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Effects of Single and Multiple Training Programmes on Flexibility: A Physiological Variable of Male Physical and Health Education Students of Federal College of Education, Zuba

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Abstract
This research was conducted to determine the effects of single and multiple training sessions on flexibility as a physiological variable of male adolescents. Data was collected from 60 randomly selected students of Federal College of Education, Zuba – FCT. Pre-training values of flexibility were determined. After 12 weeks of interval training, single and multiple, 3 times a week, 30 minutes per session the variable were applied to be compared. Two tail t-test and ANOVA procedures were applied on the collected data. The result of the t-test showed that there is no significant differences between single and multiple training groups on flexibility. However, both single and multiple training were discovered to have significant effects on the selected body parameters of the subjects. The post training scores were significantly different from the pre-training scores. From the finding of this study, it was concluded that training single or multiple session per day with the same intensity of work load produced similar training effects among adolescents.
Keywords: flexibility, single, multiple, training, physiological

Introduction

Training is a necessity to keep fit. Training has been, and will remain the means of improving skills, attitudes, character and performance. This is signified by the popular saying that "practice makes perfect". This further implies that training of any kind influences performance or the exhibition of qualities of interest. Hence, training is employed in all fields of human endeavour (sports inclusive) to improve performance (Olalere & Adesoji, 2013).

Training takes place for the purpose of increasing general fitness for improved performance capacity and for preventive and therapeutic purposes. The preventive and therapeutic effectiveness of training in form of regular exercise depends on stimulus intensity which is determined by frequency and duration of the activity. Stimulus intensity, however, cannot be specified in absolute terms because its effects depend upon the tolerance of the individual (Glazewski & Barth, 2015). According to Masiron and Denolin (1985), regular physical activity affects the human body in a variety of ways; the total effects being an increase in physical performance capacity. The duration of training session is determined by training intensity. The higher the training intensity, the shorter the individual's training session. A minimum duration has been set at 20 minutes (Masironi & Denolin, 1985). This is the time considered necessary to bring aerobic functional adaptation of the organs involved (Atakan *et al.,* 2021).

According to Thyagaraju and Venkateswarlu (2014), training methods most often used include continuous, interval, circuit and weight training. There are many methods for training athletes but Fartlek, interval training, circuit training and weight training seem to be the methods most widely used. Adequate physical fitness should be an aspiration of all, because of its immense contributions to a healthy life. Physical fitness is very important to all and sundry for good health and maximum efficiency, as the American College of Sports Medicine (ACSM) (2014) affirms that fitness means different things to different people, organizations and medical personnel. Ogunleye and Ojo (2019) asserted that physical fitness activities do not only contribute to a healthy life but also the mental capacity and development among secondary school students. It must be seen as an individual matter and such has little meaning unless considered in relation to the specific needs and interests of each individual (Roy *et al.,* 2020). More so, it is desirable for students to engage in an exercise, especially involving themselves in performing physical performance variable such as single and multiple training on flexibility (Mekari *et al.,* 2020).

Exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness (Kylasov & Gavrov, 2011). It is performed for various reasons including to aid growth and improve strength, prevent aging, develop muscles and the cardiovascular system, hone athletic skills, weight loss or maintenance, improve health, or simply for enjoyment. Many individuals choose to exercise outdoors where they can congregate in groups, socialize, and improve well-being as well as mental health (Bergstrom *et al.,* 2016; Offiong *et al.,* 2019).

Physical performance variables refer to those components of fitness that are related to muscular strength, muscular power and flexibility. Physical fitness is positively related to health status across the life span and to functional ability in all populations. Fitness abilities in adolescents are very paramount as it reflects in the process of carrying out daily activities carried out both by conscious and unconscious use of resources in the environment (Ogunleye & Ojo, 2019). Strength and flexibility in the right combinations contribute immensely to individual's activities of daily living, comfortably and safely. According to Dahab and McCambridge (2009), children can improve strength by 30% to 50% after just 8 to 12 weeks of a well-designed strength training programme.

