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EFFECT OF RESISTANCE TRAINING ON FLEXIBILITY OF MALE TAEKWONDO ATHLETES OF THE NIGERIAN ARMY

[1]Akpah Adakole John, [2]J.A. Gwani, [3]S. U. Omeiza, [4]S.Y.Musa, [5]AR. Bello, [6]S.H.Hussaini
Department of Human Kinetics and Health Education, Ahmadu Bello University Zaria
Corresponding Author's Email: budokatana@gmail.com

Abstract
The purpose of this study was to assess the effect of resistance training on the flexibility of male taekwondo athletes of the Nigerian Army. To achieve the purpose of the study a research question and null hypothesis were formulated. A repeated measures experimental research design was used for the study. A multistage sampling technique of purposive, stratified and simple random sampling was used to select 20 male taekwondo athletes, between the ages of 18 to 24 and have competed in the national championship as sample size for the study. The training intensity was maintained between 70% to 90% of one repetition maximum (1RM) on the selected biomotor ability variable of fitness. The training programme had three sessions of moderate to high intensity resistance training per week for a duration of 12 weeks. includes Resistance machine, Holtain Stadiometer, whistle (fox-40) model, electronic stop watch and a calibrated and adjustable sit and reach box for measuring the flexibility of participants was used as instruments for the study. participants trained at 70% of 1RM from baseline to 4th week, at 80% of 1RM from 4th week to 8th week and at 90% of 1RM from 8th week to 12th week. The selected biomotor ability variable was assessed at baseline, at the end of 4th, 8th, and 12th weeks of training period. The variable measured was flexibility. Descriptive statistics of mean, standard deviation and standard error was used to answer the research question, while repeated measures analysis of variance was used to test the null hypothesis formulated at 0.05 level of significant. Findings of the study revealed significant effect of resistance training on flexibility ($p = < 0.001$) of male taekwondo athletes of the Nigerian Army; therefore, the null hypothesis was rejected. Bonferroni Post hoc Test further revealed that the significant effect of the resistance training on the selected variables manifested at the end of 4th, 8th, and 12th weeks of training. On the basis of these findings it was concluded that resistance training significantly improved the flexibility of male taekwondo athletes of the Nigerian Army. On the basis of these conclusions, it is recommended that the Nigerian Army taekwondo coaches and athletes should ensure that resistance training between 70-90% of 1 RM and periodic biomotor abilities evaluation should be integrated into their comprehensive fitness training regimen in order to enhance Nigerian Army male taekwondo athletes' flexibility for performance proficiency in training and competitions.

Keywords: *Biomotor Ability, Flexibility, Taekwondo*

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INTRODUCTION

Taekwondo is a Korean martial art which has been in existence for over 2000 years. Literally, it means the path or ways of fist and foot. It is a multidimensional science and art of kicking and punching with emphasis on discipline (Zhao, Hohmann, Chang, Zhang, Pion, & Gao, 2019). It is also a dynamic form of unarmed self-defence that incorporates wide varieties of techniques for the purpose of attack and counter attack. The distinctive characteristics and attributes of this noble martial art of taekwondo, coupled with its emphasis on explosive and dynamic kicking and striking techniques, differentiate it from other martial arts and combat event (Tornello, Capranica, Minganti, Chiodo, Condello, & Tessitore, 2014). Taekwondo has transcended scientifically into a unique and universally recognised combat sport. Thus, making it one of the most widely practised martial art globally, with over 70 million participants in 180 nations of the world (Zhao *et al.*, 2019). This noble martial art of taekwondo was

formally recognised as a scoring Olympic combat sport during the Sidney 2000 Olympic Games (Ryan Chong, 2018).

Technical and tactical skills in competitive taekwondo integrate wide range of attack, counterattack, and defensive system of foot and fist techniques, coupled with foot work manoeuvring. These techniques are usually performed intermittently with high intensity, requiring speed, agility and explosive power (Bridge, Ferreira da Silva Santos, Chaabene, Pieter, & Franchini, 2014). Therefore, it is essential to develop and enhance these performance indicators in Taekwondo athletes for performance proficiency (Ferreira da Silva Santos, Herrera-Valenzuela, & Franchini, 2019).

