

EFFECT OF LOW-RESISTANCE TRAINING ON FLEXIBILITY OF YOUNG-OLDER MALE ADULTS IN SAMARU, ZARIA, NIGERIA

BY

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Abstract

The purpose of this study was to assess the effect of low-resistance training on flexibility of young-older male adults in Samaru, Zaria. Repeated-measures experimental research design was used for this study. Purposive sampling technique was used to select young-older male adults between the ages of 60 and 69 years, who volunteered to participate in this study. The training intensity was maintained between 25 and 45% of one repetition maximum (1RM) on flexibility. The training programme had two sessions of low-resistance per week for a duration of 12 weeks. Stop watch, stadiometer, resistance machines, a chair and ruler were used as instruments for this study. The participants trained at 25% of 1RM from base-line to 4th week, at 35% of 1RM from 4th to 8th week and at 45% of 1RM from 8th to 12th week. The flexibility was assessed at base-line, at the end of 4th, 8th and 12th week of the training. Descriptive statistics (mean and standard deviation) were used to answer the research question while repeated-measure analysis of variance and Scheffe's post-hoc test were used to test the stated hypothesis at 0.05 level of significance. At the end of the 12 weeks training, the major findings from the study showed significant increase in flexibility ($p = 0.000$), therefore, the null hypothesis was rejected. The Scheffe post-hoc test further showed significant means difference in the increasing effect on flexibility ($p = 0.000$) between base-line and 4th week, 4th and 8th week, 8th and 12th week of training. In conclusion, Low-resistance training from 25-45% of 1RM increased flexibility of the young-older male adults. It was further recommended that young-older male adults should train more at low-resistance intensity between 25 and 45% of 1RM to increase flexibility.

Key words: Low-resistance, ageing, flexibility, young-older adults, male, training.

Introduction

Flexibility is a key component of overall physical fitness, particularly in older adults, as it directly influences their ability to perform daily activities and maintain functional independence. With ageing individuals often experience a gradual decline in flexibility due to various factors such as reduced physical activity, physiological changes and sedentary lifestyles. This decline in flexibility can lead to limitations in range of motion, increased risk of injury and decreased quality of life in older adults. The World Health Organization (WHO, 2018) reported that older adults are the largest

and fastest growing segments of the population, which present significant challenges to every nation's health care system. They are observed to present low functional capacities affecting the physical, physiological and psychological wellbeing of individuals of this age group. These changes are normal; however, resistance exercise participation can help older adults adjust to and compensate for these changes (Chalise, 2019).

Resistance training has been widely recognized for its positive effects on muscle strength, muscle mass and functional performance, especially in older adults. However, most studies on resistance training focus on using higher loads and high-intensity exercises which may not be suitable for older adults. Low-resistance training is an alternative approach, involves using resistance machines and lighter weights during exercise. It provides a safe and feasible option for older adults who may have lower muscle strength and joint limitations. There is a lack of research specifically examining the effect of low-resistance training on flexibility in young-older male adults, typically defined as individuals aged 60 to 69. This demographic has distinct exercise needs and goals compared to younger adults, making it important to investigate if low-resistance training can effectively improve flexibility in this group.

Gerontologists described old age as a stage at which functional, mental and physical capacities decline and that older people are more prone to metabolic disorders and disabilities (Chalise, 2019; McDonald, 2019; Dionigi, 2023). In Nigeria society, someone who has reached the age of 60 years and above can be regarded as an old person and showed functional characteristics include frailty, inactivity, loss of strength, poor flexibility, gait problem and inability to sustain independent work (Akanbi, Fadayomi, Wusu, Tinuola, Olagunju, Gbadebo and Adekola, 2015; Ugbe, 2021). The UNDESA (2022) distinguished the young-older adults as between 60 and 69 years, the middle-older adults as between 70 and 79 years, and the oldest-older adults as from 80 years and above. Therefore, for the purpose of this study the researchers used participants between the ages of 60 and 69 years as young-older male adults.

