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Effect of Step Aerobics on Blood Glucose Level and Cardiorespiratory Parameters of Overweight Adults in Vom, Plateau State, Nigeria

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Abstract
Background*: This study was aimed at determining the effect of step aerobics training on blood glucose and cardiorespiratory parameters of overweight adult in Vom, Plateau State, Nigeria.*
Materials and Methods*: Twenty (20) overweight adults participants were selected using the purposive sampling technique from Vom, Plateau State, Nigeria. Participants were trained for 8weeks with a frequency of 3 days per week and a duration of 48minutes with a moderate intensity of HR max of between 50-65%. Blood Glucose Level (BGL), Resting Heart Rate (RHR), Peak Expiratory Flow Rate (PEFR) and forced expiratory volume in one second (FEV_1) were taken at pre training and post training(after 8 weeks of step aerobics training) respectively.*
Results*: Results showed that Step aerobics training significantly reduced the BGL of overweight adults ($P < 0.05$), caused no reduction on the RHR of overweight adults ($P > 0.05$) and increased the PEFR and FEV_1 of overweight adults ($P < 0.05$).*
Conclusion*: The effect of step aerobics on the overweight adults has proven to be generally positive on the basis of these findings, therefore Step aerobics should be publicized in fitness and wellness centers as a mode of training as it has shown evidence of metabolic and cardiorespiratory adaptations in overweight adults by causing a reduction in BGL, increasing PEFR and FEV_1*
Key Word: blood glucose level, resting heart rate, peak expiratory flow rate, forced expiratory volume in one second and step aerobics

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I. Introduction

Step aerobics is one of the most popular collective forms of fitness in health centers and fitness clubs. Step aerobics, invented by Gin Miller combine step-on and step-off movements with marching, dancing, jogging and jumping exercise, put together in choreographed sequences using a step bench at various heights ranging from 10 to 25 cm (24). Step aerobics is a form of aerobic exercise that is considered a low-impact activity when the bench height is relatively low. This makes it a safe form of fitness training. The main purpose of step aerobics is to develop cardio-respiratory efficiency (10). Therefore making step aerobics a suitable exercise modality for this study.

Exercise is a common physiological stressor that causes perturbation to glucose homeostasis and energy needs depending on the speed and force of muscle contraction and the utilization of energy substrates (17). At the onset of moderate-intensity aerobic exercise, glucose production by the liver increases by about 5 – 10 folds to match peripheral glucose disposal into the working muscle. In healthy individuals, glucose production can be up to 10 mg/kg/min during high-intensity aerobic exercise (i.e., 60–80% of maximal aerobic capacity,) with very minimal changes in circulating glucose concentration (16). Control of glucose homeostasis during aerobic exercise is dictated by a complex interaction between multiple hormonal regulators (e.g., insulin, glucagon, catecholamines, and glucocorticoids), the nervous system and various molecular regulators within skeletal muscles and liver, allowing for precise control of glucose concentration during most activities (17).

Resting heart rate is simply the number of times the heart beats per minute at rest. A normal resting heart rate for an adult falls between 60 and 90 beats per minute. Heart rate (HR) is a major determinant of cardiac output and is controlled by factors intrinsic to the heart as well as extrinsic, neural and hormonal factors. The inherent rhythmicity of the heart as established by its sinoatrial node, is regulated primarily by sympathetic and parasympathetic neurons emanating from the cardioregulatory center of the medulla (3). The sympathetic cardioaccelerator nerves release norepinephrine at their endings and cause HR to increase during exercise (3).

The average resting HR for a sedentary individual is approximately 72 beats per minutes. The average resting HR for a trained person is somewhat lower, depending on the state of training. At the beginning of an aerobic exercise, HR increases almost instantaneously (3). The mechanisms for this rapid response are not well understood, but a neural reflex with origin in joint receptors and muscle spindles may be involved (18).

Forced Expiratory Volume in one second (FEV_1) is the volume of gas exhaled in one second by a forced expiration following a full inspiration. The peak expiratory flow rate (PEFR) is a person's maximum speed of expiration. It measures the airflow through the bronchi and thus the degree of obstruction in the airways. The PEFR is a test that measures how fast a person can exhale (15). With the introduction of the Mini Wright's peak flow meter devised and designed by BM Wright (23) it has been in tremendous use in lung function studies and exercise physiology. FEV_1 and PEFR are strong indicators of lung function and a useful measure of how quickly lungs can be emptied. Increase in PEFR and FEV_1 has positive effect on increasing work capacity and power output (8).