Flexibility is an essential biomotor ability required for performance optimization in taekwondo training and competitions. Flexibility is the functional ability of a joint to perform series of action through a wide range of motion with ease and suppleness (Paramitha, Rosadi, Ramadhan, & Suwanta, 2020). It is also viewed as mobility characterized by the ability of the joint to move through their intended range of motion with ease, without tearing of the surrounding connective tissues of the joint region (Mikhailovich, 2020). Flexibility in the combat sport of Taekwondo describes the Taekwondo athlete's ability to perform series of wide range of simple and complex varieties of techniques with ease and suppleness, without injury and discomfort (Rahmani-Nia, 2020). These techniques can either be in a kick, punch or strike form to a definite target of designated height and distance with sufficient force and speed without losing balance (DeMarco, 2017).

One of the most common causes of poor execution of techniques and overall performance decline of Taekwondo athletes in training and completion is due to poor or restricted flexibility (Chen, Chiu, Hsu, Wang, Chou, Tsai, Lin, & Chen, 2021). Restricted flexibility of Taekwondo athletes further deters the efficiency of other performance indices, such as endurance capacity and speed work. This is because the muscular system has to exert sufficient force to overcome a given resistance to produce an efficient stride length (Zemková & Hamar, 2018). Thus, it is essential to develop, improve and sustain flexibility of Taekwondo athletes with an ideal and science-based training protocols, such as resistance and plyometric programmes (Rahmani-Nia, 2020).

Resistance training, also known as strength training or weight training, is a form of physical exercise that involves exerting muscles against an external resistance (Suresh & Kavithashri, 2021). Thus, resistance training is a potent modality for enhancing the biomotor abilities of athletes. RT encompasses a variety of exercises that target specific muscle groups by working against some form of resistance. RT can be perform using free weights (dumbbells, barbells), resistance bands, body weight, or machines (Ratamess, 2021). The primary objective RT is to increase muscle strength, endurance, size (hypertrophy), which forms the base for the enhancement of other performance variables such as agility, speed, flexibility and cardiorespiratory fitness (Nakamura & Ikezu, 2021).

The primary mechanisms through which resistance training enhances biomotor abilities include muscle hypertrophy, neural adaptations, increased neuromuscular efficiency, and improved metabolic and cardiovascular function (Suresh & Kavithashri, 2021). Through a combination of hypertrophic, neural, and metabolic adaptations, it improves strength, power, speed, endurance, flexibility, and coordination. These adaptations collectively contribute to enhanced performance across various domains of athleticism (Ratamess, 2021). For athletes, incorporating a well-structured resistance training programme tailored to their sport-specific demands can yield significant improvements in performance (Page & Ellenbecker, 2019). Thus, coaches and trainers should design programmes that balance strength, power, endurance, flexibility, and coordination to maximize athletic potential.

Research findings and literature have shown that resistance training is one of the most effective and efficient training methods used in the development of bio-motor abilities of athletes for performance proficiency especially in combat sports (Manikandan, 2014). In view of this, most sports scientists, Taekwondo coaches, trainers and athletes of most advanced nations explore and adopt this method of training (Lim, Moon, Kang, & Yang, 2016; Omidbakhsh, Fathi, & Hejazi, 2020). Therefore, the foregoing kindled the motivation of the researcher to embark on the study on the effect of resistance training (RT) on selected bio-motor abilities of male Taekwondo athletes of the Nigerian Army with a view to making valid recommendations.

STATEMENT OF THE PROBLEM

The Nigerian Army sports' policies and objectives are to ensure performance proficiency of Nigerian Army Taekwondo athletes in national championships, through the utilization of ideal and effective training method. Despite this policies and objectives, the performance profile of the Nigerian Army male Taekwondo athletes in national championship in recent times is fast declining, as reflected on their position and ranking on the national medal table from 2018 – 2023 (Nigerian Taekwondo Federation, 2023). This poses a subject of concern to the Nigerian Army Taekwondo coaches, trainers and athletes. Efforts to enhance their performance are often centred on an orthodox method of training at the detriment of other ideal method of training, such as resistance.

