Effect of 12 Weeks Basic Military Training (BMT) on Muscular Strength of Recruits at Depot Nigerian Army Zaria, Nigeria

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Abstract
This study investigated the effects of 12 weeks Basic Military training on Muscular Strength of recruits at Depot Nigerian Army Zaria, Nigeria. An experimental approach with a 4x2x2 factorial design was used for the study. The participants were selected randomly from the total population (n=400) into two groups from ten companies using Alfa-Juliet (A-J) consisting of (n=20 males & n=20 females) of trade and non-trade of 77 Regular Recruits' Intake at Depot Nigerian Army, Zaria, Nigeria for 12 weeks of Basic Military training. Data collected were analysed using mean, standard deviation and analysis of variance (ANOVA) at an alpha-level of 0.05. Findings from the study indicated that Basic military training had significant effect on the muscular strength of recruits at Depot Nigerian Army, Zaria (P = 0.001). Male and female recruits differed on the effect of basic military training on their muscular strength (P = 0.001). Recruits with trade and those without trade did not differ on the effects of the basic military training on their muscular strength (P = 0.323). It was concluded that Basic Military Training was an effective method to promote positive short-term adaptations of muscular strength in well-trained army.

Keywords: army, basic, military, muscular, strength, training, recruits

Introduction

Muscle plays a central role in metabolic health and in the metabolism of the body's proteins, serving as the main reservoir of amino acids to maintain protein synthesis in vital tissues and organs in the absence of the absorption of amino acids from the intestine and providing hepatic gluconeogenic precursors. Altered muscle metabolism contributes to the onset of disturbances. The prevention of many common pathological conditions and existing chronic diseases involves the preservation of muscle mass as well as its correct functioning. For the general public, the attributes of muscular strength training programme facilitate the optimal performance of activities of daily living (Rantanen et al., 2019); also improve a wide-ranging implications on health and wellness, increase in adequate muscle mass, muscle quality, reducing mortality rates based on the training (Fitzgerald, Barlow, Kampert, Morrow, Jackson, & Blair, 2014; Rantanen, Avlund, Suominen, Schroll, Frandin & Pertti, 2019).

Some studies suggest that training volume is an important contributing factor for increasing muscular strength as some degree of volume is thought to be required for muscle growth (Marshall, McEwen & Robbins, 2011; Rhea, Alvar, Ball & Burkett, 2002). The initial increase in strength is thought to be primarily from neural adaptations followed by larger contributions from muscle hypertrophy after the first few weeks of training as it increases muscle mass (i.e., hypertrophy) with strength in overall health and diseases prevention (Moritani & deVries, 1979; Damas, Barcelos, Nóbrega, Ugrinowitsch, Lixandrão, Santos, Conceição, Vechin & Libardi, 2019). In effect, many Resistant Training (RT) programmes (i.e., classical periodization, daily undulating periodization) consist of a hypertrophy phase or day, in an effort to provide a foundation from which to optimize strength after targeted training (Simao, Spineti, de Salles, Matta, Fernandes, Fleck & Strom-Olsen, 2012).

However, given the aforementioned suggestion that muscle growth is a large contributor to strength gain after RT, it is perhaps surprising that little direct human evidence exists for this thesis (i.e., the change in size causing the change in strength). It is hypothesized instead that the changes in strength appear to be driven more so by the principle of specificity rather than the change in muscle size (Buckner, Jessee, Mattocks, Mouser, Counts, Dankel & Loenneke, 2017).

Shannon, Larrell, Lisa, Alexandra and Shawn (2015), in their study, showed that individual muscle mass and strength gains with high (HF) vs. low (LF) resistance training (RT) frequencies. Their study was conducted on 20 subjects randomly assigned to HF (5× per week) and the other to LF (2 or 3× per week) with Muscle cross-sectional area and one repetition maximum assessed at baseline and after 8 weeks of RT. Their study showed a higher 8-week accumulated total training volume

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(TTV) ($p < 0.0001$) compared with LF. Muscle cross-sectional area and one repetition maximum values increased significantly and similarly for HF and LF protocols ($p > 0.05$) revealing that training is importantly classified based on individual manipulation and responsiveness to training.

Vogel, Crowdy, Amor, and Worsley (2014) conducted studies on 254 army recruit for assessment of aerobic fitness. In their findings, it was reported that aerobic fitness at the beginning and near the end of army recruit training showed a significant maximal muscular strength power with an increase 8%, 42.0-45ml/kgmin. Based on their research, muscular strength of the army recruit increases with a decrease on body fat content showing that muscular strength exercise leads to increase on aerobic capacity of recruits.

