

Research Article

Effects of 8 Weeks Conditioning Exercises on Muscular Endurance: A Cross-Sectional Study of Female Cadets of Ghana Immigration Service Academy, Assin Fosu, Ghana

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Abstract

Physical conditioning enables athletes to meet all the physical requirements of their sport, perform well, and minimize their risk of injury. This study aims to determine the effects of eight (8) weeks conditioning training on the muscular endurance of Female Cadets of the Ghana Immigration Service Academy. The Army Physical Training Fitness Test (APFT) was used to evaluate muscular endurance levels of the Female Cadets. The quasi-experimental pre-test post-test study design was used to conduct the study. A total of 60 female cadets were randomly stratified into two groups based on APFT age categories (22-26) and (27-31) years. Data was analyzed using descriptive statistics and paired sample t-test and independent sample t-test was used to test the hypothesis. Higher upper body muscular endurance performance as measured by the APFT was observed in the age group (27-31) years compared to age group (22-26) years. Significant difference was found in muscular endurance in the females age groups (22-26) and (27-31) years ($P < 0.05$). Significant positive effect on muscular endurance after conditioning exercises for female Cadets in both age categories, (22-26) and (27-31) years ($P < 0.05$) was observed. Conditioning exercises had a significant impact on APFT upper body muscular endurance performance in the age categories of (22-26) and (27-31) years.

Keywords

Female Cadets, Physical Conditioning, Muscular Endurance, Army Physical Fitness Test, Ghana Immigration Service

1. Introduction

A person's level of physical fitness is a key marker of their general health [1]. According to Knapik, *et al.* [2], physical preparation and fitness for military personnel includes physical training (PT). Military and security forces need to be relatively physically fit due to the high physical activity demands during military training and combat [3]. The American College of Sports Medicine [4] states that the goal of the physical training (PT) program followed during the 12-week

BT period is to improve the basic fitness components of cardiorespiratory endurance, muscular strength, and muscular endurance. The ability to meet the physical demands of any combat or duty position, complete the objective, and continue to win is characterized as physical military readiness (PMR) [5].

The Army Physical Fitness Test (APFT) comprises two minutes of maximum repetition push-ups, two minutes of

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maximum repetition sit-ups, and a two-mile run for time, which Basic Combat Training (BCT) trainees must pass to graduate [5]. Since the APFT's first implementation, soldiers have had to carry greater and heavier loads [6]. Ability across the whole range of physical fitness is required for the tactical physical demands placed on Troops [7]. There is an overlap between men and women for any fitness component [8], and women's physical performance capacity can be significantly improved by optimized physical training regimens [9]. The typical female soldier has previously shown lower absolute strength, more fatigue susceptibility during repetitive duties, and lower aerobic capacity than the average male soldier [10]. Nonetheless, after engaging in resistance training regimens, women have shown proportionate strength gains comparable to those of males. [11, 12]. According to [13], muscular endurance is defined as "the muscle's ability to continue to undertake consecutive exertions of numerous repetitions". Although field tests like the wall sit, curl-ups, and push-ups can be used to gauge muscular endurance, the emphasis is on the number of repetitions performed at a submaximal level [13, 14]. It has been determined that push-ups and curl-ups are common field tests that provide precise measurements of overall muscular endurance [15].

Studies by Sporiš *et al.* [16] examined 124 military recruits who were put through basic military training (BMT), and researchers looked at the impact of a strength and endurance-focused workout regimen throughout BMT. The training was carried out three times per week for five weeks, and the results revealed that both training regimens increased performance on the 3.2 km run by 9.82% and 13.4%, the number of sit-up repetitions completed in two minutes by 43.4% and 39.9%, and the number of push-up repetitions completed in two minutes by 67.5% and 80.8%, respectively. Also, in the research of Campos, *et al.* [17], after 12 weeks of BMT, the performance in sit-up repetitions, push-ups, and VO₂max increased by 41%, 58%, and 32%, respectively. In another research, after 8 weeks of BMT, the teams who prioritized strength training had an improvement in VO₂max of 12%, while the teams that prioritized endurance training saw an improvement of 8.5% [18]. However, there is a scarcity of research on the how conditioning exercises influences muscular endurance of female cadets between the age groups (22-26) and (27-31) years. Therefore, the goal of this study is to determine how conditioning exercises affect the muscular endurance of female cadets between the ages (22-26) and (27-31) years.

