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

DOI: https://doi.org/10.82340/injohkshe.vol1no1.3

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Abstract

This study assessed the effect of low-resistance training programme on body age of youngolder male adults in Samaru, Zaria. Repeated-measures experimental research design was used for the study. Purposive sampling technique was used to select sixteen (16) 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) and had two sessions per week for a duration of 12 weeks. Stop watch**,** stadiometer, resistance machines and body composition analyser machine were instruments used for the 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 body age was assessed at base-line, at the end of 4th, 8th and 12th week of the training period. Descriptive statistics (mean and standard deviation) were used to answer the research question while inferential statistics of analysis of variance and Scheffe's post-hoc were used to test the stated hypothesis at 0.05 level of significance. At the end of the 12 weeks training period, the major findings from the study showed significant reduction in body age (p = 0.000), therefore, the null hypothesis was rejected. The Scheffe post-hoc test further showed significant means difference in the decreasing effect on the body age (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 reduced body age 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 reduce body age.

Keywords: Ageing, Body age, Low-resistance, Male adult, Young-older

Introduction

Ageing is a biological process and has its own dynamics, which are beyond human control. Its definitions and categorizations differ from one society to another. In most developed countries of the world, chronological age is an indicator of old age, and the age of 60 years and above is considered the beginning of old age (The United Nations Department of Economic and Social Affairs Population Division (UNDESA), (2022). UNDESA (2022) have recognized the diversity of old age by defining sub-groups and distinguished the young-old as between 60 and 69 years, the middle-old as between 70 and 79 years, and the oldest-old as from 80 years and above. Therefore, for the purpose of this study the researcher used participants between the ages of 60 and 69 years as young-older male adults.

It is widely known that the natural process of ageing involves deleterious effects on the function of the body and that these effects are evident in young-older male adults (Molina-Sotomayor, Espinoza-Salinas, Arenas-Sánchez, Pradas de la Fuente, Leon-Prados & Gonzalez-Jurado, 2021). Ageing is associated with increased risk of chronic disease, profoundly affecting the independence, mobility and body function of young-older male adults (Maresova, Javanmardi & Barakovic, 2019). Advancing age is also associated with a loss tissues and organs functions, (Fragala, Cadore, Dargo, Izquierdo, Kreamer, Peterson & Ryan, 2019; Otsuka, Yamata, Maeda, Izumo, Rogi, Shibata, Fukuda, Arimitsu, Miyamoto & Hashimoto, 2022). Consequently, the effects of ageing can result in young-older male adults (60-69years) having a greater reduction in their overall health and quality of life. Sedentary lifestyle can prematurely age our bodies and leave us vulnerable to disease. To promote healthy ageing, it is essential to identify effective strategies to counteract or delay these age-related changes. Physical exercising have been shown to help slow the biological ageing process.

A person’s body age is not a measurement of the length of time one have been alive for, but rather a fundamental measurement of how physiologically ‘aged’ the body is. One may wonder why some people appear to be much younger or much older than their actual chronological age? This is because they have the body of someone who is much younger or older than they normally would at their current age. A body age test is the physiological characteristics of the body which can be used to determine how quickly they are ageing. Body age is calculated by weight, body fat percentage, visceral fat percentage, skeletal muscle percentage and resting metabolic rate to produce a guide to determine if the body age is above or below the actual calendar age. Too much visceral fat is thought to be closely linked to increased levels of fat in the bloodstream, which can lead to common diseases such as hyperlipidemia and diabetes, which impairs the ability of insulin to transfer energy from the bloodstream and using it in cells. However, high visceral fat levels can lead to metabolic obesity (Mundstock, Zatti, Louzada, Oliveira, Guma, Paris & Mattiello, 2015; Shah & Villareal, 2022). For example, it was revealed that Cristiano Ronaldo's body medical reports showed that the 33-year-old has the physiological age of a 20-year-old. He boasts 7% body fat, when the average for a professional footballer of his age is 10%, and 50% of his body is muscle mass, compared to 46% on average. Having a physical age of 13 years younger than his actual age is all down to his strict training regime.