Suffice to mention that the researcher observed that the performance declination of the Nigerian Army male Taekwondo athletes in national championship may to a large extent be due to the team's low level of biomotor abilities development, particularly flexibility. These is evident in their inability to score valid points on their opponent's electronic protector above the required scoring threshold as a result of poor flexibility level to reach the targeted scoring area of an opponent with ease and maximum impact during a match. The researcher further observed that this negative performance of the team may be due to the conservative and orthodox methods of training applied by the Nigerian Army coaches and trainers in training their athletes as against paradigm shift in training method. This trend, if not check may lead to continuous performance decline of male Taekwondo athletes of the Nigerian Army, which will in turn adversely affect the team's chances of winning national medals. Thus, truncating the team's opportunity of being selected into the national team to represent the Nation in continental and international tournaments such as All African games, Olympic Games, World Military games and World Taekwondo Championships.

PURPOSE OF THE STUDY

The main purpose of this study was to assess the effect of resistance training on the flexibility of male Taekwondo athletes of the Nigerian Army.

RESEARCH QUESTION

In line with the research focus, the study was conducted to answer the research question:

1. Would RT enhance the flexibility of male Taekwondo athletes of the Nigerian Army?

HYPOTHESIS

In line with the purpose of the study and the research question, a major hypothesis was formulated to guide the conduct of this research.

1. There is no significant effect of RT on the flexibility of male Taekwondo athletes of the Nigerian Army.

Methods and Materials

Repeated-measures experimental research design was adopted for the purpose of this study. In this design, the same participants were assessed repeatedly on the independent variable (Cohen, Manion, & Morrison, 2007). Data was obtained using RT among Nigerian Army male Taekwondo athletes at the baseline, at the 4^{th}, 8^{th} and 12^{th} week of training. The selected biomotor abilities variables of flexibility was assessed in the Army School of Physical Training (ASPT) Gymnasium, Chindit Cantonment, Zaria.

Twenty (20) male taekwondo athletes of the Nigerian Army were drawn from the total population (33) of all the male taekwondo athletes of the Nigerian Army; and served as participants for the study. A multistage sampling technique of purposive, stratified and simple random sampling were used to select the participants. The twenty (20) male taekwondo athletes of the Nigerian Army sampled for the study comprised all the eight weight categories in taekwondo competitions (fin, fly, bantam, feather, light, welter, middle and heavy weight). The twenty (20) participants successfully completed the 12 weeks' resistance training programme. The participants were assessed at the base-line, at 4^{th}, 8^{th} and 12^{th} week of resistance training on flexibility. The instruments used for data collection included: Resistance machine, holtain stadiometer, whistle (fox-40) model, electronic stop watch and a calibrated and

adjustable sit and reach box was used for measuring the flexibility of participants. The procedures for data collection were based on the guidelines and recommendations of ACSM (2020). The statistical techniques used in analysing the collected data for this study were the descriptive statistics (means and standard deviation) and inferential statistics of repeated-measures analysis of variance (ANOVA) and Bonferroni's post hoc test. An alpha-level of 0.05 was used to accept or reject the null hypothesis.

Training Protocol

Resistance training (RT) is an ideal and effective structured method of training, which utilizes weights as resistance to generate muscular contraction force necessary in the development of explosive power (Nunes, Grgic, Cunha, Ribeiro, Schoenfeld, de Salles, & Cyrino, 2021).

The résistance programme design for this study was made up of selected resistance drills utilizing American Multi Fitness Ergo Gym Resistance Machine (2020 Model AF). The resistance exercises designed for this study placed emphasis on the upper extremities of the body, lower extremities of the body and the trunk region of the body. The training protocols was designed in such a way that the upper extremities of the body are alternating with the lower extremities of the body during the exercise. That is while the arms and shoulder are engage in exercise, the legs are recovering from previous exercise. The American Multi Fitness Ergo Gym Resistance Machine (2020 Model AF) has variable resistance weight, which was easily set and reset by manipulating the resistance machine selector pin to set the desired resistance weight needed.