Flexibility is one of the physical performance variables (WHO, 2020). Flexibility is the ability of a joint to maneuver freely through an entire variety of ways. Flexibility varies between people, significantly in terms of variations in muscle length of multi-joint muscles. Flexibility in some joints is exaggerated to a definite degree by exercise, with stretching as a typical exercise element to take care of or improve flexibility. Flexibility measures area unit valid just for a selected joint. American College of Sports Medicine (ACSM) (2014) stated that sit-and-reach check has been used extensively to assess low back and hamstring flexibility and norms are established for each men and girls. Improving and maintaining an honest varies of motion within the joints enhances quality of life. One amongst the predisposing factors for physical issues like pain syndromes or balance disorders is poor flexibility. Individual body flexibility level is measured and calculated by performing sit and reach check, the results are outlined as personal flexibility score (Bartolomeil *et al.,* 2016). Blakey (1994) affirmed that flexibility is improved by stretching. Stretching ought to solely be started once muscles area unit heat and also the blood heat is raised. Barratt (2010) declared that increasing vary of motion creates smart posture and develops adept performance in everyday activities, increasing the length of life and overall health of the individual.

Flexibility is the range of motion around a joint. Good flexibility in the joints can help prevent injuries through all stages of life. If one wants to improve flexibility, one should try yoga, gymnastics and basic stretching exercise programme (Cao *et al.,* 2019). Venkateswarlu (2011) maintained that flexibility may be defined as the ability to move the body and its part through as wide range of motion as possible without undue strain to the articulation and muscle attachments. Flexibility measurements include flexibility and extension exercises. Flexibility exercises are those that decrease the angle of the body and its part through movement, the opposite of which constitutes extension exercise. As flexibility varies from joint to joint, it is considered as a specified ability of the joint involved. Some of the most important instruments used to record flexibility include goniometer and the Leighton flexometer whereas trunk flexion and extension tests constitute some of the important practical tests (Feeley *et al.,* 2016; Ribeiro *et al.,* 2017).

Dikki (1994) observed that flexibility has been defined in many ways but more particularly defined as a range of motion available in joint or group of joint mobility. Assessment of flexibility is considered necessary due to the realization that the less

flexible joints are more prone to injuries. A number of instruments like goniometer and Leighton flexometer have been developed for the assessment of the flexibility of different joints. The use of some of these instruments is however plagued by technical and cost problems (Archer *et al.,* 2017).

Sharkey and Bryan (2013) observed that the ability to move joints through a full range of motion is important in many sports. Loss of flexibility can result in reduction of movement effectively and may increase the chance of injury in some sports. It should be noted however that a high degree of flexibility in all joints may not be desirable in all sports.

The evaluation of hip flexion is perhaps considered the most important single measurement of flexibility (Corbin *et al.,* 2000). It is a compound flexibility test as it involves more than one joint and many different muscle groups. The sit and reach test developed by Wells and Dilions has been widely used to evaluate this attribute. It is simple to administer and inexpensive. Verducci (1980) reported a very high test re-test coefficient for the test (Dikki, 1992; Dikki, 1994; Dikki *et al.,* 1994) used in evaluating the flexibility of adolescent and adult subjects (Verducci, 1980). Not much has been done among children. It is not expected that physiological construct would confound the validity of the instrument among children (Mohammed, 2019).

Training methods are procedures involving repetition of action either in whole or part to improve upon performance (Venkateswarlu, 2010) or health of participant (Nieman, 1998). Several methods of training have been designed in recent years to develop the different components of performance in different sports and to yield positive health results in respect of body fat (Cormie *et al.,* 2011; Plowman, 2012). The training methods most often used include continuous, interval circuit and weight training programmes (Venkateswarlu, 2010).