Nigeria has the largest population in Africa, which is estimated at 224 million ranked 6th position (2.78% of the total world population) in 2023 (UNDESA, 2023). Nigeria ranks 24th globally among countries with the highest proportion of older persons and that the number of people aged above 60 years was estimated to increase from 9.4 million (5.1 million males) in 2020 to 11.5 million in 2025 and 26 million by 2050; that is 10% of the total Nigeria population (Mbah, 2016; National Council for Ageing, 2016; Population Bureau, 2017; Tanyi, Andre, Mbah & Tong (2018). The rising numbers of the older adults in Nigeria is among others factors attributed to the crude mortality rate that is gradually increasing (Adebawale, Atte, & Ayeni, 2012; Ugbe, 2021). Aged dependency ratio in Nigeria was estimated at 5.6% with almost all having at least a metabolic disorder and or multiple morbidities of health-related physical fitness increasing the pressure on productive population in Nigeria (Nwani & Isah, 2016; UNDESA, 2023). Ageing in Nigeria is occurring against the background of socioeconomic hardship, widespread poverty, and the rapid transformation of the traditional extended family structure (Adebanjoko & Ugwuoke, 2014). Basically, ageing is the progressive decline in the function and performance of an individual with advancing years. Ageing is, therefore, a complex process composed of several features that include an exponential increase in mortality, physiological changes that typically lead to a functional decline and the decline in physiological functions do always lead to poor gait, independent function and the manifestation of metabolic disorders (WHO, 2018; Chalise, 2019).

Flexibility is essential to the performance of daily activities, which thus helps to maintain autonomy and quality of life in the young-older male adults population (Cabral, Magalhaes, Pinheiro, Junior, Figueredo, & Dantas, 2014; Batista, Gomes & D'Elboux, 2014). Flexibility reductions may increase the risks of injury, falling, back pain, and physical dependence in young-older male adults (ACSM, 2020b). When a joint is relatively inactive due to sedentary behavior, the

muscles that cross it shorten, thereby reducing its range of motion. Moreover, independent of activity levels, the ageing process plays a role in flexibility decreases (Fragala, Cadore, Dargo, Izquierdo, Kreamer, Peterson & Ryan, 2019). Joint structures such cartilage, ligaments, and tendons change mechanically and biochemically with ageing, increasing muscular and tendon stiffness and thus impeding mobility (Nigam, Knight, Bhattacharya & Bayer 2012; Correia, Menêses, Lima, Cavalcante & Ritti-Dias, 2014; Rosado, Tomas, Correia & Gonclaves, 2016).

It is generally observed that ageing is associated with low functional abilities of various body systems, which lead to major reduction in health and physical fitness such as decrease in flexibility which has health consequences on the quality of life in the young-older male adults. This is essential in the health and performance of daily activities of young-older male adults in Samaru, Zaria, which help to maintain autonomy and their quality of life. Flexibility plays a crucial role in human health; it allows young-older male adult to stand, walk, balance, lift, push, pull and breathe. The researcher observed that young-older male adults in Samaru community are fall to sedentary lifestyles which exposed them to wellness risk factors and disorders that can be reversed with low intensity fitness programmes. Maintaining good health by older people is a thing of concern in Nigeria and there is increasing strain on the medical community to care for the ageing population. Therefore, coping with access to health care services is a matter of serious concern to all. **By implication**, Nigeria will face tremendous pressure to effectively manage its ageing population. Flexibility reductions may increase the risks of injury, falling, back pain, and physical dependence in young-older male adults. As we age, the full movement potential of a joint decreases due to changes in , arthritis, loss of muscle mass, strength, and more. However, regardless of age, the body's muscular system has the ability to positively adapt to low-resistance training (LRT). LRT is a potent stimulus that improves physical fitness by increasing flexibility. With an appropriate low-resistance training, young-older male adults may record significant improvements in flexibility.

The purpose of this study was to assess the effect of LRT on flexibility of young-older male adults in Samaru, Zaria, Nigeria. A research question and hypothesis was formulated as follows:

Research Question: Would participation in LRT programme modify the flexibility of young-older male adults in Samaru, Zaria, Nigeria?

