Physical Training, Smoking, and Injury During Deployment: A Comparison of Men and Women in the US Army

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ABSTRACT

Purpose: To investigate changes in physical training (PT), fitness, and injury during deployment and identify differences between men and women.

Methods: Data were collected on male and female US Army Soldiers through self-reported surveys completed before and after deployment to Afghanistan. Changes in physical training activities, physical fitness, injury incidence, BMI, and smoking status were analyzed. Descriptive statistics were used to compare before deployment and deployment results and differences between men and women.

Results: Surveys were completed by 727 men and 43 women. The percentage of Soldiers engaging in unit PT running of 5 miles or more per week decreased by almost half for men and women. The percentage of Soldiers doing personal PT running of 5 miles or more per week and engaged in resistance training 3 or more days per week more than doubled for men and women during deployment. Cardiorespiratory endurance for women improved by 50 seconds ($P=.06$) and for men declined by 29 seconds ($P<.01$), while muscular endurance increased by 0.6 repetitions ($P<.01$) during deployment. Injury rates for men decreased, on average, 36.2 to 19.0 injuries per 1,000 Soldiers per month ($P=.01$). Injury rates for women decreased on average from 42.6 to 14.0 injuries per 1,000 Soldiers per month ($P=.02$). During deployment, BMI did not change for men or women and smoking increased 19% for men ($P<.01$), but did not increase for women.

Conclusion: Comparisons of physical training activities and health behavior among men and women before and during deployment suggests that increased resistance training could be recommended for women and smoking cessation for men. Given the potentially important role of personal PT in maintaining physical fitness in the deployment environment, future work should support provision of the necessary environment and equipment for Soldiers to perform personal PT effectively and safely on their own. Further, the physical training gaps between men and women should be addressed, with suggestions regarding where improvements can be made, especially for women interested in seeking combat positions with high physical demands.

Military deployments can have a significant effect on Soldiers’ physical and/or mental well-being due to altered schedules, environmental conditions, and available resources during deployments. Physical training (PT), fitness levels, injury incidence, and health behaviors can be affected by these changes. Understanding how these fitness and health components are affected can help improve the readiness and effectiveness of deployed Soldiers.

Both men and women perform occupational tasks with varying physical demands during deployments. It is important that all Soldiers have the aerobic endurance and strength necessary to successfully complete missions without injury. The ability for a deployed unit to maintain a physical training program requires appropriate space, equipment, and time, which varies by location. Low levels of physical fitness have been shown to increase injury risk, which can limit unit readiness. It is essential to continue physical training, either with the unit, during personal time, or both.

In 2013, the US military announced that women would be eligible for combat roles previously only open to men. This announcement raised questions about the physical training requirements necessary for women entering these positions, and highlighted a need to better understand current physical training practices, both before and during deployment. There have been few studies examining the physical training and fitness levels of
deployed Soldiers, and none that have included women. One study looking at 137 male combat arms Soldiers during a 13-month deployment showed upper and lower body strength improved, upper body power improved, aerobic performance declined, fat mass increased, and fewer Soldiers participated in aerobic exercise and sports during deployment.8 Another investigation which looked at changes in fitness and body composition after a 9-month deployment to Afghanistan showed decreases in aerobic capacity, upper body power, and body composition, with no change in lifting strength and vertical jump performance.9

With the average deployment lasting 9 months, Soldiers and leadership should understand the effects of deployment on fitness, health, and physical training practices.8 The focus of this investigation was to see how a 9-month deployment changed Soldiers’ physical training, injury incidence, health behaviors, and fitness levels, and to compare physical training practices of men and women before and during deployment.

METHODS
Data Collected
A volunteer-based survey was administered to Soldiers in a light infantry brigade prior to their deployment in 2011, and again when they returned from deployment in 2013. The surveys obtained self-reported data on unit and personal PT, physical fitness, injury, body mass index (BMI), and tobacco use during the 6 months prior to deployment, and again during the 9 months of deployment (asked postdeployment). Participation in a variety of physical training activities was measured with questions pertaining to the frequency of resistance, sprint, cross-training, and running. The project was reviewed and approved by the US Army Public Health Command Public Health Review Board.