Prior to the commencement of the RT programme, participants were required to perform a warm-up exercises for 10 minutes. The warm-up exercise was comprised of the following;

a. General warm-up: The general warm-up was designed to tune the body physiological parameters above resting level by educating the tissues, organs, and systems of the participant's body to get set for physical exertion. The participants were required to undergo general warm-up for 5 minutes, consisting of light jogging, cycling on cycle ergometer, squat thrust and jumping jacks.
b. Specific warm-up: The specific warm-up was designed to sensitize and tune up participants' physiological variables required for specific taekwondo training, these includes static and dynamic stretching exercises. The participants were required to perform these stretching exercises for 5 minutes. These exercises included; arms, shoulders, biceps, trunk, hamstring muscles, calf muscles, upper and lower legs. this was to avoid discomfort and injury during the main RT programme.
c. Cool down exercises: The cool down exercises was designed to return the body physiological parameters to resting state after vigorous activities of the resistance training programme. The cool down exercises was for 5 minutes, which will comprise brisk walking to prevent blood pulling in the legs, light stretching and breathing exercise (in and out). The aforementioned protocols were observed strictly prior to the commencement of each training phase and after each training session, throughout the duration of the resistance training programme.

Participants also performed dynamic resistance exercises of different variations, which was arranged in in a circuit formation for easy rotation of the resistance activities, with each exercise representing a station. The American Multi Fitness Ergo Gym Machine (2020 Model AF) Resistance machine has a total of six stations. Each of the stations consisted of a specific resistance exercise aimed at developing and enhancing the explosive power of the participants. The resistance exercise used in this study included; the leg/knee extension, leg press, leg curl, hand dip, lateral pull and abdominal curl.

The RT programme was designed and structured to last for a duration of 12 weeks, with the training session structured into three phases. Each phase was designed to last for the period of four weeks. Thus, the phases of the resistance training programme were organised sequentially in the following order; first phase was week 1 to week 4, second phase was week 5 to week 8, and the third phase was week 9 to week 12 respectively in that sequence.

The resistance training session was structured to elapse for one hour (60 minutes) and the training session was on alternate days excluding Saturdays and Sundays to avoid fatigue and enable recovery of the participants. Thus, the training session was Monday, Wednesday, and Friday per week for twelve weeks (3 months).

The RT programme was conducted in the Directorate of Army Physical Training Fitness and High Performance Gymnasium Chindit Cantonment, Zaria, Kaduna State. The training took place in the morning between the hours of 7.30 and 8.30 a.m. in the following phases:

1. First Phase: This was the initial training session which was scheduled to last for 4 weeks. The RT intensity was 70% 1-RM of 15 repetitions of 3 sets with an interval of rest between each set $1^{1/2}$ minutes.
2. Second Phase: The second phase which also lasted for 4 weeks. In this phase, the resistance training intensity was 80% 1- RM of 15 repetitions of 3 sets with a rest interval of 2 -3 minutes between each set.
3. Third Phase: This was the last phase of the training session, which also lasted for 4 weeks. The resistance training intensity increased to 90% of 1-RM of 15 repetitions of 3 sets with 2-3 minutes' interval of rest between each set.

The main objective of the 12 weeks' resistance training programme was for the development of flexibility of male Taekwondo Athletes of the Nigerian Army. Thus, after the completion of each phase of training, biomotor ability test and evaluation of the participant's flexibility was conducted using sit and reach test for flexibility and the result obtained was recorded. All the training sessions in the gymnasium was strictly supervised and monitored by the researcher, two research assistants and the gymnasium technical assistants, they guided, motivated and encouraged participants to be actively involved in the training programme.

The resistance training was performed on 6 different exercise stations of resistance machines: hand dip, lateral pull, leg press, leg curls, abdominal curl and leg extensions, which are to be completed within 60 minutes. Using resistance machines was safer and easy because machines have variable resistance, which require less time to set by quickly using s selector pin to change resistance.

Static stretching exercises for the muscle groups such as triceps stretch, quadriceps stretch, side stretch, body rotation, knee-to-chest stretch, and back extension stretch were performed during rest intervals of 2 minutes between exercise stations, before and after each session. Each training session began with a 10-min warm-up and ended with another 5-min cool-down using cycle ergometer with very light resistance by completing a set of 5-10 repetitions of the exercises at a very low intensity of between 10% and 20% of IRM.