Body or physiological age, is a measure of how well or poorly the body is functioning relative to the actual calendar age. For example, person may have a calendar age, or chronological age, of 65, but because of a healthy and active lifestyle, the body is physiologically more similar to someone with a chronological age of 55. The body age would, therefore, be 55. Researchers have presented scientific evidence that age is simply a number, and a person's true body age can vary from one individual to another, regardless of their birth year. This tells us whether the health and function of a person's tissues, organs, and systems appear older or younger than their chronological age. Walston (2020) found that advanced organ age significantly increases the risk of chronic illnesses and that chronic illnesses are characterised by unique organ ageing profiles. Our body changes naturally as we age and we cannot avoid some of these changes, but physical exercise may slow or speed the process. A physiological ageing test is designed to determine the physiological characteristics of the body to the average population in order to determine how quickly they are ageing. If the body age is higher than the chronological age, this would indicate that a person is ageing at an accelerated rate, which in turn means that he is likely to have both a shorter life expectancy and be more likely to suffer from age related diseases. Body age testing can help to identify the rate at which the body is ageing, and in turn allow one to make the necessary lifestyle changes to slow the rate of ageing. Even if the body age is less than the chronological age, further testing can always be utilized to further improve his rate of ageing in order to maximize body health and longevity.

Engaging in resistance training can help reduce percent body fat, visceral fat, improve muscle mass and reduce the risk of many age-related diseases (Mundstock *et al.*, 2015). Body age is a more important number to look at when it comes to how well the body systems are working and the idea explain why people with the same birthday age so differently. It is not the number of years we live, but the quality of those years that proponents of physiological age are most interested in. For example, somebody may have lived up to 95 years, but maybe the last 20 years of their life were miserable. To estimate body age of an individual, a series of information including physical fitness level is used. Scientists believe that less than 30% of our longevity is controlled by genetics, while the highest proportion (57%) is attributed to our lifestyles. Our body's age does not always correlate with our chronological age in years, as sedentary lifestyle can play a significant role in how quickly you age.

While the benefits of resistance training for older adults are well-documented, there is need for further research on young-older male adults (aged 60-69 years), the efficacy of low-resistance training in enhancing body age and shape human health and fitness in the society. This study aimed to address this research gap and provides insights into the potential benefits of lowresistance training for this demographic. Therefore, this study aimed to assess the effect of lowresistance training on body age of young-older male adults in Samaru, Zaria, Nigeria. The question is would low-resistance training improve body age in young-older male adults? It was furthered hypothesized that there is no significant effect of low-resistance training on body age of young-older male adults in Samaru, Zaria, Nigeria.

Methodology

A pretest posttest 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 4^{th}, 8^{th} and 12^{th} week of training. The muscle mass percent was assessed in the Human

Performance and Fitness Laboratory, ABU, Zaria. The study population consisted of all youngolder 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 researchers 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 weeks training: seated chest press, pull down, biceps curl, seated dip, leg press, seated leg extension, seated leg curl and total abdominal machine. An electrical impedance was used, along with the height, weight, age, and gender information of the participants to generate results based on OMRON's 514 model data of body composition.

The Body Composition Monitor and Scale (OMRONHBF-514, weight capacity of 0-150kg, made in China) was used as the instrument to assess body age of the participants, measurements were taken barefooted and in light clothes with bioelectrical impedance analysis. The body age variable was assessed by first inputting the personal data (age, gender and height) of the participant into the machine by the researchers. It was done one after the other by climbing the sensor scale and also gripped the contact pads or sensor with the palms. When hands and feet were placed on the electrodes or plates and low doses of current passed through the body, the monitor then automatically analyzed the data and displayed the body age among other variables on the LED screen.