Physical training weekly running distance was calculated from reported average running frequency per week multiplied by average miles per run. Physical fitness was assessed using self-reported performance on the Army Physical Fitness Test (APFT), with the APFT push-up event and sit-up event reflecting muscular endurance and the 2 mile run reflecting cardiovascular fitness.6 APFT scores consisted of a timed (2 minutes) push-up event, a timed (2 minutes) sit-up event and timed 2 mile run. Injury questions asked were pertaining to Soldiers most recent injury during the time-frame specified. Body mass index (BMI (kg/m²)) was calculated from self-reported height (meters) and weight (kg). Cigarette smokers were identified as those who had smoked at least 100 cigarettes in their lifetime and smoked at least one cigarette in the 30 days prior to the survey administration date.

Data Analysis
Data were analyzed using SPSS, Version 19.0 (IBM Corp, Armonk, New York). Descriptive statistics for demographics were calculated. Means and standard deviations were calculated for all continuous variables. OpenEpi (http://www.openepi.com) was used for ANOVA, chi-square, and person-time rates. Chi-square and ANOVA tests were used to compare significant changes among before-deployment and during-deployment variables. Person-time rates were calculated for injury incidence. P values of 0.05 or less were considered significant changes, while P values between 0.06 and 0.10 were considered marginally significant changes.

RESULTS
Descriptive Statistics
Before- and during-deployment surveys were completed by 727 men and 43 women. The comparison of injury rates before and during deployment showed the average injury rate decreased from 36.2 to 19.0 injuries per 1,000 Soldiers per month for men (P<.01) and decreased from 42.6 to 14.0 injuries per 1,000 Soldiers per month for women (P=.02) (Table 1). Prior to deployment, average age and BMI was 24.7 years and 25.8 kg/m² for men, and 25.2 years and 24.4 kg/m² for women (Table 2). Age and BMI did not significantly change during deployment for men or women. Incidence of smoking increased by 19% during deployment for men (P<.01), but did not change for women.

![Table 1. Injury Rates Differences Before and During Deployment for Men and Women.](image)

<table>
<thead>
<tr>
<th></th>
<th>Before deployment injury rate (per 1,000 Soldiers per month)</th>
<th>Deployment injury rate (per 1,000 Soldiers per month)</th>
<th>P value, before deployment vs deployment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Soldiers (n=727)</td>
<td>36.2*</td>
<td>19.0*</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Female Soldiers (n=43)</td>
<td>42.6*</td>
<td>14.0*</td>
<td>.02</td>
</tr>
</tbody>
</table>

*P is calculated using 2 person-time rates z-score

For personal PT, resistance training participation of 3 or more days per week more than doubled for men, from 33% before deployment to 77% during deployment, and increased 8 fold for women, from 5% before deployment to 40% during deployment. The percentage of personnel sprinting during personal PT increased slightly for men, from 50% to 67% reporting sprinting one or more days per week, but did not change for women during...
Table 2: Demographic, Physical Fitness, and Physical Training Differences Before and During Deployment for Men and Women.