Interval training involves following a fixed pattern of periods of strenuous exercise alternated with periods of rest or light activity. It can be used to gradually improve pace or train for sports like football and hockey where bursts of speed are required (MacInnis & Gibala, 2016). Interval training implies a series of repeated bouts of exercise separated with period of relief of test (Walking/Jogging) (Fox *et al.,* 1993). The work interval of this training mode particularly in children should be selected in terms of either distance to be covered (KM) or time of work interval in second/minutes (Watson, 1995; Grissogono, 1991). Also, the relief or rest interval is stressed to consist of light walking or jogging (Fox *et al.,* 1993). This helps to estimate accumulated waste products. Low intensity interval training is stressed to be very useful for improving aerobic fitness parameters in children and secondary adults (Sheehan, 2010).

The focus of flexibility of the students is the improvement in sport performance in the areas of efficiency, accuracy, precision, speed and flexibility of the athletes (Ribeiro *et al.,* 2017). To achieve these outcomes, several training methods have been developed in recent years to develop the different components of performance in different periods of

training, thus circuit training, interval training and pressure training (Venkateswarlu, 2010). Against this background (improved performance) resulting from training, the researchers desired to investigate the effects of single and multiple training sessions on selected physiological variable (flexibility) of the students of Federal College of Education, Zuba, FCT-Abuja.

Statement of the problem

Training effects in physical activities and sports are manifested in improved performance, promotion of physical health and fitness. Available research evidence suggests that regular exercise served as protective measures against the incidence of degenerative diseases (CDC, 2011). Studies available have shown that coaches, physical educators and exercise experts are vigorously pursuing training methods that could improve skills and performance in sports. Pate and Dowda (2019) observed that nowadays, physical education teachers and coaches are interested in training programmes which are aimed at improving joint flexibility to promote good sport performance. Similarly, the experts that are in the business of exercise programme are concerned with programmes that will improve muscular fitness.

The researchers were motivated to investigate the effects of single and multiple training sessions on flexibility. Effects of training depend on duration, intensity and frequency. Multiple training sessions (increased frequency) may be assumed to result into greater effects. However, there are interested individuals that are constrained by time not to have multiple training sessions. This study wants to establish if similar pattern can be obtained between single and multiple training sessions among adolescents students.

Purpose of the study

The specific purpose of this study was to find out whether there was difference in effects of single and multiple training sessions on the selected physiological variable (flexibility).

Research questions

Specifically, this research attempted to answer the following research questions:

1. Is there any difference in the effects of single and multiple training sessions?
2. What are the effects of single and multiple training sessions on flexibility?

Hypothesis

Ho1: There is no significant differencs in flexibility of students that trained using single and multiple training sessions.

Methodology

The randomized pre-test and post-test control group 2 x 6 experimental research design was used for this study**.** The population of this study consisted of all the students of Federal College of Education, Zuba in FCT-Abuja within the ages of 18-25 years old.

The instruments used for this study were: Flexibility Box: Baseline 12-1086 sit and reach trunk flexibility box, Deluxe was used for flexibility tests.
Sit and reach trunk flexibility test has a reliability of r= 0.56 as reported by Sporis *et al.* (2011). All the instruments used for this study were reliable, valid and have been scientifically proven to be standardized.

Pre-test measurements

Flexibility: Sit and reach test.

Aim: To measure the lower back flexibility and hamstring.

Equipment: Flexibility box.

Procedure: The participants sat on the mat with legs stretched out straight ahead without shoes. The soles of the feet are placed flat against the box with both knees locked and pressed flat to the floor. With the palms facing downwards, and the hands-on top of each other or side by side, the participant reaches forward along the measuring line as far as possible. The research assistant ensures that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the participant reaches out and holds that position for one-two seconds while the distance was recorded.

Scoring: The best score of three trials was used for subsequent analyses. The participants were allowed to rest for 5 minutes between tests.

Post-test: Post-test measurements of arm strength, arm power and lower back flexibility were taken for both the experimental and control groups.

