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Effects of Resistance Exercise Training Programme on Cardiovascular Disease Risk Factors of Sedentary Adults in Lagos, Nigeria

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Abstract: The prevalence of physical inactivity and cardiovascular disease (CVD) continues to rise and is reaching epidemic proportions in developed and developing countries. There is evidence in the literature that aerobic exercise can bring about a desirable change to the CVD risk factors, but there are controversies in the literature on the capacity of resistance exercise to bring about a significant change in CVD risk factors. This study therefore examines the effect of resistance exercise on CVD risk factors. Pretest-posttest control group experimental research design was used for this study. The population for this study is apparently healthy administrative and corporate staff within the age range of 45-55 years old in Lagos, Nigeria. Multi-stage sampling technique was used for this study to select and assign participants to experimental and control groups. A total of 27 participants were recruited as the sample for the study. The instruments used were PAR-Q, an informed consent form, a data entry form, an attendance sheet, and a developed exercise training template. Variables under investigation were blood pressure, resting heart rate, fasting blood sugar, plasma triglyceride, and waist-to-hip ratio. The descriptive statistics of frequency count, percentages and mean were used to analyze the demographic data of participants, while inferential statistics of ANCOVA was used to test the stated hypotheses at a 0.05 level of significance. The results revealed that resistance exercise has significant effect on blood pressure ($F_{1,24}$=4.26, P<0.05), resting heart rate ($F_{1,24}$=4.26, P<0.05), fasting blood sugar ($F_{1,24}$=4.26, P<0.05), plasma triglyceride ($F_{1,24}$=4.26, P<0.05), and waist-to-hip ratio ($F_{1,24}$=4.26, P<0.05). This study concludes that resistance exercise is an effective strategy for reducing cardiovascular disease risk factors. Based on the findings, it is recommended that resistance exercise should be adopted in the reduction or prevention of CVD risk factors in at-risk populations.

Keywords: *Resistance Exercise, Cardiovascular Disease Risk Factors, Non-Teaching Staff, and Physical Activity.*

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I. INTRODUCTION

Cardiovascular diseases (CVDs) have been recorded as the number one leading cause of death globally, with an estimated value of over 19 million deaths in 2021 (World Health Statistics, 2022a). In the United States, CVDs have been identified as the underlying cause of death with an estimated 941,652 deaths in 2022 (AHA, 2025). In Nigeria, 150,000 die annually as a result of heart-related diseases, and alarmingly, the global deaths as a result of CVDs is expected to increase to 23 million by the year 2030 if adequate measures are not taken (World Health Organization, 2022a). The Federal Ministry of Health Nigeria (2023), reported that 34 percent of the adult population in Nigeria live with high blood pressure before the age of 50 years, and the number is said to be on the increase as a result of poor diet, absence of healthy lifestyle and lack of exercise. According to the World Health Organization (WHO) (2022a), the most common cardiovascular condition in Nigeria and the United States is stroke followed by heart failure but the commonest risk factor is hypertension. Victor, Ezekiel, Timothy, Kester, Innocent, and Ross (2015), concluded in their study that the adult Nigeria population bears a substantial burden of modifiable CVD risk factors and that impaired fasting blood sugar is a result of present multiple CVD risk factors. Another study by James, Richard, Aminu, Mahmoud, and Nick (2015), using a blood pressure (BP) benchmark of 140/90mmHg, gave a crude prevalence rate of hypertension in Nigeria as between 6.2% to

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48.9% for male and 10% to 47.3% for female population. The recent statistics presented by the American Heart Association (AHA) (2025), show that 122.4 million (46.7%) US adults had hypertension between 2017-2020. Overall crude prevalence rates were reported to be generally higher in males than in females. According to Sun, Grave & Siervogel, (2007), elevated blood pressure (BP) during childhood and adolescence is common and increases the risk of hypertension in adulthood, contributing to adverse cardiovascular (CV) outcomes. In adults, hypertension and other CV health problems are associated with several other markers of CV risk such as obesity, unhealthy nutrition patterns, and physical inactivity (AHA, 2025; Pascual, Rodilla & Costa, 2009). Therefore, cardiovascular health has become a source of global concern in reducing the rate of mortality and economic burden.