Hypothesis: There is no significant effect of low-resistance training on flexibility of young-older male adults in Samaru, Zaria, Nigeria.

Methodology

A repeated measures experimental research design was used for this study. Data was obtained using low-intensity resistance training among young-older male adults at base-line, and at the end of 4th, 8th and 12th week of training. The flexibility was assessed in the Human Performance and Fitness Laboratory, ABU, Zaria. The study population consisted of all young-older male adults who were residents of Samaru, Zaria who are between the ages of 60 and 69 years. A sample size of 16 young-older male adults who were residents in Samaru, Zaria, participated in the training. The researcher used purposive sampling technique in selecting the participants by identifying only young-older adults by gender (male) and age (60-69 years) residing in Samaru, Zaria. Furthermore, participants that volunteered for the training were informed of the purpose of the study, completed a physical activity readiness questionnaire (PAR-Q) to identify any medical conditions and current medication that could affect their ability to perform the required training and result, and further signed a written consent form. The following machines were used for the 12-week training: seated chest press, pulldown, biceps curl, seated dip, leg press, seated leg extension and seated leg curl.

A Modified Chair Sit and Reach Test was used to test lower body (lower back and hamstrings) flexibility of the body and designed to test the functional fitness of older adults. It is

generally recommended for those who are 60 years of age and above. For chair sit and reach test, the participant was asked to sit on the edge a chair (placed against a wall for safety), and one foot must remained flat on the floor. The other leg was extended forward with the knee straight, heel on the floor, and ankle bent at 90°. One hand was placed on top of the other with tips of the middle fingers even. Then, the participant was instructed to reach forward toward the toes by bending at the hip and keep the back straight and head up. They were to keep the knee straight, and held the reach for 2 seconds. The distance was measured with a ruler between the tip of the fingertips and the toes. If the fingertips touched the toes then the score was zero. If they did not touch, measurement of the distance between the fingers and the toes (a negative score) was taken, if they overlap (a positive score) was taken. The participant performed three trials and the average of the scores was recorded to the nearest centimeter (cm) as the distance reached. The higher the score, the better the result (Jones & Rikli, 2002; Wood, 2010).

Training Protocols

Table 1: Low-intensity resistance training protocols showing different intensity levels
Low-Resistance Training Protocols

Week	Repetitions	Sets	Rest between sets	Rest between exercise stations	Intensity (% 1RM)
Base-line – 4	8 – 10	2	2 mins	2 mins	25
5 – 8	10 – 12	2	1½mins	2 mins	35
9 – 12	10 – 12	3	1 mins	2 mins	45

Source: self-developed training programme*Set, (Repetition), Intensity, Rest interval between sets

*2, 3 = Number of sets, (8-10) = Number of repetitions per set, 25%-45% 1RM = Percentage intensity of One Repetition Maximum, 1min, 1½ min & 2min = Time of resting interval in minutes between sets and 2 min rest between exercises respectively.

2 training sessions per week (nonconsecutive days). Before each session, warm up exercises was performed for 5 minutes. Training lasted for 45 minutes. Participants breathe out at the beginning of the movement and breathe in as they returned to the starting position.

The training protocol presented in the table 1 above shows the different intensities which reflects the number of sets, repetitions, intensity, rest interval between exercise stations and sets. The exercises were performed in the Human Performance & Fitness Laboratory of the Human Kinetics and Health Education department of ABU, Zaria, on seven (7) different exercise stations of resistance machines: seated chest press, leg press, seated dip, seated leg curls, pull down, leg extension and biceps curls, which are to be completed within 35 minutes. Using resistance machines is safer and easy because machines have variable resistance which require less time to set by quickly using a 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 training session. Each training session began with a 5-min warm-up and end with another 5-min cool-down using bike ergometer and very light resistance by completing a set of 5-10 repetitions of the exercises at a very low intensity of between 10% - 20% 1RM.