A total of 100 students of Federal College of Education, Zuba – FCT aged between 18 and 25 years were used to serve as subjects of the study. The subjects were stratified into 'A' and 'B' of 50 each. 'A' group took part in the multiple training sessions while 'B' group took part in single training session. The students of Federal College of Education, Zuba – FCT were chosen. Being one of the higher institutions in the senatorial district, admission into the school was drawn from across the state. The simple random sampling technique was used in assigning the subjects to the training groups through the use of wrapped pieces of paper carrying 'S' for single and 'M' for multiple that was picked by the subjects selected from the school registers (odd numbers) to take part in the research. Subjects who picked 'S' took part in the single training session once in a day (morning only) and subjects who picked 'M' took part in the multiple training (twice a day) morning and afternoon sessions.

Training method

The training method employed in this research was the aerobic interval training method. This process involved a series of repeated bouts of exercise separated with period of relief or rest; such exercise includes walking/jogging (Fox *et al.*, 1993). The twelve weeks training duration which consisted of a minimum of 30 minutes training session was completed by stretching exercise. The training was proceeded by a three minutes pre-training warm up activities and terminated by a two minutes cool down session. The training was conducted three times in a week on a standard track of 400m. The subjects were divided into two groups Group 'A' multiple training group, trained twice a day while Group 'B' single training group, trained once a day.

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Measurement of flexibility

The flexibility of the subjects was determined using the vertical toe sit and reach test of lumber flexibility. The test was reported to be both valid (Dikki, 1992) and reliable (Dikki, 1994). The procedures for sit and reach technique used for assessment of flexibility are as follows:-

a. The subject sit flat on the floor with the legs stretched straight, toes pointing up
b. The hands with fingers straight and shoulder width apart went over the toes with the head and body erect
c. Ruler calibrated in centimeters (cm) was put under fingers to measure part of the fingers that extended over the toes; what was obtained was recorded.
d. The score was measured to the nearest centimeter.

The data collected were subjected to the following statistical tools

1. Descriptive statistics of mean, standard deviation and standard error of the mean was also applied on the data
2. T-tests for related sample was used for the analysis to test the significant difference between single and multiple training sessions
3. One Way Analysis of Variance

All hypotheses were tested and rejected or accepted at the 0.05 probability level of significance.

Presentation of results

Table 1 shows pre-training and post-training mean scores ($\bar{x}$), Standard Deviation (SD), Standard Error (SE), the Minimum (min) and Maximum (Max) scores measured for the selected body parameters.

Table 1: Mean scores of pre-training and post-training physical and physiological characteristics of subjects

Variables	Training Status	$\bar{x}$	SD	SE	Min	Max
Age (Years)		15	1.4	.2	13	17
Flexibility (cm)	Pre-training	3.3	1.2	.2	1.1	6.0
	Post-training	4.2	1.1	.1	2.5	6.5

The pre-training scores in the table were relatively lower than the post-training scores as shown in the table. There was an increase in the mean of the flexibility rate of the subject.

Table 2: Comparison of pre-training and post-training physical and physiological characteristic of single training session group subjects

Variables	Training Status	$\bar{x}$	SD	SE	t
Age (Years)		14.6	1.4	.3	-
Flexibility (cm)	Pre-training	3.1	1.2	.2	
	Post-training	4.3	1.1	.2	-1.33

Table 2 indicates comparison of pre-training and post-training physical and physiological characteristics of single training groups. The table 2 showed no much difference between pre and post-training flexibility mean values of the subjects.

Table 3: Comparison of pre-training and post-training physical and physiological characteristics of multiple training session group subjects

Variables	Training Status	$\bar{x}$	SD	SE	t
Age (Years)		15.4	1.4	.3	-
Flexibility (cm)	Pre-training	3.4	1.1	.2	
	Post-training	4.4	1.1	.2	-1.33

Table 3 shows comparison of pre-training and post-training physical and physiological characteristics of the multiple training groups. The table showed no much difference between the pre-training and post-training mean values of the flexibility of the subjects between pre-training and post-training.