One major intervention in the area of reducing the burden of cardiovascular diseases is the use of exercise to act on physiological parameters that can cause cardiovascular diseases. Regular physical activity is vital for good physical and mental health and also helps to improve overall health and fitness, maintain a healthy weight, reduce risk for many chronic diseases, and promote good mental health (AHA, 2025; WHO, 2022b; ACSM, 2022; and Otinwa, 2014). Regular physical activity was reported by WHO (2022b) to decrease the risk of premature death by 30%, and up to 10% of all Non-Communicable diseases (NCDs) can be prevented with physical activity. In a study by Thompson (2016), it was indicated that a low level of physical activity exposes a patient to a greater risk of dying than smoking, obesity, hypertension, or high cholesterol. Moderate-intensity resistance exercise is recommended as a supplement for aerobic exercise training for BP and CVD risk reduction in patients with hypertension (Pescatello, Franklin, Fagard, Farquhar, Kelley & Ray, 2004; Sharman & Stowasser, 2009; ACSM, 2010) as well as healthy individuals and men with low-risk CV disease. Exercise promotes improvements in a variety of general health and CVD risk factors (Benton, 2005). However, the relative improvement in these factors differs between the exercise types.

The two types of exercise are resistance exercise and aerobic exercise. Resistance exercise is categorized according to its impact on muscle contraction. There is dynamic resistance exercise which has to do with exercise that produces changes in the length of muscles when contracting, there is also the isometric resistance exercise which produces no change in the length of muscles when contracting (Coombes, 2015). Aerobic exercises are carried out with the help of oxygen to generate energy for the muscle to propel. However, there have been major arguments and discrepancies in research as to the type of exercise that has the capacity to effectively act on blood pressure and CV risk factors of sedentary adults. Veronique (2011), concluded that there was no significant reduction in blood pressure of hypertensive patients compared to their normotensive counterparts using the different types of resistance training. Kodama (2010), argued that aerobics exercise brings about a high level of physical fitness and a significant reduction in blood pressure and other associated risk factors. Meta-analyses conducted by Meredith, Friberg, Jennings, Dewar, Fazio, Lambert, and Esler, (2016) and Grassi, Seravalle, Calhoun, and Mancia, (1994), provided some evidence demonstrating that blood pressure does not decrease as a result of resistance exercise. Carlson, Dieberg, Hess, Millar, and Smart (2014), also observed that vascular stiffness was greater among strength-trained athletes as compared with age-matched controls. The arguments of whether resistance exercise can yield desired results as well as or more than aerobic exercise in at-risk adults can be validated by determining the effects of resistance exercise on the cardiovascular risk factors of at-risk adults.

➢ *Purpose of the Study*

The purpose of this study is to ascertain the effects of resistance exercise on cardiovascular risk factors of sedentary adults in Lagos, Nigeria.

➢ *Research Hypotheses*

The following hypotheses were developed and tested in this study;

- There will be no significant difference in the pre-test and post-test values of blood pressure of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme.
- There will be no significant difference in the pre-test and post-test values of resting heart rate of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme.
- There will be no significant difference in the pre-test and post-test values of the waist-to-hip ratio of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme.
- There will be no significant difference in the pre-test and post-test values of plasma triglyceride of sedentary adults in Lagos, Nigeria, after exposure to resistance exercise training programme.
- There will be no significant difference in the pre-test and post-test values of fasting blood sugar levels of sedentary adults in Lagos, Nigeria, after exposure to resistance exercise training.

II. METHODOLOGY

The study design adopted in this study was the pretest-posttest control group experimental design. The study population comprised of administrative and corporate workers in Lagos, Nigeria, who were between the ages of 45 and 55 years. A total of 27 participants volunteered and were screened to be part of the study. The inclusion criteria were; age between 45-55years, non-participation in any exercise group between 6 months of the study, no pre-medical

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condition that may prevent exercise, no pregnancy between 6 months to the study; and must spend at least 6-8 hours during the day being sedentary. Participants who met the inclusion criteria were randomly distributed into either experimental or control groups. Out of the 27 participants in the study, 12 participants were in the experimental group and 15 participants were in the control group.