Seven (7) resistance exercise stations were performed engaging muscle groups, with a focus on strengthening the upper and lower-body muscles that are relevant for daily activities, which include seated leg press, seated chest press, seated leg curl, leg extension, pull down, biceps curl and seated dip. The training was structured according to recommendations of the American College of

Sports Medicine and consisting of seven 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. The LRT programme was structured based on current recommendations on the practice of LRT for the young-older male adults (Garber, Blissmer, Deschenes, Franklin, Lamonte, Lee, Nieman & Swain, 2011, ACSM, 2020). The intensity for the training was determined by selecting a load equating to relatively 25%, 35% and 45% of their 1-RM progressively after every four weeks. The intensity was determined by calculating the percentage of one repetition maximum (% 1RM) as follows: the low-resistance training of 2 sets, 8-10 reps at 25% 1-RM max for the first 4 weeks, 2 sets of 10-12 reps at 35% in the second 4 weeks and 3 sets of 10-12 reps at 45% for the last 4 weeks of the training (ACSM, 2020b; Diogo, Henrique, Daniel and Mário, 2020).

As training progresses, resistance or load was gradually increased after every four weeks of training. These increments were 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 older adults (Kraemer, Adams, Cafarelli, Dudley, Dooly & Feigenbaum, 2002). The incremental load increase first started with number of repetitions (8-10), then followed by 10% 1RM increase after every 4 weeks so that the initial training intensity was preserved throughout the 12-week training. The participants performed a total of 2 sets of 8-10 repetitions each at every exercise station, with a load corresponding to 25% 1RM in the first 4 weeks of training. Then, the load was increased to 2 and 3 sets of 8-12 repetitions at 35% 1RM for another 4 weeks and 45% 1RM for the last 4 weeks, respectively.

Also, the participants pushed or pulled the same relative loads and completed the same amount of work progressively and were tested at different points (at base-line, at the end of 4th, 8th and 12th week) of low-resistance training for comparison. The training sessions lasted 45 minutes for 2 alternate days per week (Wednesday and Saturday). The low-resistance training exercises were performed in Human Performance & Fitness Laboratory, ABU, Zaria, between 8:00 am–10:00 noon. The low-resistance training followed the principles of specificity, individualization, adaptation, and progression (ACSM, 2020; Fragala *et al.*, 2019; Ferraro, Muehlenkamp, Paintner, Wasson, Hager & Hoverson, 2008; Haff & Triplett, 2016). The low-resistance training exercises were arranged in an alternating order, working on the upper-body and lower body muscles such that while leg muscles were recovering the arms muscles were working. The sequence of the exercises were arranged in such a way that no two consecutive exercises 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 muscles or multi-joints exercises first and synergists or single-joint exercises last. For example, leg press followed by seated leg curls or leg extension and chess press followed by biceps curls or seated dips. During the execution of movements, participants were instructed to breathe in during the eccentric phase and breathe out during the concentric phase using execution movement speed of a ratio 1:2 concentric/eccentric phases respectively.

The researchers assessed flexibility at base-line and at the end of 4th, 8th and 12th week. Young-older male adults in Samaru, Zaria of Kaduna state served as participants (volunteers) and were invited to Human Performance and Fitness Laboratory of the Department of Human Kinetics and Health Education, ABU, Zaria where the assessments and low-resistance training exercises were conducted.

The participants were fully informed about the experimental procedures and the purpose of the study. The researchers explained to the participants the details concerning the 12 weeks training. Measurements were taken on four different occasions: at base-line, and at the end of 4th, 8th and 12th week of low-resistance training. The researchers' roles were to make sure the exercises were performed correctly, in a safe manner and also to monitor the maintenance of the load and repetitions by the participants. The researchers were present and supervised all the training sessions. The participants were also not allowed to perform other exercise programme during the training period.

The researchers used the 10-RM test to estimate the 1-RM values for each of the exercise, as proposed by Haff and Triplett (2016); Tan, Wang and Lius (2015); Klerch (2021). This protocol was employed to gauge the maximal intensity (100%) of each exercise station. Thus, the values for the training intensity (25%, 35%, and 45% of 1-RM) were calculated and then used during the training sessions. A new evaluation was conducted at the end of 4th and 8th weeks of the training to estimate the appropriated % of 1-RM values of each participant.