<table>
<thead>
<tr>
<th></th>
<th>Men (n=727)</th>
<th>Women (n=43)</th>
<th>% Difference</th>
<th>Predeployment</th>
<th>Deployed</th>
<th>% Difference</th>
<th>Predeployment</th>
<th>Deployed</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td>24.7±5.1</td>
<td>25.8±5.1</td>
<td>+4%</td>
<td>25.2±4.7</td>
<td>26.3±4.7</td>
<td>+4%</td>
</tr>
<tr>
<td><strong>BMI (kg/m2)</strong></td>
<td></td>
<td></td>
<td></td>
<td>25.8±3.3</td>
<td>26.0±3.2</td>
<td>+&lt;1%</td>
<td>24.4±2.8</td>
<td>24.5±2.5</td>
<td>+&lt;1%</td>
</tr>
<tr>
<td><strong>Smokers (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td>47%</td>
<td>56%</td>
<td>+19%</td>
<td>40%</td>
<td>38%</td>
<td>-5%</td>
</tr>
<tr>
<td><strong>APFT 2 mile run (minutes)</strong></td>
<td>14.34±1.33</td>
<td>14.82±1.40</td>
<td>+3%</td>
<td>17.83±2.14</td>
<td>16.99±1.78</td>
<td>24%</td>
<td>43.4±17.2</td>
<td>44.2±11.3</td>
<td>+2%</td>
</tr>
<tr>
<td><strong>Sit-ups (repetitions)</strong></td>
<td>69.8±10.7</td>
<td>69.5±9.9</td>
<td>-&lt;1%</td>
<td>66.8±13.4</td>
<td>69.1±14.2</td>
<td>4%</td>
<td>43.4±12.7</td>
<td>44.2±11.3</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Push-ups (repetitions)</strong></td>
<td>65.9±12.6</td>
<td>66.5±12.3</td>
<td>+1%</td>
<td>43.4±17.2</td>
<td>44.2±11.3</td>
<td>+2%</td>
<td>43.4±12.7</td>
<td>44.2±11.3</td>
<td>4%</td>
</tr>
</tbody>
</table>

% *P < .10 is considered significant

† ANOVA
‡ Chi-square

PHYSICAL TRAINING, SMOKING, AND INJURY DURING DEPLOYMENT: A COMPARISON OF MEN AND WOMEN IN THE US ARMY
The percentage of Soldiers running 5 or more miles per week during personal PT doubled for men (25% to 59%), and increased more than 8 times for women (7% to 58%).

For unit PT, resistance training participation of 3 or more days per week remained about the same for men during deployment (36% and 37%) and slightly decreased for women (24% to 21%). Participation in unit sprinting drills 3 or more days per week decreased for men (18% to 6%) and women (17% to 0%) during deployment. Participation in unit cross-training drills 3 or more days per week decreased for men (37% to 7%) and women (19% to 14%) during deployment. Unit running mileage of 5 miles or more per week decreased for both men (68% to 30%) and women (63% to 38%) during deployment (Table 2; Figures 1 and 2).

Physical Fitness

During deployment, cardiorespiratory endurance improved for women by 0.84 minutes (50 seconds) (APFT 2-mile) \((P=0.06)\). Cardiorespiratory endurance decreased for men by 0.48 minutes (29 seconds) (APFT 2-mile) \((P<0.01)\) but their muscular strength improved by 0.6 repetitions (APFT push-ups) \((P<0.01)\) during deployment (Table 2).

When comparing PT for men and women before deployment (Table 2), personal resistance training showed the largest difference between the 2 groups with 72% of men and 40% of women participating 3 or more days per week. The smallest difference between men and women during deployment was seen in personal running mileage with 59% of men and 58% of women participating 3 or more days per week.

The focus of this investigation was to assess how a nine 9-deployment affected Soldiers’ physical training activities, physical fitness, injury incidence, and health behaviors. It also showed differences between men and women. Deployment resulted in increases in personal physical training, decreases in unit physical training, improvement in physical fitness, reductions in reported injury incidence, and increases in smoking among men.

While deployed women saw a 50 second improvement in 2-mile run time, a measure of cardiorespiratory
endurance on the APFT, men’s run time performance declined by 29 seconds. Lester et al. and Sharpe et al. also showed cardiorespiratory endurance among men was negatively affected by deployments of 13 months and 9 months respectively. The reported increase in personal running mileage among both men and women during deployment appears to have had a positive effect for women. For men, personal running may not have been a sufficient replacement for the decrease in unit training. More men also initiated smoking while deployed which may have affected their aerobic fitness. Several studies have observed cigarette smoking to have a negative effect on aerobic and muscular fitness. A study of male Navy personnel observed smokers were almost 30 seconds slower at the 1.5 mile run/walk, performed 6 fewer curl-ups and 5 fewer push-ups on average, when compared to nonsmokers. The increase in cardiorespiratory endurance in women could be due to increased personal distance running and resistance training frequency during deployment. Past studies have reported a combination of strength and endurance training promotes increases in muscular and aerobic endurance.