The experimental group and control group were subjected to an initial test on all the cardiovascular disease risk factors under investigation. Following testing, the experimental group participated in resistance exercise programme that comprised manual and machine-induced resistance exercises. The experimental group met with the training team three times a week for twelve weeks. The training periods were between 7 am to 8 am on the different training days. The control group was asked to go on with their daily routine, while a group chat was created for them with daily health tips. The instruments used were PAR-Q, an informed consent form, a data entry form, an attendance sheet, and a resistance exercise training template. Variables under investigation were blood pressure, resting heart rate, fasting blood sugar, plasma triglyceride, and waist-to-hip ratio. After the intervention programme, a post-test screening was carried out on the same variables tested at the initial screening for both the experimental and control groups. Hypotheses were tested using the inferential statistics of ANCOVA at 0.05 alpha level.

III. RESULTS

Table 1:Demographic Data of the Participants

Variables	Experimental Group		Control Group		Total	
	F	%	F	%	F	%
Gender						
Male	5	41.7	**7**	46.7	12	44.4
Female	7	58.3	8	53.3	15	55.6
Age						
45-50years	9	75.0	11	73.3	20	74.1
51-55years	3	25.0	4	26.7	7	25.9

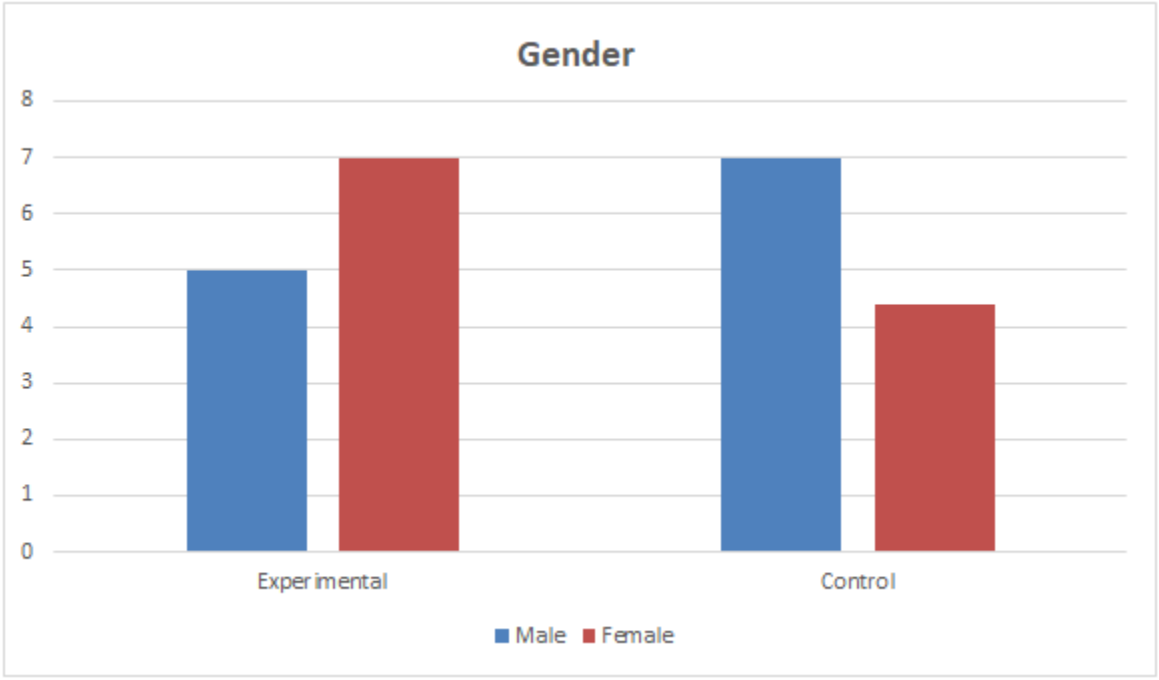