Six (6) resistance exercise stations were performed engaging muscle groups, with a focus on strengthening the upper-and lower-body muscles that are relevant for developing and enhancing the flexibility of Taekwondo athletes. The training was structured according to recommendations of the American College of Sports Medicine and consisting of six stations resistance exercises for each major muscle groups of the upper and lower limbs, such as the chest, back, biceps, triceps, lower back, gluteus, quadriceps and hamstrings. Each exercise was performed by active participation (without assistance) of three sets with a minimal interval of 60 seconds between sets and at least 120 seconds between exercise stations. The RT programme was structured based on current recommendations on the practice of RT for athletes (Garber *et al*., 2011, ACSM, 2020). The intensity for the training was determined by selecting a load equating to 70%, 80% and 90% of 1RM progressively after every four weeks. The intensity was determined by calculating the percentage of one repetition maximum (% 1RM) as follows: the moderate-high intensity of 3 sets, 15 reps at 70% of 1RM max for the first 4 weeks, 3 sets of 15 repetitions at 80% of 1RM in the second 4 weeks and 3 sets of 15 reps at 90% of 1RM for the last 4 weeks of the training (ACSM, 2020; Diogo, Henrique, and Mario, 2020).

As training progresses, resistance or load were gradually increased after every four weeks of training. These increments was within the range recommended by the ACSM in their relevant position stand on progression models in RT that have been used without adverse effects in similar studies with athletes (Davies, Tran, Hogan, Haff, & Latella, 2021). The incremental load increase was first started with number of repetitions (15), then followed by 10% of RM increase after every 4 weeks so that the initial training intensity was preserved throughout the 12-week training. The participants performed a total of 3 sets of 15 repetitions each at every exercise station, with a load corresponding to 70% of 1RM in the first 4 weeks of training. Then, the load was

increased to 3 sets of 15 repetitions at 80% of 1RM for another 4 weeks and 90% of 1RM for the last 4 weeks, respectively.

The participants push or pull the same relative loads and complete the same amount of work progressively and was tested at different points (at base-line, at the end of 4th, 8th and 12th week) of resistance training for comparison. The moderate-high intensity RT programme followed the principles of specificity, individualization, adaptation and progression (Haff & Triplett, 2016; Fragala *et al*., 2019; ACSM, 2020). The resistance training exercise was arranged in an alternating order, working on the upper-body and lower body muscles such that while leg muscles were recovering the arms muscles will be working. The sequence of the exercises was arranged in such a way that no two consecutive exercise involving same muscle groups follow each other i.e. alternating exercise for arms, legs and between flexor and extensor muscle groups. The training also ensured muscular balance; that is, training of large muscle or multi-joints exercises first and synergist or single-joint exercise last. For example, leg press was followed by leg curls or leg extension and abdominal curl followed by biceps curls or hand dips. During the execution of movements, participants were instructed to breathe in during the eccentric phase using execution movement speed of a ratio 1:2 concentric/eccentric phases, respectively.

Data obtained from the study was analysed using descriptive statistics of mean, standard deviation and standard error and inferential statistics using repeated-measures analysis of variance. This was because the same group of participants were measured at four points over time (at base-line, at the end of 4th, 8th and 12th) of training phases respectively. An appropriate test of Bonferroni post hoc was used to further determined where the difference in the training effect was located. All analyses were performed using the statistical package for social sciences (SPSS) version 23. The decision to retain or reject the null hypothesis formulated for the study was be made at an alpha-level of $P < 0.05$ and the results are presented and discuss below

Results and Discussions.

The results are presented according to the research questions and null hypotheses formulated. Descriptive statistics on the physical characteristics of participants age (years), weight (kg), height (m) and body mass index (kg/m^2) is presented in Table 1.

Table 1: Physical Characteristics of Male Taekwondo Athletes of the Nigerian Army

Variable	N	Mean	SD	SEM
Age (years)	20	20.45	1.19	0.26
Weight (kg)	20	79.10	8.95	2.00
Height (m)	20	1.84	0.04	0.01
BMI (kg/m^2)	20	23.25	2.46	0.55

Note: SD = Standard deviation, SE = Standard Error, BMI = Body Mass Index

Source: Test conducted in 2023 by the researcher

Table 1 showed the descriptive analysis of the physical characteristics of the participants used in this study. The mean age and corresponding standard deviation of the participants was 20.45±1.19 years, while the mean weight (kg), height (m), and BMI (kg/m^2) of the participants were 79.10±8.95kg, 1.84 ± 0.04 m, and 23.25 ± 2.46 (kg/m^2) respectively. The observation of the BMI classification revealed that the participants were within normal (23.25 kg/m^2) range.