Overweight is defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilogram divided by the square of his height in meters square (Kg/m^2). A BMI of 25.0 – 29.9 is classified as overweight (22)

According to the 2010 WHO survey data on Nigeria, the prevalence of overweight was 26% and 37% in men and women respectively, while the prevalence of obesity was 3% and 8.1% in men and women respectively (7). Excess fat accumulation tends to reduce the sensitivity of the body cells to insulin, thereby increasing the circulating blood glucose level. Chronic high glucose concentration in the blood causes tissue injury, this in turn leads to increase risk for heart attack, stroke, end-stage kidney disease, retinopathy and blindness, and ischemia and gangrene of the limbs (11).

This excess fat accumulation propels the heart to beat faster to enable it meet the body's oxygen and nutrients demand due to the increased body surface area; thus increasing resting heart rate which may lead to heart related mortality (25).

Excessive accumulation of connective tissue in abdominal cavity pushes diaphragm to thoracic cavity, reduces excursions of thorax and ventilation of lower part of lungs (9). This excess fat accumulation in the bronchi tree could reduce the volume of gases passing through the respiratory airways and thus result to decreased FEV_1 and PEFR. These changes in lung volumes can develop to obstructive and restrictive lungs diseases.

Based on the following gaps observed, this research examined the effects of step aerobics on blood glucose level, resting heart rate, peak expiratory flow rate and forced expiratory volume in one second of overweight adults.

II. Research Methodology

2.1 Research Design/Population

The pretest-posttest single group research design was used for this study. This design evaluates causal relationships between intervention and outcome. In this design, a single group of research participants was pretested, given some treatment or independent variable manipulation, and then post tested. If the pretest and posttest scores differ significantly, then the difference may be attributed to the independent variable (4). Thus, the participants would be assessed at baseline and at the end of the training (8 weeks) on the selected variables.

The population of this study was made of all overweight adults respondents in the Medical Laboratory Unit and Animal Health section of the National Vertinary Research Institute (NVRI), Vom, Plateau State, Nigeria. The population of 33 overweight adults were used for this study.

2.2 Sample and Sampling Techniques

A sample of 20 overweight adults was used for this study. The purposive sampling technique was used to draw the sample. Purposive sampling technique was used to select the overweight adults from the Medical Laboratory Unit and Animal Health section of the National Vertinary Research Institute (NVRI) Vom, Plateau State. Participants were included based on the inclusion criteria. I.e. adults with a body mass index of between 25 to 29.9 kg/m^2. The weights and heights were assessed for the computation of their body mass index (BMI) as body weight in kilogram divided by the height in meters squared. The researcher used a digital Weighing scale in Kilograms made by Camry, China (2012) to assess participants' weight and a meter rule to determine participants' height. Body weight in kilogram was divided by the height in meters squared to determine BMI.

2.3 Instrumentation

The following instruments were used for data collection in this study:

1) Stop watches: Digital Sport Timer Alarm, (Casio, made in China 2010). Used in timing the various stages of step aerobics training.

2) Meter rule: (Made in Nigeria) used in measuring participants' height in meters
3) Step benches: 15 cm height (Made in Nigeria) used by the participants to step up and down during the step aerobics training.
4) Digital Automatic Blood pressure Monitor (Made in Japan): used in measuring resting heart rate of participants in beats per minute.
5) Digital Spirometer made by Medical Institute of Research (MIR) in Italy: used in measuring PEFR and FEV_1 of participants in liters per minute and liters per second respectively.
6) Accu Chek Glucose Meter made in Japan was used in measuring blood glucose level of participants in mg/dl.
7) A digital Weighing scale in Kilograms made by Camry, China (2012) was used in measuring weight of participants in kg.

2.4 Test Description

2.4.1 Determination of Blood Glucose Level

The blood glucose levels of the participants were assessed using the fasting glucose test method. The test was carried out by the researcher at early hours of the morning before taking breakfast. The Accu Chek Glucose Meter was used in measuring blood glucose level. On each test strip there is a test area containing sensitive chemicals. When blood is applied to the test area, the glucose dehydrogenase enzyme (Mut. Q-GDH 2) reacts with the blood glucose. The subsequent chemical reaction changes the colour of the test area. The meter registers this colour change and converts the signal obtained into a blood glucose result (Accu-Chek Active Manuel).

Procedures

1. Participants sat in an upright position with hand stretch out.
2. Using a blood lancet, one of the fingers was pricked to draw blood.
3. The initial blood was wiped out because it contains dead epithelial cells which do not depict the true component of blood.
4. Subsequent blood was placed at the sensor of the glucose test strip.
5. The Accu Chek glucose meter was turned on and the test strip was inserted into the space provided for the test strip.
6. The Accu Chek glucose meter displays the result on its screen.
7. The reading was then recorded in mg/dl.