Fig 1: Distribution of Participants According to Gender

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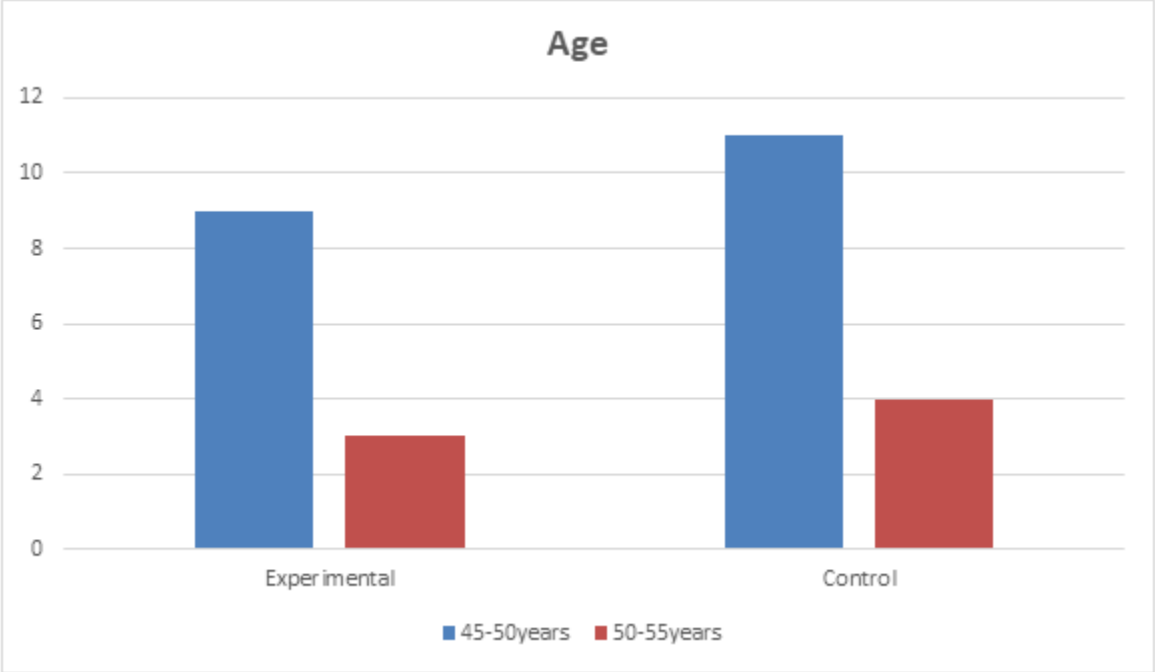

Fig 2: Distribution of Participants According to Age

Table 1, Figure 1, and Figure 2 present the demographic characteristics of the participants in the study. The result shows that 5(41.7%) of the participants in the experimental group were male and 7(58.3%) participants were female. While 7(46.7%) of the participants in the control group were male and 8(53.3%) of the study participants in the control group were female. Gender distribution of the combined sample reveals that 12(74.1%) of the study participants were male, while 15(25.9%) were female. As regards the age distribution of the participants, 9(75.0%) of the participants from the experimental group fall between 45-50 years old, while those between 51-55 years old accounted for 3(25.0%). Similarly, for the control group, 11(73.3%) of the participants were between 45-50years old, while 4(26.7%) 51-55 years old. Age distribution of the combined sample reveals that 20(74.1%) of the study participants representing the majority were within 45-50 years old, while 7(25.9%) were between 51-55years.

❖ *Hypotheses Testing*

➢ *Hypothesis One:*

There will be no significant difference in the pre-test and post-test values of blood pressure of sedentary adults in Lagos, Nigeria, after exposure resistance exercise training programme.