Answers to Research Question and Tests of Hypothesis

To answer and test each research question and null hypothesis, the data collected on flexibility was analysed and presented using descriptive and inferential statistics accordingly.

Table 2: Descriptive Analysis of the Effect of Resistance Training on Flexibility (cm) of Male Taekwondo Athletes of the Nigerian Army over the Period of Training

Variable	Test Period	N	Mean	SD	SEM
Flexibility	Baseline	20	19.78	1.23	.2762

Variable	Test Period	N	Mean	SD	SEM
	Week 4	20	22.01	1.19	.2666
	Week 8	20	24.45	1.18	.2649
	Week 12	20	26.91	1.46	.3275

Table 2 shows the result of the descriptive analysis of the data collected on the effect of resistance training on the flexibility of male Taekwondo athletes of the Nigerian Army at base-line, at the end of 4th, 8th and 12th weeks of resistance training. Flexibility of the participants was assessed with sit and reach test (cm) at base-line, at the end of 4th, 8th and 12th weeks of resistance training.

The results revealed the performance of the participants on flexibility with sit and reach test at base-line, at the end of 4th, 8th and 12th week of resistance training. The mean and standard deviations of the scores of the participants increased from 19.78 ± 1.23 to 22.01 ± 1.19 cm at the 4th week of resistance training. The results further revealed that at 8th and 12th week of resistance training, the performance of the participants also improved to 24.45 ± 1.18 and 26.91 ± 1.46 cm progressively. The overall performance of the participants improved with progressive increase in the distance reached (cm) in sit and reach test for flexibility at the end of 4, 8 and 12 weeks of resistance training, which answered the research question six (6).

In order to test whether the progressive increase in mean flexibility of the participants at the end every four weeks of resistance training was statistically significant, the collected data were analysed using repeated-measures analysis of variance. The results are presented in Table 3 according to the Specific-hypothesis.

Specific-Hypothesis

There is no significant effect of RT on the flexibility of Male Taekwondo Athletes of the Nigerian Army.

Table 3: Repeated Measures Analysis of Variance on the Effect of Resistance Training on Flexibility of Male Taekwondo Athletes of the Nigerian Army

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Flexibility	Sphericity Assumed	568.673	3	189.558	924.551	< 0.001
	Greenhouse-Geisser	568.673	1.516	375.172	924.551	< 0.001
	Huynh-Feldt	568.673	1.619	351.146	924.551	< 0.001
	Lower-bound	568.673	1.000	568.673	924.551	< 0.001
Error(flexibility)	Sphericity Assumed	11.687	57	.205		
	Greenhouse-Geisser	11.687	28.800	.406		
	Huynh-Feldt	11.687	30.770	.380		
	Lower-bound	11.687	19.000	.615		

SPSS data analysis output (p = < 0.001)

Table 20 shows the results of repeated-measures analysis of variance on flexibility of the participants. The results showed that resistance training caused significantly improved the flexibility of the male Taekwondo athletes of the Nigerian Army at 4th, 8th and 12th weeks of resistance training, respectively, with a progressive increase in the distance reached during the sit and reach test for flexibility (p = < 0.001). Therefore, the null hypothesis which states that there is no significant effect of RT on the flexibility of male Taekwondo athletes of the Nigerian Army was rejected. In

order to identify where the significant effect of the resistance training on flexibility occurred, the Bonferroni post-hoc test was carried out and the result of the analysis is presented in Table 4:

Table 4: Summary of Bonferroni Post hoc Test Results for Differences in the Effect of Resistance Training on the Flexibility of Male Taekwondo Athletes of the Nigerian Army