Ho1: There is no significant difference in the flexibility of subjects that trained using single and multiple training sessions.

To determine the significant difference between single and multiple training on flexibility, the t-test was applied on the means of flexibility; table 4 shows the test result.

Table 4: A Comparison of the difference in flexibility of the single and multiple training groups

Variables	$\bar{x}$	SD	SE	t
Single	4.0300	1.127	.206	1.33
Multiple	4.4067	1.062	.194	

df = 58, t-critical = 2.000

The result in table 4 does not indicate significant difference between single and multiple training programmes per day on flexibility using the same duration and intensity. The null hypothesis that states that there is no significant difference on the flexibility of subjects that trained using single and multiple training is therefore accepted. Although the multiple training group achieve a greater flexibility than the single training group, the difference is however insignificant. The type or method of training method does not seem to favour significantly the improvement in flexibility

Comparison of the different groups in the experiment

A further analysis of the mean of the groups (pre-training single, post training single, pre-training multiple and post-training multiple) was carried out using the one way analysis of variance procedure. Table 5 shows the analysis of variance models for the selected body parameter of the subjects.

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Table 5: One way analysis of variance for body parameters

Source	DF	Sum of Squares	Mean of Squares	F-ratio	P
Between groups	3	31.2330	10.4110		
Within Groups	116	148.1942	1.2775	8.1493	0.0001
Total	119	179.4272			

The main difference is significant at the .05 level

The analysis of variance models in the table shows that the groups differ significantly from their pre-training scores for the body parameter. However, both single and multiple training groups did not differ from each other in their post training scores. This further confirmed the findings from the hypothesis where no significant differences was observed between the post-training multiple groups and post-training single group for the selected body parameter of the subjects. The mean and standard deviation for each of the parameters are shown in table 6.

Table 6: Mean scores of the selected subjects body parameters

Training Status	Flexibility
Pre-training Single	3.1±1.2
Pre-training Multiple	3.4±1.1
Post-training single	4.0±1.1
Post-training Multiple	4.4±1.1
Total	3.7±1.2

The results from table 6 revealed that flexibility showed differences for the post-training scores from the pre-training scores in the two groups.

Discussion of the findings

The findings of this study revealed that treatment had significant effects on the flexibility of the students. There was no significant difference (p=1.33) between single and multiple training programmes per day on flexibility of the students who took part in this study using the same duration and intensity. This means that single and multiple training were effective in developing lower back flexibility and improves the muscles of the back, hip and thigh. Ribeiro *et al*. (2017) reported that resistance training improves the flexibility of different joint movements in young adults, both men and women. Also, free weights' training improves lower back flexibility better than other conventional resistance training (Ogunleye & Ojo, 2019). Furthermore, this study reveals that there was a significant improvement on the flexibility of younger ones after twelve weeks of free weights training.

The study also revealed no significant difference between single and multiple training per day. This observation seems to be in line with Pate and Dowda (2019) in their examination of training outcomes as related to frequency. Duration of training programmes also yield

an equivocal finding. Two days per week protocol produced a significant training effect as did a 7 times per week protocol. However, Pate and Dowda did not show the kind of training they employed. The efficiency of interval training in children has been questioned because of its similarity to spontaneous play (short bout of high intensity activity, followed by period of rest) that is characteristic of youngsters.

Conclusion

From the findings of the study, it is concluded that training single or multiple session per day with the same intensity of work load produces similar training effects among adolescents. Exercises designed to produce changes in flexibility have been shown to be effective in increasing flexibility, and youth who participate in active sports generally have better flexibility than those who do not.

Recommendations

1. On the basis of the findings of this study, it is recommended that adolescents that are constrained in terms of time can use the single training session as it produces similar physiological effects as the multiple training sessions.
2. Single and multiple trainings, if properly supervised, can be used to improve the lower back flexibility. And if this strategy is employed, the effectiveness of physical activities flexibility will be guaranteed.

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