Training Protocols

Table 1: A 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	$1^1/_2$ mins	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, $1^1/_2$ min & 2min = Time of resting interval in minutes between sets and 2 min rest between exercise stations 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 Table 1 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 and 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 requires 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 exercises 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, 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, 2020; Diogo, Henrique, Daniel & Mario, 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, 2002b). 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 and Fitness Laboratory, ABU, Zaria, between 7:00–10.00 am. The low-resistance training followed the principles of specificity, individualization, adaptation, and progression (ACSM, 2020; WHO, 2020a, 2020b; Fragala *et al.*, 2019; Ferraro, Muehlenkamp, Paintner, Wasson, Hager & Hoverson 2008; Haff & Triplett, 2016). The lowresistance 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 singlejoint 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 body age at base-line and at the end of 4th, 8th and 12th week. Youngolder 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 was recalculated again in order to determine their loads for the next four weeks and continuously. In the training, participants performed between 8 – 12 repetitions per set during the training sessions at 25%, 35% and 45% of 1RM progressively. Safety protocols were also observed such as warm-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.

Procedure for data analysis

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 (at baseline, at the end of 4th, 8th and 12th week) of training. A Scheffe post-hoc analysis was 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 27. Level of significance was set at 0.05 alpha.

Results

Table 2: Descriptive Analysis of the Effect LRT on Body Age of the Participants

Variable	Week	N	Mean	Std.	Std. Error
Body age (yrs)	Base-line	16	62.438	10.360	2.590
	4	16	60.438	9.136	2.284
	8	16	59.500	8.595	2.149
	12	16	57.750	8.258	2.065

Source: Test conducted in 2022 by the researcher

Table 2 presents the descriptive analysis of the collected data on the body age at base-line, at the end of 4th, 8th and 12th week of LRT among young-older male adults in Samaru, Zaria. An observation of the results revealed that mean and standard deviations scores of body age of the participants at base-line, at the end of 4th, 8th and 12th week of LRT were 62.44 ± 10.36yrs,

60.44 ± 9.14yrs, 59.50 ± 8.60yrs and 57.75 ± 8.26yrs, respectively. This results showed progressive reduction in the mean body age of the participants at the end of every four weeks of training, which answered the research question. In order to test whether the decreased in body age was statistically significant, the collected data was analyzed using inferential statistics of Analysis of Variance presented on Table 3, according to the hypothesis.

Hypothesis

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

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

Source		Sum of squares	Df	Mean square	F	Sig.
Body Age	Sphericity assumed	183.062	3	61.021	35.460	.000
	Greenhouse-Geisser	183.062	1.508	121.411	35.460	.000

	Huynh-Feldt	183.062	1.640	111.637	35.460	.000
	Lower-bound	183.062	1.000	183.062	35.460	.000
Error(Body Age)	Sphericity assumed	77.438	45	1.721		
	Greenhouse-Geisser	77.438	22.617	3.424		
	Huynh-Feldt	77.438	24.597	3.148		
	Lower-bound	77.438	15.000	5.163		

Source: SPSS data analysis output (p = 0.05) on Body age, 2022.

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

Table 4: Summary of Scheffe's Post-hoc Analysis Results for Differences in the Effect on the Body Age of the Participants

(I) week	(J) week	Mean difference	Std. Error	$Sig.^b$	95% confidence interval for $difference^b$ Lower Bound	Upper Bound
Base-line	Week 4	2.000^*	.447	.000	1.047	2.953
	Week 8	2.938^*	.559	.000	1.746	4.129
	Week 12	4.688^*	.688	.000	3.222	6.153
Week 4	Base-line	-2.000^*	.447	.000	-2.953	-1.047
	Week 8	$.938^*$	.266	.003	.371	1.504
	Week 12	2.688^*	.395	.000	1.846	3.529
Week 8	Base-line	-2.937^*	.559	.000	-4.129	-1.746
	Week 4	$-.937^*$	.266	.003	-1.504	-.371
	Week 12	1.750^*	.281	.000	1.150	2.350
Week 12	Base-line	-4.687^*	.688	.000	-6.153	-3.222
	Week 4	-2.687^*	.395	.000	-3.529	-1.846
	Week 8	-1.750^*	.281	.000	-2.350	-1.150

