.23) [c*]

[a]Significant baseline to post-FTX differences.
[b]Significant baseline to 30-post-FTX differences.
[c]Significant baseline to 90-post-FTX differences.
[d]Significant post-FTX to 90-post-FTX differences.
[e]Significant 30-post-FTX to 90-post-FTX differences.
[f]Norms from McNair et al., 1992.
[g]Norm vs. baseline POMS subscale scores.
[h]Norms for male psychiatric outpatients differed significantly from means for Marines on all subscales at all time points, except those marked with [i].
[i]Mean scores for Marines did not differ from norms for male psychiatric outpatients.
** $p < .01$; * $p < .05$

Figure 1. POMS Anger: Marines vs. Norms

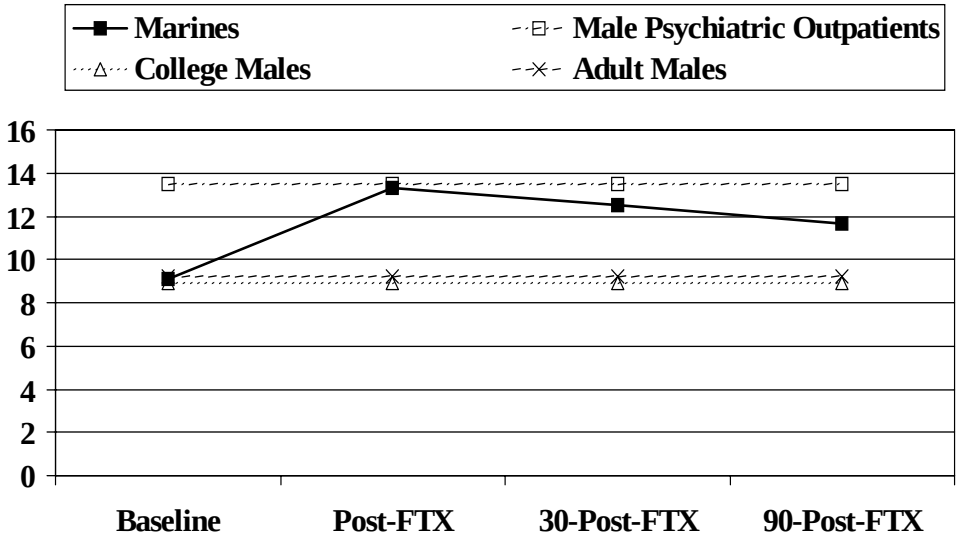


Figure 1. Comparison of Mean POMS Anger Scores for Marines vs. Normative Groups

Footnotes:

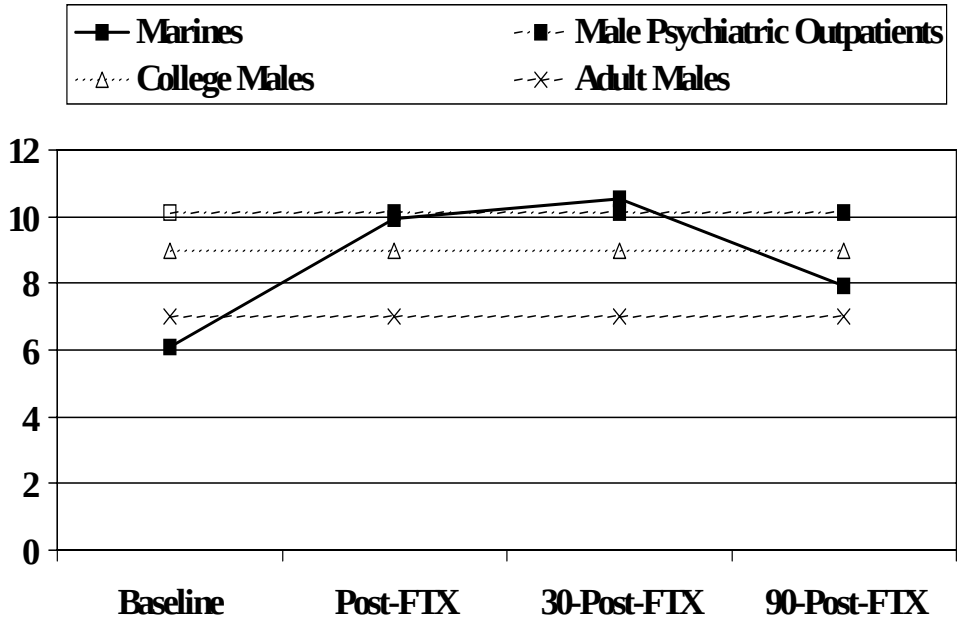
Post-FTX = at completion of field training exercise.
30-Post-FTX = 30 days after completion of field training exercise.
90-Post-FTX = 90 days after completion of field training exercise.

Figure 2. Comparison of Mean POMS Fatigue Scores for Marines vs. Normative Groups

Footnotes:

Post-FTX = at completion of field training exercise.
30-Post-FTX = 30 days after completion of field training exercise.
90-Post-FTX = 90 days after completion of field training exercise.

Figure 2. POMS Fatigue: Marines vs. Norms



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14. ABSTRACT (maximum 200 words)

Associations between physical and emotional stress and increases in mood symptoms have been documented in a variety of populations. In military personnel, more physical symptoms and decrements in ability to perform critical tasks have been shown to accompany such stress-induced dysphoria. Most research in this area has focused on the immediate effects of stress on mood. We wondered what immediate mood effects strenuous high-altitude training would have in male Marines, what mood effects would endure 30 and 90 days after completion of training, and how mood scores would compare with normative data. Sixty male Marines (mean age = 19, range = 18-28) completed the Profile of Mood States (POMS) at multiple time points before and after participating in a 30-day, cold-weather, high-altitude field training exercise. Detailed anthropometric measurements were taken at the same time points. The Marines reported significant increases in mood symptoms from baseline to completion of training, most of which endured for up to 90 days. In terms of anger and fatigue, the degree of mood symptoms reported by the Marines was elevated to levels comparable to normative data for adult male psychiatric outpatients. Rigorous military training in challenging environments may result in enduring mood symptoms that approach levels of clinical significance. Such dysphoria may have implications for readiness for duty and performance of critical tasks. Military populations may represent new opportunities for application of behavioral medicine techniques. Behavioral interventions such as stress coping techniques may be useful in military populations to reduce the impact of these mood symptoms.

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