Also, Heyward (2014), in his book, recommended fitness training assessment and exercise prescription for different categories, young, adult, old and those with health challenges. Based on recommendations, physical activity must be placed from lower, mild and high intensity exercise after review on health conditions of participants. In his study, standards for exercise must be based on health stability and the modes for training will differ for promotion of health and wellbeing. This is one of the reasons recruits must be trained based on physical fitness as crucial for war fighters performance in the battlefield and missions.

According to Santtila, Hakkinen, Karavirta and Kyolainen (2012), muscular strength is the ability of the muscle to generate force against physical object. In the fitness world, this typically refers to how much load a military officer can carry for a prolonged period of time and during measuring strength training exercises (Williams, Rayson & Jones, 2013); measuring strength usually involves figuring out the highest weight one can lift for a given exercise regimen (Santtila et al., 2012). The effects of aerobic and strength training involving running/jogging and, or marching test have been shown to enhance or improve physiological fitness of a soldier (Nindl, Barnes, Alemany, Frykman, Shippee & Friedl, 2015).

Research Questions

This study was conducted to answer the research question:

1. Would basic military training improve the muscular strength of recruits at Depot Nigerian Army, Zaria?

Hypothesis

Ho1: There is no significant effect of BMT on muscular strength of male/female and trade/non trade recruits at Depot Nigerian Army, Zaria.

Methodology

The study was designed to investigate the effect of 12 weeks Basic Military training on Muscular Strength of recruits at Depot Nigerian Army Zaria, Nigeria. This study was designed according to Ahmadu Bello University Ethical Committee on the use of Human Participants for Research (ABU ECUHSR) with a letter of introduction from the Department of Human Kinetics and Health Education, Ahmadu Bello University, Zaria to the Commandant, Depot Nigerian Army, Zaria for permission to use the recruits and facilities within the Barracks, before participants' enrolment. Participants were selected from 77 Regular Recruits' Intake at Depot Nigerian Army, Zaria, Nigeria. An experimental approach with a 4x2x2 factorial design was used for the study. The participants were selected randomly from the total population (n=400) into two groups from ten companies using Alfa-Juliet (A-J); each company consisted of 20 males and 20 females of trade and non-trade recruits. This implies a total of 40 participants per company and 400 in all. They were exposed to 12 weeks of Basic Military training. All participants were fully informed about the study.
The following instruments were used for data collection:

i. Holtain stadiometer, made in USA model NJ 07072.
ii. Digital stop watch (Casio), made in UK, model 015.
iii. Whistle (Fox-40) model.
iv. Marking tape and Powdered chalk

With respect to measurement of muscular strength, push up was used to measure upper extremities, chest, flexors of the arm, shoulder girdle and triceps muscle; sit up was used to measure abdominal/trunk region and hip flexor muscle; while Beam Heaves/pull ups was used to measure upper body and shoulder of participants from 18 to 26 years (trade and non-trade categories) for pre- and post- training. Participants were scheduled for testing at a standard time of day similar to their training schedule.

The general warm up was followed by a specific warm up test performed in consecutive repetitions within the specified time of one minute and with a maximum of 70 per minute. Standardized procedures were used for the one repetition maximum (1RM) (Hoffman, 2006). For each exercise, a warm-up set of 5–10 repetitions was performed using 40–60% of the participant's perceived 1RM. After a 1-min rest period, a set of 2–3 repetitions was performed at 60–80% of the participant's perceived 1RM. Subsequently, 3–5 maximal trials (one repetition sets) were performed to determine the 1RM.

The experiment adopted standard techniques. For the Push Up, proper technique was enforced by requiring all participants to flex their arms, shoulder girdle, elbow and upper back muscle by lowering their entire body as a single unit until their upper arms were at least parallel to the ground. Then the participants returned to their starting position by raising their entire body until their arms were fully extended. Their body must remain rigid in a generally straight line position and move as a unit while performing each repetition. The test cycle is completed by extending their arms back to the starting position. Upon lowering the bar to their chest, participants were required to pause briefly and wait for an "UP!" signal before initiating concentric movement. The purpose for this pause was to eliminate the influence of bouncing and distinguish eccentric from concentric muscle activation during electromyography analysis. Any trials that involved excessive arching of the back or bouncing of the weight were discarded.