(I) flexibility	(J) flexibility	Mean Difference (I-J)	Std. Error	Sig.[b]
Baseline	Week 4	-2.229*	.075	< 0.001
	Week 8	-4.673*	.135	< 0.001
	Week 12	-7.132*	.196	< 0.001
Week 4	Baseline	2.229*	.075	< 0.001
	Week 8	-2.444*	.113	< 0.001
	Week 12	-4.903*	.186	< 0.001
Week 8	Baseline	4.673*	.135	< 0.001
	Week 4	2.444*	.113	< 0.001
	Week 12	-2.459*	.115	< 0.001
Week 12	Baseline	7.132*	.196	< 0.001
	Week 4	4.903*	.186	< 0.001
	Week 8	2.459*	.115	< 0.001

**SPSS data output. ***The mean difference is significant at the 0.05 level

The Bonferroni post-hoc test analysis on the effect of resistance training on flexibility of participants in Table 4 above revealed significant (p = < 0.001) progressive increase in the flexibility of participants, with increase in the difference between the means obtained in the sit and reach test for flexibility of -2.229*, -2.444* and -2.459* between the base-line and 4th week, 4th and 8th week, 8th and 12th week, respectively. There was a significant increase in the sit and reach test for flexibility of the participants at the end of every 4 weeks of resistance training. This increase in the distance reached in cm during the sit and reach test was an indication of improved flexibility of participants. The highest increased effect was recorded between 8th and 12th week (-2.459*). Therefore, the null hypothesis was rejected.

DISCUSSION OF FINDINGS

The purpose of this study was to assess the effect of resistance training on the flexibility of male taekwondo athletes of the Nigerian Army. The results of hypotheses formulated and tested indicate that there was significant effect of resistance training on the flexibility of male taekwondo athletes of the Nigerian Army after 12 weeks of resistance training.

The results of the analysis in the present study revealed that resistance training significantly enhanced the explosive power abilities of male taekwondo athletes of the Nigerian Army at the end of 4th, 8th and 12th weeks of training (P = < 0.001). There was a progressive significant increase in the sit and reach test for flexibility of the participants however, the highest significant increase was recorded between the 8th and 12th weeks of resistance training. The significant improvement in the flexibility of the participants resulting from resistance training may be attributed to an increase in muscle length, muscle elasticity and function of connective tissues surrounding the joint region along the range of motion (Saghiv *et al.*, 2020). Resistance training has shown to lengthen muscle fibres by causing small amounts of microtrauma to the muscle tissue. This microtrauma stimulates the body's muscle repair mechanisms, which may result in longer and more flexible muscle fibres (Saghiv *et al.*, 2020).

Also in a study conducted on the effect of resistance training on flexibility by Rahman and Islam (2020), it was observed that the effect of resistance training on flexibility was also attributed to improvement in the elasticity of muscle and connective tissues surrounding (ligaments and tendons). In particular, muscle and fascia which are responsible for 41 % of joints resistance to movement, thereby mediate reduction in passive tension and stiffness of these tissues translating it into a wide range of motion. They also stressed that resistance training increases the production of collagen and other connective tissue components, making them more resilient and less prone to injury. This improved elasticity can translate to improved flexibility, particularly in the muscles and connective tissues that are frequently used during athletic activities in combat sports like Taekwondo.

Saraiva *et al.* (2014), observed that resistance training improve an athlete's joint range of motion. This was particularly true for resistance exercises that require a full range of motion such as squats, lunges, and deadlifts. By performing these exercises through a full range of motion, Taekwondo athletes can improve their joint mobility and flexibility. The finding of this study was in line with the study of Solissa (2020), who conducted a study to determine the effect of circuit resistance training methods and interval training methods on the ability of the Taekwondo Round-House kick in terms of flexibility. The results obtained from the study were similar to those of the present study that a significant improvement occurred in the flexibility ability of Taekwondo athletes round-house kick in the circuit resistance training method, when the base-line and the post measurements were compared.

CONCLUSION

Based on the findings of this study, the researcher concluded that Resistance training at 70-90% of 1 RM exerted significant effect on the flexibility of male taekwondo athletes of the Nigerian Army.

RECOMMENDATION

On basis of the research conclusion, the researcher recommended that the Nigerian Army taekwondo coaches and athletes should ensure that resistance training between 70-90% of 1 RM and periodic biomotor abilities evaluation should be integrated into their comprehensive fitness training regimen in order to enhance the Nigerian Army male taekwondo athletes' flexibility for performance proficiency in training and competitions.

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