2.4.2 Determination of Resting Heart Rate

The resting heart rates of the participants were determined by the researcher using a Digital Automatic Blood pressure Monitor recorded in beats per minute. The Omron M2 basic is a fully automatic blood pressure monitor device that operates on the oscillometric principle. The cuff tab of the Digital Automatic Blood pressure Monitor was placed on the arm just above the cubical fossa where the heart beat can be felt. The procedure was repeated twice and the average was recorded.

Procedures

1. Each Participant sat in an upright position.
2. Wear loose fitting clothing and remove any tight cloth, ring, wrist watch.
3. The cuff tab of the Digital Automatic Blood pressure Monitor was wrapped on the arm just above the cubical fossa where the heart beat can be felt.
4. The Digital Automatic Blood pressure Monitor was turned on.
5. The heart rate was displayed on the screen and recorded in beats per minute.
6. An average of two readings was recorded for each participant.

2.4.3 Determination of PEFR and FEV_1

Peak expiratory flow rate and Forced expiratory volume in one second were measured using a digital spirometer. Measurement of PEFR and FEV_1 was taken in liters per minute and liters per second respectively.

Procedures

1. Each Participant stood in an upright position.
2. Place the mouth piece of the digital spirometer in the mouth and close lips tightly.
3. Each participant took the deepest breath possible and then exhale into the sensor (mouth piece) as hard as possible for as long as possible.
4. Reading was displayed on the screen of the digital spirometer for both PEFR and FEV_1.
5. Test procedure was repeated twice and average was recorded.

2.5 Test Procedures

2.5.1 Pre-Test Measurement

The pre-test measurement took the following order after adequate rest from each test:

1. Resting Heart rate
2. Blood Glucose level
3. Peak expiratory flow rate
4. Forced expiratory volume in one second

2.5.2 Pre-Training Explanation

Participants were given preliminary instructions as recommended by the Canadian Society for Exercise Physiology for example no eating, drinking caffeine, smoking, or drinking alcohol before each exercise session. The preliminaries, training procedures, objectives of the study and pre-test measurements were presented to the participants before training commenced.

2.5.3 Training Procedure

Participants began with a total body warm up exercise for about ten (10) minutes with subsequent rest and thereafter proceeded to take their respective positions with a step bench in front of each participant. Participants stepped up and down a 15 cm step bench in accordance with a 105 bits per minute music cadence for the first 4 weeks (which is slow tempo music). In the last 4 weeks, participants stepped up and down a 15 cm step bench in accordance with a 110 bits per minute music cadence (which is a faster tempo music) there by establishing a training intensity of 90 to 100 beats per minute as target heart rate zone. Participants were motivated during the training session to boost their morale via words of encouragement. The training session was terminated with stretching exercises as cool down.

2.5.3.1 Duration

The training session lasted for 48 minutes. Every 5 minutes of the training session was accompanied with a 3 minutes rest. This was to achieve a training of 30 minutes and 18 minutes of rest. The frequency of the training session was three (3) times a week for 8 weeks.

2.5.3.2 Rating of Perceive Exertion

RPE was monitored as another measure of training intensity. Rating of perceived exertion was measured using Borg's RPE scale. Participants rated their subjective exercise intensity from a scale of 6–20; six being equivalent to complete rest and 20 being equivalent to maximum effort. Participants trained within the Borg's scale RPE of 10-12 (somewhat hard). This was achieved by educating the participants of the consciousness of how they felt while training. Participants were told to cease training as soon as they felt stressful or gasp deeply for air while training. RPE was recorded after each set throughout the exercise session. The mean RPE was calculated for the whole exercise session.

Table 2.5.3.3 Training Section for the First 4 Weeks

Stages of Training Each Day	Duration of Training (min)	RPE	Training Intensity	Tempo of Music (bit per min)
1 (WU with R)	10			
2 (ST)	5	8-10 (light)	Low	105
3 (R)	3			
4 (ST)	5	8-10	Low	105
5 (R)	3			
6 (ST)	5	8-10	Low	105
7 (R)	3			
8 (ST)	5	8-10	Low	105
9 (R)	3			
10 (ST)	5	8-10	Low	105
11 (R)	3			
12 (ST)	5	8-10	Low	105
13 (R)	3			
14 (CD)	10			

Key: WU = warm up, R = rest, ST = step training, CD = cool down, REP = rating of perceived exertion

Participants began with a total body warm up exercise for about ten (10) minutes with subsequent rest and thereafter proceeded to take their respective positions with a step bench in front of each participant. Participants stepped up and down a 15 cm step bench in accordance with a 105 bits per minute music cadence

(which is slow tempo music). Every 5 minutes of the training session was accompanied with a 3 minutes rest. This was to achieve a training of 30 minutes and 18 minutes of rest. Participants trained within the Borg's scale RPE of 8-10 (light).