For the Pull Up, a successful attempt required the participant to descend to the "parallel" position, where the greater trochanter of the femur was aligned with the knee. At this point, an investigator located lateral to the participant, provided an "UP!" signal, indicating that proper range of motion had been achieved; no pause was required for the squat exercise. Rest periods between attempts were 2–3 min in length. Upon determining their 1RM for each exercises, each participant was allotted a 5-min rest period before completing three additional one repetition sets with 40%, 60%, and 80% of their 1RM; 1-min rest periods were provided between these sets.

For the Sit up on the word of command "sit-up position ready," the participants assumed a supine position on the floor with their knees flexed at a 90-degree angle, the feet of the participants may be together or up to 12 inches (30.48 cm) apart measured between the feet, and the heel was the only part of the participant's foot that was in contact with the ground with the toes pointing upward. The legs were slightly abducted and the knees were supported by the research assistant. The participants fingers must be interlock behind their head, their elbows pointing forward and the back of their hands must touch the ground, while their arms and elbows need not touch the ground. At the blast of the whistle, the participants lifted their upper bodies forward to, or beyond the vertical position. After the participants have reached or surpassed the vertical position, the participants lowered their body until the bottom of their shoulder blades touched the ground to the starting position. The participants' heads, hands, arms or elbows do not have to touch the ground. Their fingers must remain interlaced behind their neck throughout the exercise and the participants should not rest between the sit-ups. The participants were expected to do as many sit-ups as they could within the stipulated time of one minute with a maximum of 70 per minute. At the end of each repetition, the research assistant stated the number of sit-ups the participant had correctly performed. All testing was completed according to the Nigerian Army norm for physical fitness evaluation (push up, pull up and sit up standard chart).

The descriptive statistics of mean and standard deviation were used to compute the demographic characteristics of the participants. Inferential statistics of repeated-measures analysis of variance (ANOVA) were used to evaluate the effects of the 12 weeks Basic Military training programmes on Muscular strength of recruits based on the data collected during training at an alpha-level of 0.05 to retain or reject the null hypothesis; the analyses were computed using the Statistical Package for Social Sciences SPSS version 23.0.

Presentation of results

Table 1: Descriptive Summary of the selected variables of the recruits after 4th, 8th, and 12th week of training (N=400)

Duration of training	**Variable**	**Male**		**Female**	
		Mean	**SD**	**Mean**	**SD**
Baseline	Age (years)	21.2	1.62	20.8	1.83
	HT (m)	1.7	0.07	1.7	0.12
	WT (kg)	63.9	41.56	58.7	6.41
	Muscular strength(min)	26.1	0.78	21.9	1.28
4th Week	Age (years)	21.2	1.62	20.8	1.83
	HT (m)	1.7	0.07	1.7	0.12
	WT (kg)	60.6	6.96	58.1	6.31
	Muscular strength(min)	36.1	0.33	27.1	8.52
8th week	Age (years)	21.2	1.62	20.8	1.83
	HT (m)	1.7	0.07	1.7	0.12
	WT (kg)	60.3	7.23	58.1	6.30
	Muscular strength(min)	46.0	0.44	32.2	0.83
12th week	Age (years)	21.2	1.62	20.8	1.83
	HT (m)	1.7	0.07	1.7	0.12
	WT (kg)	61.8	7.10	58.0	6.12
	Muscular strength(min)	49.3	1.94	39.7	0.93

HT= Height (m), WT = Weight (kg), Muscular strength (min)

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At the onset of the training, the minimum and maximum ages of the recruits were 18 and 26 years for both male and female participants respectively. The mean ages for the male was 21.2 years with a standard deviation of 1.62 years and the females' mean age was 20.8 with a standard deviation of 1.83years. The mean height for males and females were 1.7m and 1.7m respectively with standard deviations of 0.066m and 0.121m. The overall mean was 1.69m with a standard deviation of 0.101m. Their mean weights were 63.9±41.56kg and 58.7±6.41kg for the males and females respectively.

The table shows the mean levels of the fitness variables of muscular strength (measured by the average of the Pull-up, Sit-up and Push-up) on which the effects of the 12- weeks training were assessed. The observation after four weeks of training, as shown, revealed a major modification in the selected variables of the recruits. The mean weight reduced from 63.9 kg to 60.6 kg for the males, while females have their weight reduced from mean of 58.7 kg to 58.1 kg. For muscular strength, there was a major improvement in the muscular strength from 26.1 to 36.1 and from 21.9 to 27.1 for the male and female recruits respectively.

The modification observed on the variables after four weeks of training continued to improve at the 8th week as shown in Table 1. The mean weight reduced from 60.6 kg to 60.3 kg for the males while females maintained the 58.1 kg obtained at the 4th week of training. The improvement obtained in the muscular strength at the 4th week continued at the 8th week of the training. The mean obtained for the males was 46.0, an increase from 36.1 obtained at the 4th week for the males and 32.2 from 27.1 obtained for the female recruits.

