EFFECT OF ERGONOMIC BICYCLE EXERCISE ON ANTHROPOMETRIC MEASUREMENT AMONG UNDERGRADUATE STUDENTS IN A NIGERIAN UNIVERSITY

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ABSTRACT

The study examined the effects of a six-week ergonomic bicycle exercise programme on anthropometric measurements among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. Three objectives, three research questions and three hypotheses were formulated to guide the study. A quasi-experimental design was adopted for the study. The population for the study comprised of all undergraduate students of Ignatius Ajuru University of Education, and a sample size of 182, was recruited for the study. The instrument for data collection was a self-structured questionnaire titled effect of a 6-week ergonomic bicycle exercise programme on anthropometric measurement (E6-WEBEPAM) with 0.68 coefficient of reliability. Data was analysed using frequency counts, percentages, mean and standard deviation while the hypotheses were tested using paired samples t-test at 0.05 alpha level of significance. The findings from study showed the mean body weight for male undergraduate students was72.51kg and that of the female student was 66.33kg prior to six-weeks ergonomic bicycle exercise intervention; while it was 65.18kg for male students and 61.67kg for female undergraduate students post six-weeks of ergonomic bicycle exercise intervention. The mean body mass index for male students was 24.30kg/m^2 and 24.38kg/m^2 for female students prior to 6-weeks intervention; and 21.80kg/m^2 for male students and 22.69kg/m^2 post intervention. Percentage body fat was 18.15% for male students and 28.78% for female students prior to exercise intervention; while post exercise intervention was 15.16% for the male students and 26.75% for female students. Furthermore, the paired samples t-tested analysis revealed six-weeks participation in exercise riding the stationary ergonomic bicycle has significant effect on body mass (t= -12.287; p= 0.000); body mass index (t= -12.077; 0.000) and percentage body fats (t= -12.079; p= 0.000) among undergraduate students of Ignatius Ajuru University of Education. It was recommended that the university management should provide stationary ergonomic bicycles on campus and at the same time grant the students unlimited access to these fitness facilities.

Keywords: anthropometric measurements, ergonomic bicycle, exercise, undergraduate students

Introduction

Anthropometric data refers to the measurements and characteristics of the human body, they are used to assess body size and body composition (Cadadel & Kiel, 2022). These measurements can include various aspects such as height, weight, body mass index (BMI), circumference of limbs or body parts, length of limbs, and proportions of different body segments (Cadadel & Kiel, 2022). Anthropometric data is often used in fields such as ergonomics, nutrition, medicine, sports science, and anthropology to study human variation, growth, development, and health (Cadadel & Kiel, 2022; Kumar & Parkinson, 2018). This data can be collected through direct measurements, surveys, or specialized equipment such as callipers, scales, and anthropometers.

Anthropometric data provide valuable information in both clinical and exercise laboratory settings. In clinical settings, the importance of anthropometric data lies in its ability to provide valuable insights into an individual's health status, nutritional status, growth and development, and risk factors for various diseases. Anthropometric measurements, which include parameters such as height, weight, body mass index (BMI), waist circumference, and skinfold thickness, serve as objective indicators of body size, shape, composition, and proportions (Bhattacharya et al., 2019; Bhatti et al., 2021).

In the laboratory setting, anthropometric measurements provide a baseline assessment of participants' body size, shape, and composition before starting an exercise program or research study. This information helps establish individualized exercise prescriptions, track changes over time, and evaluate the effectiveness of interventions. In addition, anthropometric data are used in laboratory settings to tailor exercise prescriptions to participants' individual needs, goals, and abilities. For example, body weight, BMI, and body composition measurements inform decisions about appropriate exercise intensity, duration, and type to achieve desired outcomes such as weight loss, muscle gain, or cardiovascular fitness improvement (Bhattacharya et al., 2019; Bhatti et al., 2021).

Body weight is the mass or quantity of heaviness of an individual (United States National Library of Medicine, 2021). It can also be described as the vertical force exerted by the mass of an individual as a result of gravity (American College of Cardiology and American Heart Association, 2020). It is usually measured using manual or digital weighing scales and the unit of measurement is in pounds or kilograms. Normal healthy body weight varies, what is normal for one person may not be for another as normal healthy body weight depends on the age of the individual, his/her height and gender (Sperrin et al., 2016). Sudden weight gain or loss are extremes that are associated with adverse conditions of the body and may be due to thyroid problems, cancer, digestive diseases, heart diseases, kidney diseases (Jaime & Mank, 2024). Good nutrition and participating in regular exercise can help in weight loss while eating extra calories within a well-balanced diet and treating any underlying medical issue may help in weight gain.