Table 2.5.3.4 Training Section for the Last 4 Weeks

Stages of Training Each Day	Duration of Training (min)	RPE	Training Intensity	Tempo of Music (bit per min)
1 (WU with R)	10			
2 (ST)	5	10-12 (somewhat hard)	Moderate	110
3 (R)	3			
4 (ST)	5	10-12	Moderate	110
5 (R)	3			
6 (ST)	5	10-12	Moderate	110
7 (R)	3			
8 (ST)	5	10-12	Moderate	110
9 (R)	3			
10 (ST)	5	10-12	Moderate	110
11 (R)	3			
12 (ST)	5	10-12	Moderate	110
13 (R)	3			
14 (CD)	10			

Key: WU = warm up, R = rest, ST = step training, CD = cool down, REP = rating of perceived exertion

Participants began with a total body warm up exercise for about ten (10) minutes with subsequent rest and thereafter proceeded to take their respective positions with a step bench in front of each participant. Participants stepped up and down a 15 cm step bench in accordance with a 110 bits per minute music cadence (which is a fast tempo music). Every 5 minutes of the training session was accompanied with a 3 minutes rest. This was to achieve a training of 30 minutes and 18 minutes of rest. Participants trained within the Borg's scale RPE of 10-12 (moderate).

2.6 Statistical Analysis

Descriptive statistics of mean and standard deviation of all the parameters for the different stages of training were used to describe the stages of training after the pre (0 weeks) and post (8 weeks) duration. Paired t-test was used to determine significant difference between pre and post data of the variables using an alpha level of 0.05.

III. Results

The physical characteristic of the participants, baseline and posttest descriptive statistics of the variables is presented in table 3.1, the paired t-test pre and post test variables is presented in table 3.2 to 3.5 and the result of the paired t-test is illustrated in figure 3.1 to 3.4.

Table 3.1: Mean, Standard Error of Mean, Standard Deviation of Physical Characteristics, Blood Glucose Level and Cardio-respiratory parameters (RHR, PEFR and FEV_1) of the participants

Variable	Mean	SEM	SD
Weight (kg)	74.8	2.52	±11.28
Height (m)	1.65	0.02	±0.09
BMI (kg/m^2)	27.5	0.06	±1.49
BGL (mg/dl)			
Pre-test	90.6000	2.37354	±10.61479
Post-test	79.4000	2.64117	±11.81167
RHR (beats/min)			
Pre-test	76.4000	1.08434	±4.84931
Post-test	74.8500	1.98053	±8.85720
PEFR (l/min)			
Pre-test	319.7000	35.89056	±160.50745
Post-test	391.6000	43.50447	±194.55791
FEV_1(l/sec)			
Pre-test	2.9055	0.20904	±0.93485
Post-test	3.0855	0.25193	±1.12667

Note: BMI= body mass index, SD= standard deviation, SEM= standard error of mean, kg= kilogram, m= meter, BGL= blood glucose level, RHR= resting heart rate, PEFR= peak expiratory flow rate, FEV_1= forced expiratory volume in one second.

The mean weight of the participants was 74.8±2.52 kg, with mean height and BMI of 1.65±0.02 m and 27.5±0.06 kg/m^2 respectively.

Table 3.1 showed that 8 weeks of step aerobics decreased the blood glucose level of overweight adults from 90.6000±2.37354 to 79.4000±2.64117 mg/dl, decreased the resting heart rate of overweight adults from 76.40000±1.08434 to 74.85000±1.98053 beats/min, increased the peak expiratory flow rate and forced expiratory volume in one second of overweight adults from 319.7000±35.89056 to 391.6000±43.50447 liter/min and 2.9055±0.20904 to 3.0855±0.25193 liter/sec respectively.

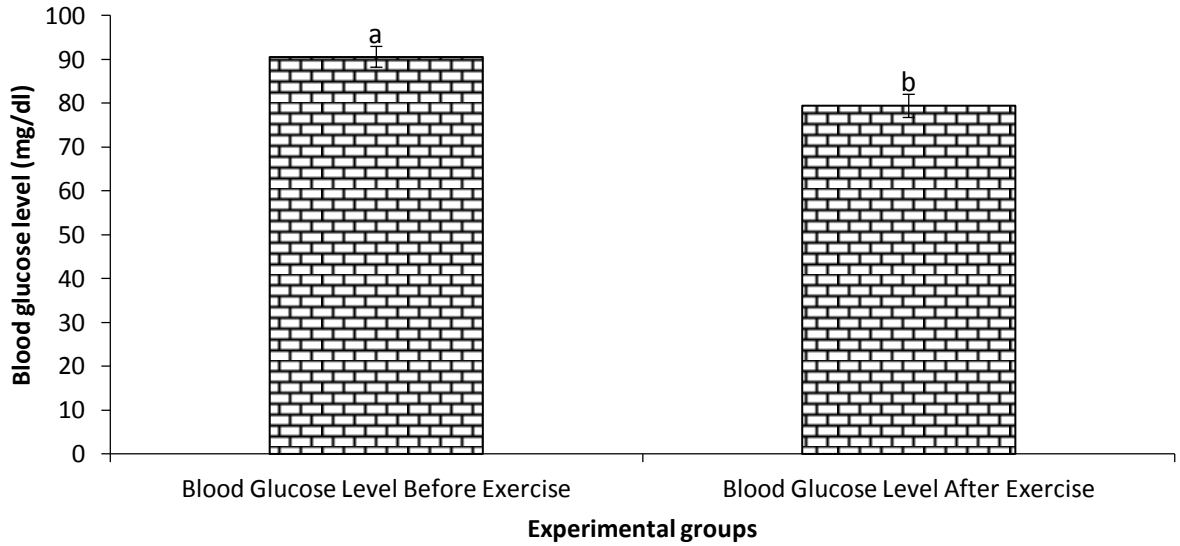
Table 3.2 Paired t-test Analysis of the Pre and Post test scores of Blood Glucose Level of Overweight Adult Participants.