2. Materials and Methods

2.1. Research Design

The quasi-experimental research design (pre-test and post-test studies) was used to conduct the study. The pre-test and post-test study design have the advantage of directionality, which means that a dependent variable (knowledge or

attitude) is tested before and after intervention with an independent variable (training or an information presentation session) [19]. The study was conducted at the Ghana immigration service Academy located at Assin Fosu in the central region of Ghana.

2.2. Participants

The study included a total of sixty (60) female cadets at Ghana immigration service Academy. The study included Female cadets within the age groups, (22-26) and (27-31). Females cadets with underlining medical conditions that could affect the collection or interpretation of the data and those engaging in other types of activities other than the conditioning exercises were exempted from this study. Female cadets were already stratified into two age groups according to the Army physical fitness training test.

2.3. Measurements

All participants were measured on the same day. The initial measurement was taken for all participants within the first week of their admission to the academy and the post measurement was taken immediately after the end of their 8th week of training.

The Army Physical Fitness Test table was the instruments used to collect the data for the study. It consists of three events namely: push-up, sit-up, and 3.2km run which will be used to measure muscular endurance and cardiorespiratory endurance respectively. Other equipment such as Digital stop watches, disks, markers, ribbons, whistles, and scoring sheets was also used in the measurement procedure. The Procedure of the push-ups is as follows: Participants will be required to begin the test in the standard "up" position with the body rigid and straight, the hands positioned slightly wider than shoulder width apart, and the fingers pointed forward. On the "go" command, the tester will begin the stopwatch, and participants will bend their elbows, lowered themselves to a point where her upper arm is parallel to the ground, and then return to the starting position with elbows fully extended. The participants are not supposed to touch the ground with their knees during the push-up. The number of push-ups the participants can perform within two minutes will be recorded and the APFT table will be used to determine the score of the participants.

Before the sit ups, participants were been taken through the proper posture in executing the test. The subjects were instructed to lie on their back with their knees bent at a 90-degree angle, their fingers were interlocked behind their head, and a second person grabbed their ankles, keeping their feet firmly on the ground. The subject elevated their upper body to a vertical position, with the base of the neck anterior to the base of the spine, before returning to the starting position. They were not supposed to rest more than 1-second while their back is on the ground during the sit-up. The

subjects were to perform as many correct sit-ups as possible within the timeframe allocated. The number of sit-ups the participants were able to perform within two minutes were recorded and the APFT table was used to determine the score of the participants.

Regarding the procedure for the 3.2km run, participants were instructed to start running on a cinder track, and to cover the distance of 3.2km. The time it took to finish the 3.2km run was recorded using the digital stop watch and the APFT table was used to determine the score of the participants.

The training group underwent series of progressive endurance and strength training activities. The exercises performed includes gutter push-ups, jumping jacks, lunges, mountain climb, bicycle crunches, burpees, Japanese touches, Hindu push-ups, squat jumps, shuttle run, jumping ropes, beach walk and adventure walk. The training session was performed 4 times a week for 8 weeks for both age groups.

2.4. Statistical Analysis

IBM Statistical Package for Social Sciences (SPSS) software Version 26 for Windows was used to organize and analyze data collected. The alpha level for rejecting or failing to reject the hypothesis was set at 0.05. Descriptive statistics was used to calculate the mean, standard deviation, minimum and maximum value of the dependent variables (Push-up, sit-up, and 3.2km run). Independent sample t-test was used to compare mean differences in muscular endurance between the two age groups of female cadets (22-26) years and (27-31) years. Paired sample t-test was used to determine the effect of conditioning exercises on muscular endurance.

2.5. Ethical Consideration

The study was approved by the University of Cape Coast's Institutional Review Board (UCC). The study followed the principles of the Declaration of Helsinki on human subject research. All participants were able to withdraw from the study without repercussions and were not forced to participate. Prior to the study, a written informed consent form was issued to the participants and they were briefed about the

confidentiality of the study, purpose, risks and benefit involved in the study.

3. Results

The average values of APFT test for muscular endurance among the two female age groups (22-26) and (26-31) are presented in Table 1. Before the training, the average values of push-ups (2mins) and Sit-ups (2 min) repetition for the age group (22-26) pre-test score was ($M=12.35$, $SD= 5.15$) and ($M=8.42$, $SD= 3.67$) and post-test ($M=15.33$, $SD= 4.01$) and ($M=10.32$, $SD= 3.52$) respectively.