Muscular endurance, as measured by APFT push-up performance, improved for men during deployment. This improvement could be due to the increase in the rates of frequency in personal resistance training of 3 or more days per week from 33% to 72% during deployment. Although women also increased the rates of personal time resistance training participation during deployment from 5% to 40% (Table 2, Figure 2), their muscular endurance fitness levels did not change. This could indicate that women desire to improve their muscular endurance, but are unfamiliar with appropriate resistance training exercises. Resistance training instruction and equipment geared towards women might help overcome these issues. The benefits of PT during deployment include reduction in injury risk, maintaining a healthy weight and improved circulation, balance, coordination, and bone/ligament strength. The American College of Sports Medicine recommends that men and women should perform 2 to 3 days of resistance training for each major muscle group, with 2 to 4 sets per muscle group to improve strength and power.

When comparing physical training activities of men and women, similarities were seen in running mileage with their unit before deployment and during personal time during deployment. Physical training differences between men and women were seen in personal resistance training before deployment and during deployment. Both running and resistance training are crucial components to improving and maintaining Soldiers’ cardiovascular and muscular endurance. Resistance training during personal time and with the unit should be highly encouraged for women by unit leaders as it has shown...
to improve occupational task performance. Gender differences in physical performance decreased in the repetitive box lift and the 2-mile loaded run when women participated in endurance and strength/power training. Another study looked at strength and cardiovascular training, and showed individuals who participated in both types of training had the largest percentage improvement in assigned occupational tasks (mannequin drag, lift and carry, and load carriage). Women benefit from resistance training, but participation is low in garrison compared to men. Encouraging similar physical training regimens between men and women might be an effective method for preparing men and women for combat and other physically demanding military occupational tasks.

Injury rates decreased during deployment for both men and women. Even though unit level PT decreased and personal PT participation increased, the combined frequency of unit and personal physical training during deployment stayed similar to that seen before deployment. The ability for Soldiers to train on their own while deployed allowed them more flexibility to train at their own pace and intensity level, which may explain why injury rates decreased among deployed Soldiers. A study by Knapik et al observed Soldiers that participated in similar ability groups for long-distance running had lower injury risk and equal or greater improvements in fitness as basic training progressed.

Cigarette use did not change during deployment for women, but increased by 19% for men. A study of 48,304 US male and female service members by Smith et al showed smoking rates increased during deployment among those that had never smoked by 2%, and among those who had previously quit smoking by 53%. Smoking initiation was especially high during prolonged deployments, multiple deployments, and combat exposures. Another study showed that male and female Soldiers reported initiating smoking during deployment due to boredom (54%), social factors (24%), and stress (13%).

STRENGTHS AND LIMITATIONS
Data were collected through self-reported surveys, which can be subject to recall bias as well as questions about honesty in answers and lack of comprehension of the questions. Prior analyses have found high correlations between actual and self-reported Army Physical Fitness Test data.

CONCLUSION
During deployment, unit PT participation decreased, while personal PT participation increased for both men and women. Personal PT played a larger role in physical training compared to unit PT participation during deployment, which may have contributed to the decrease in injury rates, possibly due to more self-paced personal training. Body mass index remained similar for both men and women, while there was an increase in the number of men who began smoking. Comparisons of physical training activities and health behavior among men and women before and during deployment suggest that increased resistance training could be recommended for women and smoking cessation for men.

Information on personal PT activities described in this paper can be used to inform future unit PT and personal PT recommendations to improve fitness levels in garrison and during deployment. Given the potentially important role of personal PT in maintaining physical fitness in the deployment environment, future work should aim to provide the necessary tools for Soldiers to perform personal PT effectively and safely on their own. Addressing physical training gaps between men and women, such as the lack of resistance training among women in garrison, suggest where improvements can be made, especially for women looking to successfully fill combat positions with high physical demands.

REFERENCES


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