Variable	Test Period	Mean	SEM	SD	DF	T	P
BGL	Pretest	90.6000	2.37354	10.61479	19	7.241	0.000**
	Posttest	79.4000	2.64117	11.81167			

t(19) = 1.645, P<0.05, ** = significant, * = not significant

Table 3.2 showed that 8 weeks of step aerobics caused statistical significant reduction on the blood glucose level of the overweight adults (P<0.05).

The results of table 3.2 is presented in figures 3.1



a, b= significance at p<0.05

Fig 3.1 Bar graph showing the effect of step aerobics on blood glucose level of overweight adults before and after the training.

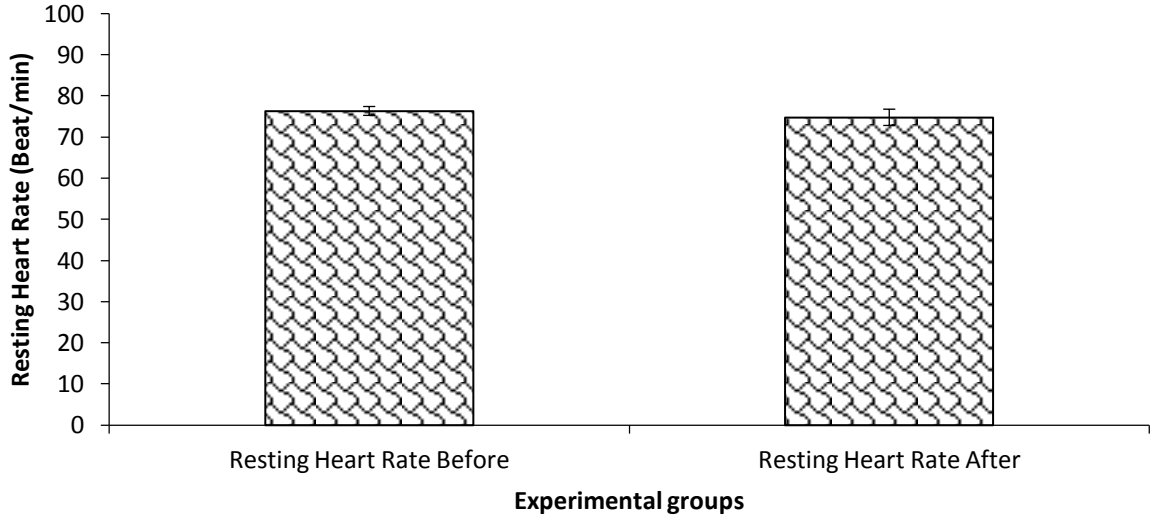
Table 3.3 Paired t-test Analysis of the Pre and Post test scores of Resting Heart Rate of Overweight Adult Participants.

Variable	Test Period	Mean	SEM	SD	DF	t	P
RHR	Pretest	76.4000	1.08434	4.84931	19	0.943	0.358*
	Posttest	74.8500	1.98053	8.85720			

t(19) = 1.645, P<0.05, ** = significant, * = not significant

Table 3.3 showed that 8 weeks of step aerobics caused no statistical significant reduction on the resting heart rate of overweight adults (P>0.05).