Also, as shown in Table 1, after training, the average values of push-ups (2mins) and Sit-ups (2 min) repetition for the age group (27-31) was ($M=12.44$, $SD= 4.69$) and ($M=8.52$, $SD= 2.95$) for pre-test and post-test ($M=18.60$, $SD= 2.14$) and ($M=12.39$, $SD= 2.75$) respectively.

Table 1. Statistical analysis of APFT test for the age groups (22-26) and (27-31) years.

| Variables | 22-26 Age group | |
|-----------------------|-------------------|------------------|
| | Pre-test | Post-test |
| | Mean (\pm SD). | Mean (\pm SD) |
| Push-ups (2 min) reps | 12.35 \pm 5.15 | 15.33 \pm 4.01 |
| Sit-ups (2 min) reps | 8.42 \pm 3.67 | 10.32 \pm 3.52 |
| Total | 20.77 \pm 8.10 | 25.65 \pm 6.65 |
| 27-31 Age group | | |
| Variables | Pre-test | Post-test |
| | Mean (\pm SD) | Mean (\pm SD) |
| Push-ups (2 min) reps | 12.44 \pm 4.69 | 18.6 \pm 2.14 |
| Sit-ups (2 min) reps | 8.52 \pm 2.95 | 12.39 \pm 2.75 |
| Total | 20.94 \pm 6.77 | 30.89 \pm 4.07 |

Table 2. Independent sample t-test result of muscular endurance between the post-test score of the age groups of female cadets (22-26years) and (27-31years).

| Age group | N | M | SD | SE | Df | T | Sig |
|-----------|----|-------|------|------|----|-------|---------|
| (22-26) | 30 | 25.65 | 6.65 | 1.21 | 58 | -3.75 | 0.00(s) |
| (27-31) | 30 | 30.99 | 4.07 | 0.74 | | | |

p < 0.05 s = significant

Table 3. Descriptive statistics and paired sample t-test result for muscular endurance by training of the age groups of female cadets (22-26years) and (27-31years).

| Age group | Pre-test | | Post-test | | n | 95% CI for Mean Difference | | r | t | df |
|-----------|----------|------|-----------|------|----|----------------------------|-------|--------|----------|----|
| | M | SD | M | SD | | | | | | |
| (22-26) | 20.77 | 8.10 | 25.65 | 6.65 | 30 | 2.68 | 7.09 | .70(s) | 4.54(s) | 29 |
| (27-31) | 20.94 | 6.77 | 30.99 | 4.07 | 30 | 8.13 | 11.97 | .65(s) | 10.69(s) | 29 |

p < 0.05 s = significant

On average, age group (27-31) years performed better on the push-up and sit-up than the age group (22-26) years.

Table 2 shows the significant difference between the age groups of female cadets (22-26years) and (27-31years) as assessed by the APFT test after training. As show from the results, the mean score of female cadets in the age group (27-31) ($M = 30.99$, $SD = 4.07$) was significantly higher than that of females cadets within the age group (22-26) ($M = 25.65$, $SD = 6.65$), $t(58) = -3.75$, $p < .001$ in relation to the number of completed repetitions in both push-ups and sit-ups after training. A significant difference between muscular endurance of female cadets within the ages of (27-31) and (22-26) was observed from the independent sample t-test.

Table 3 indicates the differences between the total mean scores of muscular endurances before training and after training. There was a significant difference in the mean scores of muscular endurance for female cadets within the age group (22-26) after training ($M=25.65$, $SD= 6.65$) and before training ($M=20.77$, $SD= 8.10$); $t(29)=4.54$, $p < .001$. Also, for the age group (27-31), a significant difference was observed after training ($M=30.99$, $SD= 4.07$) and before training ($M=20.94$, $SD= 6.77$); $t(29)=10.69$, $p < .001$. These results suggest that 8 weeks conditioning exercises does have effect on muscular endurance of female cadets. On average, muscular endurance was about 4.88 lower before training in the age group (22-26 years). Also, muscular endurance appears to increase an average of about 10.05 following training in the age group (27-31 years).

4. Discussion

Historically, military endurance training has consisted of steadily paced, moderately intense marches, walks, or runs with or without weight carriage [20]. The purpose of this studies was to determine how conditioning exercises affect the muscular endurance of female Cadets between the age groups (22-26) and (27-31). The major findings of this present study demonstrated that an 8-week conditioning exercise program can improve the muscular endurance of female cadets regardless of age differences. It was confirmed in this present study that exercises that include a combination of

strength and endurance training induced a positive adaptation on muscular endurance. The participants included newly recruits cadets who have not been trained. The positive changes observed in this study for both female cadets age groups are due to their participation in the conditioning exercise program.