The modification observed at the 12th week of training did not alter much for some of the variables. It revealed that the mean obtained for the males, in muscular strength, was 49.3, an increase from 46.0 obtained at the 8th week for the males and 39.7 from 32.2 obtained for the female recruits.

Ho1: There is no significant effect of BMT on muscular strength of male/female and trade/non-trade recruits at Depot Nigerian Army, Zaria.

Table 2: Repeated-measures Analysis of Variance on muscular strength of recruits after 12weeks of basic military training

Source		**Sum of Squares**	**Df**	**Mean Square**	**F**	**P-value**
Week	Sphericity Assumed	152017.983	3	50672.661	2614.326	.000

	Greenhouse-Geisser	152017.983	1.247	121925.224	2614.326	.000
	Huynh-Feldt	152017.983	1.255	121086.170	2614.326	.000
Error(week)	Sphericity Assumed	5465.918	282	19.383		
	Greenhouse-Geisser	5465.918	117.200	46.637		
	Huynh-Feldt	5465.918	118.013	46.316		
Sex	Sphericity Assumed	49343.769	1	49343.769	2502.901	.000
	Greenhouse-Geisser	49343.769	1.000	49343.769	2502.901	.000
	Huynh-Feldt	49343.769	1.000	49343.769	2502.901	.000
Error(sex)	Sphericity Assumed	1853.175	94	19.715		
	Greenhouse-Geisser	1853.175	94.000	19.715		
	Huynh-Feldt	1853.175	94.000	19.715		
Trade	Sphericity Assumed	17.138	1	17.138	.989	.323
	Greenhouse-Geisser	17.138	1.000	17.138	.989	.323
	Huynh-Feldt	17.138	1.000	17.138	.989	.323
Error(trade)	Sphericity Assumed	1629.631	94	17.336		
	Greenhouse-Geisser	1629.631	94.000	17.336		
	Huynh-Feldt	1629.631	94.000	17.336		
Week * sex	Sphericity Assumed	8314.257	3	2771.419	144.497	.000
	Greenhouse-Geisser	8314.257	1.218	6828.769	144.497	.000
	Huynh-Feldt	8314.257	1.225	6786.720	144.497	.000
Error(week*sex)	Sphericity Assumed	5408.699	282	19.180		
	Greenhouse-Geisser	5408.699	114.448	47.259		

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	Huynh-Feldt	5408.699	115.157	46.968		
Week * trade	Sphericity Assumed	56.420	3	18.807	1.020	.384
	Greenhouse-Geisser	56.420	1.123	50.238	1.020	.324
	Huynh-Feldt	56.420	1.127	50.054	1.020	.324
Error(week*trade)	Sphericity Assumed	5200.301	282	18.441		
	Greenhouse-Geisser	5200.301	105.567	49.261		
	Huynh-Feldt	5200.301	105.956	49.080		
Sex * trade	Sphericity Assumed	27.973	1	27.973	1.546	.217
	Greenhouse-Geisser	27.973	1.000	27.973	1.546	.217
	Huynh-Feldt	27.973	1.000	27.973	1.546	.217
Error(sex*trade)	Sphericity Assumed	1701.106	94	18.097		
	Greenhouse-Geisser	1701.106	94.000	18.097		
	Huynh-Feldt	1701.106	94.000	18.097		
Week * sex * trade	Sphericity Assumed	38.805	3	12.935	.715	.544
	Greenhouse-Geisser	38.805	1.135	34.192	.715	.417
	Huynh-Feldt	38.805	1.139	34.056	.715	.417
Error(week*sex*trade)	Sphericity Assumed	5104.556	282	18.101		
	Greenhouse-Geisser	5104.556	106.682	47.849		
	Huynh-Feldt	5104.556	107.110	47.657		

The variability in the muscular strength of the recruits differed significantly within the measured periods of training as revealed with an observed F-value of 2614.326 obtained at 3, 282 DF and at significant level of 0.000 ($P < 0.05$). The observed Greenhouse-Geisser and Huynh-Feldt correction for sphericity all collaborated the calculated F-value. The male and female recruits differed significantly, F-value =

2502.301 and p-value = 0.000 (P < 0.05) at 1, 94 DF. Looking at the mean, the male mean score is significantly higher than the female recruits over the training period. But those with trade did not differ significantly in their muscular strength from those who had non-trade, F-value = 0.989 and p-value = 323 (P > 0.05) at DF = 1,94. This means that on the basis of weeks of training and sex of recruits, the null hypothesis that there is no significant effect of BMT on muscular strength of male/female and trade/non-trade recruits at Depot Nigerian Army, Zaria was rejected. Table 3 shows summary of the mean separation test conducted using Scheffe Post hoc procedure for mean score by weeks of training.