The results of table 3.3 is presented in figures 3.2



a, b= significance at p<0.05

Fig 3.2 Bar graph showing the effect of step aerobics on resting heart rate of overweight adults before and after the training

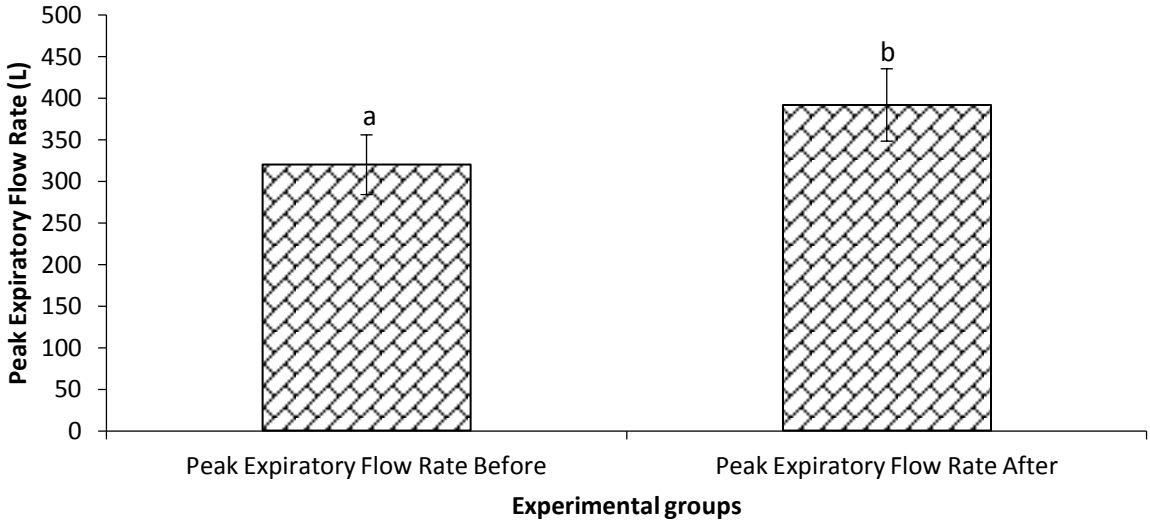
Table 3.4 Paired t-test Analysis of the Pre and Post test scores of Peak Expiratory Flow Rate of Overweight Adult Participants.

Variable	Test Period	Mean	SEM	SD	DF	t	P
PEFR	Pretest	319.7000	35.89056	160.50745	19	3.823	0.001**
	Posttest	391.6000	43.50447	194.55791			

t(19) = 1.645, P<0.05, ** = significant, * = not significant

Table 3.4 showed that 8 weeks of step aerobics caused statistical significant increase in the peak expiratory flow rate of overweight adults (P<0.05).

The results of table 3.4 is presented in figures 3.3



a, b= significance at p<0.05

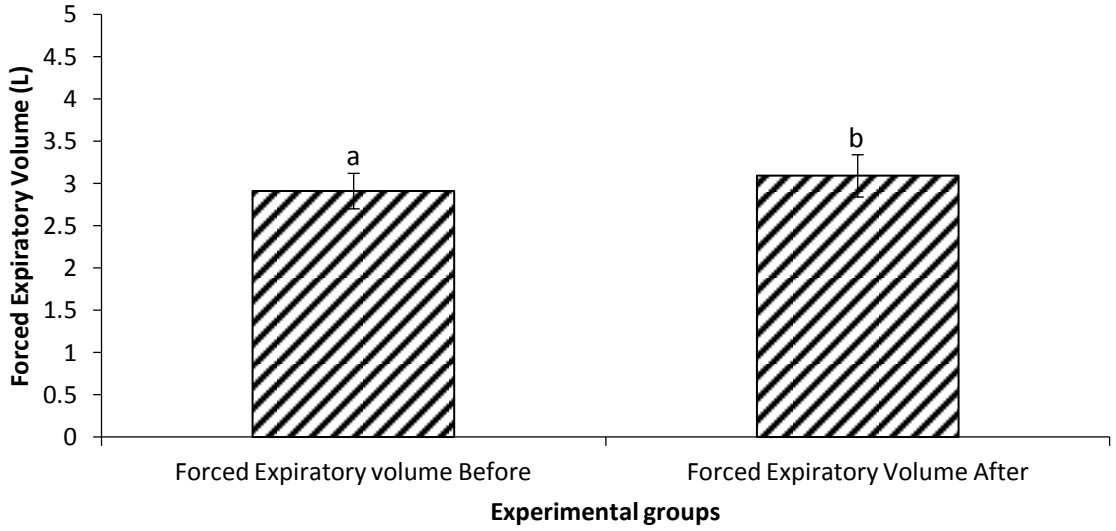
Fig 3.3 Bar graph showing the effect of step aerobics on PEFR of overweight adults before and after the training

Table 3.5 Paired t-test Analysis of the Pre and Post test scores of Forced Expiratory Volume in one second of Overweight Adult Participants.