The researchers allowed each participant to push or pull the weight that he could performed between 6-10 repetitions. The calculation of the 1RM was done based on the total number of reps pushed or pulled while using a moderate weight(Tan, Wang &Lius, 2015; Klerch, 2021). Prior to each test, the participants were asked to complete a 5 minutes warm-up, which consisted of cycling on a bike ergometer and 6-10 repetitions of leg press and seated chest press machine with a very light weights. A two minutes rest was allowed after the warm-up. Then 25% of 1RM was calculated and selected as the starting load for the participants. After four weeks of training, the participants' 1RM loads wasrecalculated again in order to determine their loads for the next four weeks and continuously. In the training, participants performed between 8 – 12repetitions per set during the training sessions at 25%, 35% and 45% of 1RM progressively. Safety protocols were also observed such aswarm-up and cool-down procedures were held constant throughout all the training sessions. Physical distancing by spacing out the resistance machines 2 meters apart, washing of hands before and after each training sessions with soap and running water were also observed as part of safety measures.

The data obtained was analyzed using descriptive statistics of mean, standard deviation and inferential statistics using repeated-measures analysis of variance, because the same group of participants were measured at four points over time (atbaseline, at the end of 4th, 8th and 12th week) of training. A Scheffe post-hoc testwas used to further determine where the difference in the training effect occurred or located. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 21. Statistical level of significance was set at 0.05.

Results

Table 2: A Descriptive Analysis of Flexibility of the Participants over the 12 Weeks of Training

Variable	Week	N	Mean	Std. Deviation	Std. Error
Flexibility (cm)	Base- line	16	4.500	1.265	.316
	4	16	6.563	1.153	.288
	8	16	8.188	.911	.228
	12	16	9.750	.683	.171

Source: Test conducted in 2022 by the researcher

Table 2 above presents the descriptive analysis of the data collected on the flexibility of the participants at base-line, at the end of 4th, 8th and 12th week of LRT among young-older male adults in Samaru, Zaria. The result revealed that the mean at base-line onflexibility of the participants was 4.50 ± 1.27 cm, and at theend of 4th, 8th and 12th week of LRT, there was a progressive increase in mean flexibility of the participants from 6.56 ± 1.15 cm, $8.19 \pm .91$ cm and $9.75 \pm .68$ cm, respectively. This results showed progressive increase in mean flexibility of the participants at the end of every four weeks of training, which answered the research question. In order to test whether the increased in flexibility is statistical significant, the data was analyzed using Repeated-measures Analysis of Variance presented in Table 3, according to hypothesis.

Hypothesis

There is no significant effect of low-resistance training on flexibility of young-older male adults in Samaru, Zaria, Nigeria.

Table 3: Repeated-measures Analysis of Variance on Flexibility of the Participants after 12 Weeks of Low-resistance Training

Source		Sum of squares	Df	Mean square	F	Sig.
Flexibility	Sphericity assumed	242.625	3	80.875	244.664	.000
	Greenhouse-Geisser	242.625	1.978	122.692	244.664	.000
	Huynh-Feldt	242.625	2.276	106.598	244.664	.000
	Lower-bound	242.625	1.000	242.625	244.664	.000
Error(Flexibility)	Sphericity assumed	14.875	45	.331		
	Greenhouse-Geisser	14.875	29.663	.501		
	Huynh-Feldt	14.875	34.141	.436		
	Lower-bound	14.875	15.000	.992		

Source: SPSS data analysis output($p = 0.05$) on flexibility, 2022.

Table 3 shows the result of repeated-measures ANOVA on flexibility of the participants used in this study. The result showed that LRT caused significant increase on flexibility of the participants ($p = 0.000$). Therefore, the null hypothesis which states that there is no significant effect of LRT on flexibility of young-older male adults in Samaru, Zaria was rejected. To identify where the significant effect occurred, the Scheffe Post-hoc analysis were carried out and presented in Table 4.