After 8 weeks of conditioning exercises in this present study, improvement in upper body muscular endurance was observed. 23.8% and 22.6% change was observed in push-ups and sit-ups respectively for female cadet age group 22-26 years. 49.5% and 45.42% improvement were observed in the age group 27-31 years. In total, 23.5% and 47.5% improvement in upper body muscular endurance was observed in female cadet age groups (22-26) and (27-31) years respectively.

Studies by Wood, *et al.* [21] examined the effect of mixed basic military training on the physical fitness of male and female soldiers following 12 weeks of mixed basic military training. In their studies, females showed a marked improvement of 76.5% and 178.6% in push-ups and sit-ups which is consistent with the observation in this current studies. Previous research by Anderson and colleagues [22] examined sex and age differences in physical performance, comparing army basic training and operational populations. In their studies, army basic combat training women within the age group (22-26) years had a higher mean score of 17.9 compared to the age group (27-31) years with 16.3 average scores in the APFT push-up test which is inconsistent with this current studies. For sit-ups, an average mean score of 36.4 was recorded for age group (27-31) years and 36.0 was recorded for age group (22-26) years which is consistent with results of this current studies. For non-infantry operational women, higher mean score of 38.7 and 65.6 for push-ups and sit-ups was recorded for the age group (22-26) years compared to the age group (27-31) years with mean scores of 37.8 and 63.0. However, in this study, age group (27-31) years had higher mean scores compared to (22-26) years age group. It has also been demonstrated in studies by Knapik, *et al.* [23] stated that age can be associated with decrease in muscular endurance specifically with fitness reduction as one ages. However, other factors including individuals general body fitness and body composition could affect results. Higher body mass

index has been demonstrated to negatively affect cardiovascular event [23] which could account for the observed results in this research. An increase in BMI was observed in a Navy study where decline in physical fitness test was observed in men and women [24]. Studies by Wood, *et al.* [21] sought to evaluate gender differences prior to, throughout (12 weeks), and after a 20-week mixed basic military training (BMT) treatment. There was improvement in the outcome measure for both male and female soldiers in both timed Sit-ups and Push-ups performance.

This study revealed a significant difference between the two age groups (22-26) years and (27-31) years on muscular endurance capabilities on the APFT performance ($p < 0.001$). Previous studies by Anderson and colleagues [22] showed no significant differences in push-ups and sit-ups across age groups. Decline in physical performance associated with age is less likely to manifest in population who are active including basic combat training (BCT) soldiers. Also, soldiers in BCT are already exposed to similar training used in the APFT which could affect the performance output. Thus, the observed result which was not consistent with the finding in this study.

The results of the mean score of the two-age group on the APFT performance (muscular endurance) after training was significantly different and was influenced by conditioning exercises performed. The average mean score for age group (22-26) years was 5.34 lesser than the average mean score for age group (27-31) years. Studies have confirmed the decline in physiological performance as one ages [22]. However, in a population where individuals are physically fit, decline in physical fitness associated with age may not have an impact. Thus, the impact age has on physical performance of female cadet recruits who were all exposed to the conditioning exercises would be lessen.

5. Conclusion

This current study identified the important role of conditioning exercises on female cadet recruits. The findings showed that 8 weeks conditioning exercise had a positive effect on the upper body muscular endurance of female cadet recruits as assessed by the APFT regardless of age. Female cadet recruits age group (27-31) years had higher performance on the APFT measure compare to their (22-26) year age group.

6. Recommendation

It is recommended that physical activity and fitness would be emphasized and promoted in our society and educational system, with girls in focus which can help improve the fitness of youth who desire to enter into careers that demands higher physical abilities. Moreover, conditioning exercises should be extended from 8 weeks to 12 weeks and applied systematically and progressively to elicit effective changes and adap-

tation on females conditioning. Furthermore, a well-planned physical fitness program including combat activities should be introduces alongside the APFT to go beyond the testing for only general health and fitness.

Abbreviations

APFT: Army Physical Fitness Test
BCT: Basic Combat Training
BMT: Basic Military Training
PMR: Physical Military Readiness
PT: Physical Training

Conflicts of Interest

The authors declare no conflicts of interest.

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