Variable	Test Period	Mean	SEM	SD	DF	t	P
FEV_1	Pretest	2.9055	0.20904	0.93485	19	2.243	0.037**
	Posttest	3.0855	0.25193	1.12667			

t(19) = 1.645, P<0.05, ** = significant, * = not significant

Table 3.5 showed that 8 weeks of step aerobics caused statistical significant increase in forced expiratory volume in one second of overweight adults (P<0.05).
The results of table 3.5 is presented in figure 3.4



a, b= significance at p<0.05
Fig 3.4 Bar graph showing the effect of step aerobics on FEV_1 of overweight adults before and after the training

IV. Discussion

This study investigated the effect of 8 weeks step aerobic training on blood glucose levels and cardiorespiratory parameters of overweight adults in Vom, Plateau State.

In this study, the decrease in blood glucose level (post training) of overweight adults was statistically significant compared to the pre step aerobics training (P< 0.05). This reduction could be as a result of the utilization of glucose as fuel for the exercising muscles. This finding agrees with a study (2) on glucose level of Nigerian college students after a 12-week resistance training programme, result showed a significant effect of the training especially on blood glucose. Also agrees with a study (20) on the effect of aerobic exercise on fasting glucose level in patients with diabetes and found out that the average value of the fasting plasma glucose level had a statistical decrease after the therapy. Another research (1) agrees with the findings of this study after evaluating on the plasma biochemical changes during moderate and vigorous exercises and found out that glucose level was significantly reduced in moderate exercising subjects compared with the controls.

In this study, the decrease in resting heart rate (post training) of overweight adults was not statistically significant compared to pre step aerobic training. A statistically significant decrease in the resting heart rate may be achieved if the intensity of training was a higher volume of intensity. Unlike a study (14) on the comparative effects of exercise on selected cardiorespiratory parameters among young adults from different ethnic groups resident in Nigeria which showed a significant decrease in pre exercise pulse rate. Contrary to the statistically insignificant decrease in resting heart rate of this study, a research (21) on the effects of aerobic training on resting heart rate dynamics in sedentary subjects found out that after 8 weeks of training; mean resting heart rate decreased for both moderate and high volume training groups respectively. Unlike another study (12) on the effect of 12 weeks combining power and aerobic step exercises on women's health profiles. Aerobic step exercises were executed in 80-90 percent of maximum heart rate. Lower body part power exercises were done before aerobic step exercises and upper body part power exercises were done after aerobic step exercises. Subject's resting heart rate was decreased significantly. There was also a significant decreased in measured heart rate after the training session.

In this study, the increase in peak expiratory flow rate (post training) of overweight adults was statistically significant compared to pre step aerobic training (p< 0.05). This increase in peak expiratory flow rate could be due to strengthening of the respiratory muscles, increased elasticity of the lungs and easy passage of air in the bronchi tree. This finding agrees with a group of researchers (6) who studied "Moderate intensity aerobics training and found improvement in pulmonary function in young Indian men". After the training, there was significant improvement in peak expiratory flow rate. Also agreeing with a study (5) on the effect of aerobic

exercise training on peak expiratory flow rate: a pragmatic randomized controlled trial. Result shows that peak expiratory flow rate value improved by 17% in the experimental group after the 16 weeks training. This finding agrees with yet another study (13) on the effects of cardiorespiratory response to aerobic exercise programs with different intensity: 20 weeks longitudinal study. Result showed that significant improvement was seen in high intensity group in majority of cardiorespiratory parameters (peak expiratory flow rate) as compared to the lower intensity group and this improvement was specifically seen at the end of the twentieth week.

In this study, the increase in forced expiratory volume in one second (post training) of overweight adults was statistically significant compared to pre step aerobic training ($p< 0.05$). This increase could have been as a result of the improved filling capacity of the lungs. This finding agrees with a study (14) on the comparative effects of exercise on selected cardiorespiratory parameters among young adults from different ethnic groups resident in Nigeria. There was a significant increase in post exercise of forced expiratory volume in one second in Igbo when compared to Yoruba. A research (19) shows that maximal exercise improve FEV_1. Significant difference was found in FEV_1 between pre and post-tests results in the group that performed the aerobic test protocol.

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References

[1]. Adedapo, K.S, Akinosun, O.M, Arinola, G.O, Odegbemi, B.O and Adedeji O.I (2009) Plasma biochemical changes during moderate and vigorous exercises. *Int J Sports Sci Eng*. 3(2):073-076.

[2]. Ajayi-Vincent, O.B, Adesina, M.O, and Babalola O.O. (2013) Glucose level of Nigerian college students after a 12-week resistance training programme. *JETERAPS* 4(3):399-406.

[3]. American College of Sport Medicine., (1993). "*Resource Manual for Guidelines for Exercise Testing and Prescription*". Second edition. Lea & Febiger. Pages 67-68.

[4]. Andrew, M.C., (2014) Single group pretest-posttest experimental research design. *Oxford University Press.*

[5]. Chaitra, B., and Vijay, M.. (2011) Effect of Aerobic Exercise Training on Peak Expiratory Flow Rate: a Pragmatic Randomized Controlled Trial. *IJBMR* 2(3):789–92.