Table 4: Summary of Scheffe's Post-hoc test Results for Differences in the Effect on the Flexibility of the Participants for the 12-Week Training

(I) week	(J) week	Mean Difference	Std. Error	Sig. ^b	95% confidence interval for difference ^b		
					Lower Bound	Bound	Upper
Base-line	Week4	-2.063*	.143	.000	-2.368	-1.757	
	Week8	-3.688*	.237	.000	-4.192	-3.183	
	Week12	-5.250*	.250	.000	-5.783	-4.717	
Week4	Base-line	2.063*	.143	.000	1.757	2.368	
	Week8	-1.625*	.180	.000	-2.008	-1.242	
	Week12	-3.188*	.228	.000	-3.673	-2.702	
Week8	Base-line	3.688*	.237	.000	3.186	4.192	
	Week4	1.625*	.180	.000	1.242	2.008	
	Week12	-1.563*	.157	.000	-1.898	-1.227	
Week12	Base-line	5.250*	.250	.000	4.717	5.783	
	Week4	3.118*	.228	.000	2.702	3.673	
	Week8	1.563*	.157	.000	1.227	1.898	

Source: SPSS data analysis output. *The mean difference is significant at the 0.05 levels.

The Post-hoc analysis on flexibility of the participants in Table 4 above revealed significant increase in flexibility ($p = 0.000$) with an increase means difference of 2.06*, 1.63*, 1.56* between base-line and 4th week, 4th and 8th week, 8th and 12th week, respectively. The result showed significant differences between the means on the increasing effect every 4 weeks of training. The highest increasing effect was between base-line and 4th week (2.06*). Therefore, the null hypothesis was rejected.

Discussion

The results of the analysis showed that LRT had significant increasing effect on flexibility of the participants at the end of 4th, 8th and 12th week of training. The significant increase in flexibility may be attributed to increase strength of ligaments, tendons and cartilages at the joints, thus increases flexibility. Low-resistance training improved the function of connective tissues surrounding the joints (Correia, Meneses, Lima, Cavalcante & Ritti-Dias, 2014; Carneiro, Ribeiro, , Gobbo, Schoenfeld & Junior, 2015; Ribeiro, Campos-Filho, Avelar, Dos Santos, Aguiar and Fleck 2017). The increases in flexibility after a low-resistance training programme in young-older male adults was in agreement with Cyrino, Oliveira & Leite, 2004; Fatouros, Kambas & Katrabasas, 2006; Goncalves, Gurjao & Gobbi, 2007; Correia *et al.*, 2014; Carneiro *et al.*, 2015; Ribeiro *et al.*, 2017; Kasovic, Stefan and Kalcik, 2022. LRT have significant improvement on flexibility of young-older male adults by reducing passive tension and stiffness of the tissues (ligaments, tendons and cartilages) surrounding a joint.

The exact mechanisms responsible for increased flexibility after the low-resistance training is as a result of physiological adaptation of muscle and connective tissues surrounding the joints (Carneiro *et al.*, 2015). Ligaments and tendons tends to become more elastic, making the joints soft and more flexible. In particular, muscle and fascia are responsible for 41% of joint's resistance movement and its mediated reduction in passive tension and stiffness of these tissues translated into a greater range of motion. Resistance training results in a certain degree of muscle growth, which allows more fibres to sit in the same space will have the same flexibility potential as the original fibre making the muscle to stretch farther (Ribeiro *et al.*, 2017). It is possible that the range of motion of these joints might continue to increase if training were to exceed 12 weeks. This finding indicates that LRT performed at a minimum of 12 weeks can result in improvement of flexibility in young-older male adults, reversing or slowing the ageing-induced losses.

Conclusion/Recommendations

On the basis of this results, it is concluded that low-resistance training at 25-45% 1RM increased flexibility of the young-older male adults in Samaru, Zaria. The researchers recommended that young-older male adults should participate in low-resistance training (between 25 – 45 % 1RM) to improve body flexibility. The researchers' further recommend the need to expose young-older male adults to low-resistance training as a means of improving body flexibility and joints health.

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