Research Questions: Would basic military training improve the muscular strength of recruits at Depot Nigerian Army, Zaria?

Table 3: Summary of Scheffe Post-Hoc procedure on the mean muscular strength for the four training periods

(I) Week	(J) Week	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Week 1	Week 4	-7.635*	.336	.000	-8.296	-6.975
	Week 8	-15.210*	.254	.000	-15.710	-14.711
	Week 12	-20.446*	.172	0.000	-20.784	-20.108
Week 4	Week 1	7.635*	.336	.000	6.975	8.296
	Week 8	-7.575*	.331	.000	-8.226	-6.924
	Week 12	-12.811*	.317	.000	-13.434	-12.187
Week 8	Week 1	15.210*	.254	.000	14.711	15.710
	Week 4	7.575*	.331	.000	6.924	8.226
	Week 12	-5.236*	.149	.000	-5.530	-4.942
Week 12	Week 1	20.446*	.172	0.000	20.108	20.784
	Week 4	12.811*	.317	.000	12.187	13.434
	Week 8	5.236*	.149	.000	4.942	5.530

*. Mean difference is significant at the 0.05 level

The Table reveals that measured muscular strength of the recruits' improvement differed significantly between the different periods of the training at which measurement was taken. Thus improvement in muscular strength at the onset of the training was significantly lower than was obtained at the 4th week of training (P < 0.05). The mean muscular strength at the 8th week of training was significantly higher than that obtained at the 4th week and the observation at the 12thweek was significantly

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different from that obtained at the 8th week ($P < 0.05$). The observation here implies that basic military training had significant improvement on the level of muscular strength of the recruits at the Depot in relation to the associated research question which sought to determine whether basic military training will improve the muscular strength of recruits at Depot Nigerian Army, Zaria.

Discussion of the findings

The effects of the training on the muscular strength were found to be significant, and the muscular strength of the recruits significantly improved from the 4th week of the training. The training was found to have a progressive and significant improvement on the muscular strength of the recruits. The effect on the muscular strength was found to be more significant among male than was obtained among female recruits. But trade orientation, whether recruit had a trade or not did not significantly affect the impact of the training on the recruits' muscular strength. The finding here agrees with Heyward (2014) and Vogel, Crowdy, Amor, and Worsley (2014), who found that basic military training showed significant improvements in performance and physiological parameters when the frequency, duration and intensity of the training are held constant and are prescribed in accordance with sound military principles. The finding is in line with Shannon, Larrell, Lisa, Alexandra and Shawn (2015), who stated that basic military training is uniquely stressful for young recruit soldiers, most of whom are beginning the transition to adulthood, and is a standard mechanism for the recruitment of military personnel on a global scale.

Conclusion

It has been proven in the studies that maintaining high levels of muscle strength is important to a variety of populations. The need to maximize strength is also of particular importance for many combat men/women, as the capacity to produce near maximal forces is often required in sprint and promotion of endurance to carry military equipment for tactical operations.

Recommendations

Based on findings from the study, the study therefore recommends the following:

1. Physical training exercise is important for maintenance of good health and a healthy body weight for recruits for discharging their duties during tactical missions. It is recommended that recruits should engage in strength or resistance training two to three times per week, to build strong muscles to stand taller, carry artillery, burn more calories, and improve the quality of their daily combat task during missions and battlefield operations.
2. Recruits should be trained from moderate high intensity two or more days of the week for developing muscular strengths to build strong, healthier muscles, burn

calories and bones. This will help develop good posture and relieve back pain of recruits during missions and combat task.

3. Trainers and instructors at the Depot could train recruits on different muscular strengths training exercises and programmes to strengthen tendons, ligaments and bones. This prevents the recruits from injury, improve balance and stability during their tactical mission.

4. Recruits during military training exercise should be encouraged to engage in muscular strength training to reduce sedentary lifestyle, in prevention of major disease such as type II diabetes, heart diseases, and improve health.

5. Muscular strength programmes for military recruits should be revised in accordance with the American College of Sports Medicine (ACSM) training procedures, and CrossFit military fitness programmes and Army Combat Readiness test programmes for optimal performance of soldiers to address multiple fitness domains, potentially providing improved physical and mental readiness in a changing operational environment.

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