[6]. Chaitra, B., Narhare, P., Puranik, N, and Maitri V. (2012) "Moderate intensity aerobics training improves pulmonary function in young Indian men". *Biomedical Research* 23(2):231-233.

[7]. Ejike, C., and Ijeh, I., (2012). Obesity in young-adult Nigerians: variations in prevalence determined by anthropometry and bioelectrical impedence analysis, and the development of % body fat prediction equations. *IAM* 5:22.

[8]. Enright, S.J. and Unnithan, V.B. (2011) effect of inspiratory muscle training intensities on pulmonary function and work capacity in people who are healthy: A randomized controlled trial. *JPT*. 91:894-905.

[9]. Farah, C.S. and Salome, C.M. (2012) Asthma and obesity: A known association but unknown mechanism. *Respirology*. 17:412-21

[10]. Forte, R., De Vito, G., Murphy, N., and Boreham, C., (2001). Cardiovascular response during low intensity step aerobic dance in middle ages subjects. *EJSS* 1:1-7.

[11]. Guyton, A., and Hall, J.E., (2011) "*Text book of medical physiology*". 9th ed. Philadelphia: W.B. Saunders Company; 300-18.

[12]. Hallage T., Krause M.P., Haile L., Miculis, C.P., Nagle, E.F., Reis, R.S., (2010) The effects of 12 weeks of step aerobics training on functional fitness of elderly women. *J. Strength Cond. Res.* 24 (8): 2261–2266.

[13]. Hulke, S.M., Phatak, M.S., and Vaidya Y.P. (2012), The effects of cardiorespiratory response to aerobic exercise programs with different intensity: 20 weeks longitudinal study. *JRMS*. 17: 649-655.

[14]. Oluwole, A.O., Isaac, A.O., Olubusola, J.E., Olaoluwa, O.S., and Olutayo. A.M. (2014)

a. The comparative effects of exercise on selected cardiorespiratory parameters among young adults from different ethnic groups resident in Nigeria. *AJCEM* 2(6):123-127.

[15]. Phillips, N., (2012) *Peak Expiratory Flow Rate*, Medically Reviewed by George Krucik, MD Healthline.

[16]. Raguso, C.A., Coggan, A.R., Gastaldelli, A., Sidossis, L.S., Bastyr, E.J., and Wolfe, R.R., (1995) Lipid and carbohydrate metabolism in IDDM during moderate and intense exercise. *Diabetes* ;44(9):1066–1074.

[17]. Riddell, M.C, and Perkins, B.A., (2006) Type 1 diabetes and exercise. Part I: applications of exercise physiology to patient management during vigorous activity. *Can. J. Diabetes*. 30:63–71.

[18]. Rowell, L.B., (1980). What signals govern the cardiovascular responses to exercise? *Med. Sci. Sports Exerc*. 12:307.

[19]. Sezer, N., (2004), Cardiopulmonary and Metabolic Responses to Maximum Exercise and Aerobic Capacity is Hemiplegic Patients . *FUNCT NEUROL*., 19(4): 233-8.
[20]. Tulay, K.T, Ciledag, F.O, Burcu, T, and Yasin T. (2016) The effect of aerobic exercise on fasting glucose level in patients with diabetes. *Eur J Pharm Med Res.* 3(2):46-49
[21]. Tulppo, M.P., Arto, J.H, Timo, H.M, Raija, T.L., Seppo, N., Richard, L.H., and Heikki V.H. (2003) The effects of aerobic training on heart rate dynamics in sedentary subjects. *J. Appl. Physiol*. 95: 364-372.
[22]. World Health Organization, (1998). "*Obesity: preventing and managing the global epidemic. Report of WHO Consultation on Obesity, World Health Organization":* Geneva.
[23]. Wright, B.M, (1978) A miniature Wright peak-flow meter, *BMJ*. (9):2 6152.
[24]. Zar'bska A. Aktywno fizy czna „fitness" (2007) jako forma oddzia ywania usprawniaj co-zdrowotnego (doctoral dissertation). Akademia Wychowania Fizycznego i Sportu im. *Jdrzeja niadeckiego w Gdasku. Gdask* .
[25]. Ziraba, A.K., Fotso, J.C., and Ochako, R. (2009) Overweight and obesity in urban Africa: a population of the rich or the poor? *public health*. 9:465.

E.C. Umeh, et. al. "Effect of Step Aerobics on Blood Glucose Level and Cardiorespiratory Parameters of Overweight Adults in Vom, Plateau State, Nigeria." *IOSR Journal of Sports and Physical Education (IOSR-JSPE,) 8*(1) (2021): 38-47.