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

The Scheffe's Post-hoc analysis on body age of the participants in Table 4 above revealed significant reduction in body age (p = 0.000) with means decrease difference of 2.00*, 0.94*, 1.75* between base-line and 4th week, 4th and 8th week, 8th and 12th week, respectively. The result showed significant reduction in the effect at the end of every 4 weeks of training. The highest decreasing effect was between base-line and 4th week (2.00*). Therefore, the null hypothesis was rejected.

Discussion

The results of the analysis on body age showed significant reduction among the participants at the end of 4th, 8th and 12th week of training. The significant decrease in the body age may be attributed to increasing oxygen flow to muscle cells and boosting the productivity of mitochondria, the powerhouse of the cell (https://pubmed.ncbi.nlm.nih.gov/). Low-resistance training can also mitigate muscle loss associated with ageing and allow individuals to enjoy their favorite activities for longer. The significant decrease in the body age may also be attributed to increase vascularization processes that occurred in the muscle (Schott, 2019; Vikberg, Sorien, Branden, Jonhansson, Nordstrom & Hult, 2019). The findings of this study is in line with the results of Fragala *et al.* (2019); Lavin, Roberts, Fry, Moro, Rasmussen and Bamman (2019) and Zampino, Sember, Adelnia, Spencer, Fishbein & Schrack. (2020): who reported an average muscle mass gained of 1.5 kg after 10 weeks of low-resistance training. Also, the synthesis of myofibrillar protein is primarily responsible for increase in muscle mass percent following LRT as reported in earlier studies by Wilkinson, Phillips, Atherton, Patel, Yarasheski & Tarnopoisky (2008); Burd, West and Staples (2010).

The increase in muscle mass percent is also due to an increase in the number and thickness of actin and myosin filaments, myofibrils and sarcoplasm. Thus, the mechanisms by which these increases in muscle mass percent occur fall broadly into three categories; mechanical tension, muscular damage and metabolic stress (Schoenfeld, 2010; 2013; Lavin *et al.*, 2019; Tumkur, Kumar, Oliver, Lloyd, Pedley & Radnor, 2021; Alkhayl *et al,* 2022). Furthermore, the finding of this study is in line with the results of Schoenfeld (2010; 2013); Schoenfeld, Grgic, Ogbom and Krieger (2017c); Schott (2019) and Vikberg, Sorien, Branden, Jonhansson, Nordstrom and Hult (2019): who reported that LRT increases muscle mass percent in young-older male adults. Based on these findings, it could be stressed that LRT is one of the best ways to improve muscle mass, muscle strength, endurance and functional mobility, which can help mitigate the agerelated loss of muscle mass, there by lower a person’s "body age"—a measure of physical vitality compared to chronological age. A high muscle mass means higher resting metabolic rate, greater muscular strength and muscular endurance, which are vital fitness components in improving physiological function and in turn reducing body age of young-older male adults. These effects contribute to a more youthful "body age," which in turn enhances overall wellbeing. This is especially relevant for young-older male adults, as maintaining a higher level of physical function can significantly impact their quality of life.

Conclusion

On the basis of this results, it is concluded that low-resistance training at 25-45% 1RM reduced body age of the young-older male adults in Samaru, Zaria.

Recommendations

The researchers recommended that young-older male adults should participate in lowresistance training (between 25 – 45 % 1RM) to reduce body age. The researchers' further recommend the need to expose young-older male adults to low-resistance training as a means of improving body age, health and fitness in young-older male adults.

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