Table 2: ANCOVA Result on Blood Pressure of Sedentary Adults in Lagos, Nigeria after Exposure to Resistance Exercise Training Programme

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Blood pressure	660.459	1	660.459	220.537	.000	.902
Resistance	371.209	1	371.209	123.953	.000	.838
Error	71.874	24	2.995			
Total	1588.630	26				

$P < 0.05$; $F(1, 24) = 4.26$

From the results in table 2, there is a significant difference (reduction) in the pre-test and post-test values of blood pressure after exposure to resistance training programme, because the calculated F-value of 123.953 is greater than the critical value $F(1, 24) = 4.26$ at 0.05 level of significance

➢ *Hypothesis Two:*

There will be no significant difference in the pre-test and post-test values of resting heart rate of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. This hypothesis was tested using Analysis of Covariance, and the result is presented in Table 3

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Table 3: ANCOVA Result on Resting Heart Rate of Sedentary Adults in Lagos, Nigeria, after Exposure to Resistance Exercise Training Programme

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Resting heart	911.171	1	911.171	204.733	.000	0.895
Resistance	354.343	1	354.343	79.618	.000	0.768
Error	106.813	24	4.451			
Total	1228.296	26				

$P < 0.05$; $F(1, 24) = 4.26$

From the results in table 3, there is a significant difference (reduction) in the pre-test and post-test values of resting heart rate after exposure to resistance training programme, because the calculated F-value of 79.618 is greater than the critical value F (1, 24) = 4.26 at 0.05 level of significance.

- *Hypothesis Three:*

There will be no significant difference in the pre-test and post-test values of waist-to-hip ratio of sedentary adults in Lagos, Nigeria, after exposure to resistance exercise training programme. This hypothesis was tested using Analysis of Covariance (ANCOVA) and the result is presented in Table 4

Table 4: ANCOVA Result on Waist-Hip-Ratio of Sedentary Adults in Lagos after Exposure to Resistance Exercise Training Programme

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Waist-to-hip	3100.809	1	3100.809	318.316	.000	0.930
Resistance	499.973	1	499.973	51.325	.000	0.681
Error	233.791	24	9.741			
Total	3531.407	26				

$P < 0.05$; $F(1, 24) = 4.26$

From the results in table 4, there is a significant difference (reduction) in the pre-test and post-test values of waist-to-hip ratio after exposure to resistance training programme, because the calculated F-value of 51.325 is greater than the critical value F (1, 24) = 4.26 at 0.05 level of significance.

- *Hypothesis Four*

There will be no significant difference in the pre-test and post-test values of plasma triglyceride of sedentary adults in Lagos, Nigeria, after exposure to resistance exercise training programme. This hypothesis was tested using Analysis of Covariance (ANCOVA) and the result is presented in Table 5

Table 5: ANCOVA Result on Plasma Triglyceride of Sedentary Adults in Lagos, after Exposure to Resistance Exercise Training Programme

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Plasma	1991.279	1	1991.279	1519.348	.000	0.984
Resistance	505.121	1	505.121	385.408	.000	0.941
Error	31.455	24	1.311			
Total	3323.185	26				

$P < 0.05$; $F(1, 24) = 4.26$

From the results in table 5, there is a significant difference (reduction) in the pre-test and post-test values of plasma triglyceride after exposure to resistance training programme, because the calculated F-value of 385.408 is greater than the critical value F (1, 24) = 4.265 at 0.05 level of significance

- *Hypothesis Five*

There will be no significant difference in the pre-test and post-test values of fasting blood sugar level of senior non-teaching staff in University of Lagos after exposure to resistance exercise training. This hypothesis was tested using Analysis of Covariance (ANCOVA) and the result is presented in Table

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Table 6: ANCOVA Result on Fasting Blood Sugar Level of Sedentary Adults in Lagos after Exposure to Resistance Exercise Training Programme

Source	Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Square
Fasting blood	4120.091	1	4120.091	703.742	.000	0.967
Resistance	612.732	1	612.732	104.659	.000	0.813
Error	140.509	24	5.855			
Total	5291.185	26				

$P < 0.05$; $F(1, 24) = 4.26$

From the results in table 6, there is a significant difference (reduction) in the pre-test and post-test values of fasting blood sugar level after exposure to resistance training programme, because the calculated F-value of 104.659 is greater than the critical value F (1, 24) = 4.26 at 0.05 level of significance

IV. DISCUSSION OF FINDINGS

The first hypothesis states that there will be no significant difference in the pre-test and post-test values of blood pressure of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. The findings of this study reveal that resistance exercise brings about a significant reduction on blood pressure. This finding negates the meta-analysis conducted by Meredith, Friberg, Jennings, Dewar, Fazio, Lambert and Esler, (2016) that resistance exercise only cannot yield a significant result in the reduction of blood pressure.

The second hypothesis states that there will be no significant difference in the pre-test and post-test values of resting heart rate of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. The findings of this study reveal that resistance exercise shows significant reduction on the resting heart rate of participants. This study negates the position of Meredith, et.al., (2016) that resistance training cannot yield a positive result in the reduction of resting heart rate, but the study is in agreement with the findings of ACSM (2010) and Coombes (2015), that resistance exercise (strength training) is an effective strategy in the reduction of resting heart rate of at-risk adults. This study also disagrees with the claims of Carlson, Dieberg, Hess, Millar, and Smart (2014), that resistance training leads to vascular stiffness that may later result in high resting hate rate.

The third hypothesis states that there will be no significant difference in the pre-test and post-test values of the waist-to-hip ratio of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. Findings from this study show that there was a significant difference in the pre-test and post-test measurements of the waist-to-hip ratio of participants when compared to their control group after exposure to resistance exercise. The study further reveals that there is a direct relationship between load consistency and waist-to-hip reduction in resistance exercise, as participants who were consistent in adhering to the weight of loads and number of repetitions were found to record a higher rate of reduction in waist-to-hip ratio than their fellow participants in the same experimental group who were not up to 90% consistent with adhering to recommended repetitions and weight of loads. This study confirms the position of ACSM (2010) that resistance exercise is very essential in the planning of a weight reduction exercise programme. The study is in contrast with the claims of Kodama (2010), that strength training/resistance exercise does not yield a better result on weight reduction than aerobic exercise.

The fourth hypothesis states that there will be no significant difference in the pre-test and post-test values of plasma triglyceride of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. The findings showed that resistance exercise is an effective strategy in reducing plasma triglycerides. This study is in support of the findings of the clinical experiment conducted by ACSM (2015) that finally recommends the adoption of resistance exercise as an essential supplement to aerobic exercise in the reduction of plasma triglyceride in at-risk populations.

The fifth hypothesis states that there will be no significant difference in the pre-test and post-test values of fasting blood sugar level of sedentary adults in Lagos, Nigeria after exposure to resistance exercise training programme. This study shows that there was a significant difference in the fasting blood sugar level of participants in the experimental group after exposure to resistance exercise. Various studies by Mancia, (1994), Kodama (2010), Rezaeimanesh, (2011), Thompson (2016), etc., are in line with the fact that blood sugar reduces as a result of aerobic exercise, but there are arguments in the literature as to the capacity of resistance exercise to reduce fasting blood sugar. While Veronique (2011) argued that the major fuel needed for resistance exercise is from fat metabolism and does not necessarily require the utilization of blood glucose, Pescatello, Franklin, Fagard, Farquhar, Kelley, and Ray (2004), Sharman and Stowasser (2009), and ACSM (2010), argued in contrast that as adaptation to resistance exercise prolongs, fat reduction to give way for muscle hypertrophy and glucose depletion are evident in the participants. The result of this study therefore agrees with this claim and negates the conclusion of a meta-analysis conducted by Pattyn, Cornelissen, Eshghi and Vanhees, (2013) and Meredith, et.al. (2016), that resistance

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exercise only cannot yield a positive result in the reduction of fasting blood sugar. This study also supports the position of the ACSM (2015), that resistance exercise should be considered in planning a better strategy in the reduction of fasting blood sugar level of at-risk population.

RECOMMENDATIONS

This study recommends as follows;

- Resistance exercise should be adopted in the prevention and reduction of cardiovascular disease risk factors.
- In administering exercise for any purpose, resistance exercise should be an integral part to achieve a better result.
- Senior non-teaching staff between the ages of 45-55years are to constantly be encouraged to participate in resistance exercise programme in the prevention and treatment of CVD risk factors.

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