Body Mass Index (also referred to as BMI) is a numerical value of weight of an individual in relation to his/her height. It is an indicator of body fat and it is used as a screening tool to identify whether an adult is at a healthy weight. A BMI between 18.5 and 25kg/m^2 indicates a normal weight, less than 18.5kg/m^2 is considered underweight while between 25kg/m^2 and 29.9kg/m^2 is considered overweight; A BMI of 30kg/m^2 and above is considered obese (American Heart Association, 2024).

Body fat consists of essential body fat and storage fat. Essential body fat is present in nerve tissue, bone marrow, and all organs and cannot be lost without compromising physiological function. Storage fat, on the other hand, represents an energy reserve that accumulates when excess energy is ingested and decreases as more energy is expended than consumed. According to Jeukendrup and Gleeson (2010), essential fat constitutes approximately 3% of total body mass in men and about 12% in women. Women generally possess a higher proportion of essential fat due to hormonal functions and reproductive requirements such as childbearing. Overall, total body fat percentage—comprising both essential and storage fat—typically ranges from 12% to 15% in young men and from 25% to 28% in young women.

Exercise as a type of physical activity is planned, structured and repetitive bodily movement requiring physical or mental effort done to improve health (Makinde et al., 2014; Dasso, 2019). Exercise refers to any form of bodily movement that contributes to the improvement or maintenance of physical fitness, health, and overall well-being. It is therefore a deliberate type of physical activity undertaken with the specific purpose of enhancing or sustaining health and fitness. It involves the voluntary movement of the body, which can range from structured and planned activities such as jogging, weightlifting, swimming, or yoga to more everyday activities such as walking, gardening, or taking the stairs instead of the elevator.

The World Health Organization (WHO) and American Heart Association (AHA) recommend 150 minutes of moderate intensity physical activity or 75 minutes of vigorous physical activity weekly and the time intervals between each should be at least 10 minutes or more per session (AHA, 2024). Moderate or rigorous physical exercises simply means exercises that are of low impact, regular and gradually progress over a period of time. It includes aerobics, swimming, cycling, brisk walking, dancing, active forms of yoga etc. (Centre for Disease Control and Prevention, 2025).

Regular participation exercise offers numerous health benefits which includes improved cardiovascular health and circulation, increased muscle strength and endurance, enhanced flexibility, balance, and coordination, weight management and body composition improvement, reduced risk of chronic diseases such as heart disease, diabetes, and certain types of cancer, better mental health, including reduced stress, anxiety, and depression, improved cognitive function and brain health amongst others (Centre for Disease Control and Prevention, 2022). It is important to note that the type, intensity, duration, and frequency of exercise can vary depending on individual fitness goals, preferences, and physical abilities. In addition, it is essential to consult with a healthcare professional before starting any new exercise program, especially if the individual has pre-existing health conditions or concerns.

Exercise can be categorized into various types, these include: aerobic exercise (activities that increase the heart rate and improve cardiovascular health, such as brisk walking, running, cycling, swimming, and dancing), strength training (exercises that involve resistance or weight training to build and tone muscles, improve bone density, and increase metabolism. For instance lifting weights, using resistance bands, or doing bodyweight exercises like push-ups and squats), flexibility and stretching exercises (activities aimed at improving flexibility, joint mobility, and muscle elasticity, such as yoga, Pilates, and stretching routines) and balance and coordination exercises (activities designed to enhance balance, stability, and coordination, which can help prevent falls and improve overall physical function; examples include tai chi,

balance exercises on unstable surfaces, and certain yoga poses) (Harvard Health Publishing, 2024).

Aerobic exercise, also known as cardiovascular exercise, primarily targets the cardiovascular system and involves sustained, rhythmic movements that increase the heart rate and breathing rate. It focuses on improving the body's ability to utilize oxygen efficiently. Aerobic exercises involve continuous, repetitive movements that engage large muscle groups over an extended period. Examples include running, brisk walking, cycling, swimming, aerobic dance, and jumping rope. These activities typically last for a prolonged duration, typically 20 minutes or more, to achieve the desired cardiovascular benefits. Aerobic exercise primarily targets endurance and stamina by enhancing the body's ability to sustain prolonged physical activity. It improves oxygen delivery to muscles, enhances energy production through aerobic metabolism, and increases the efficiency of the cardiovascular and respiratory systems. While each type of exercises offers unique benefits, a well-rounded fitness program typically includes a combination of aerobic, strength training, flexibility, and balance exercises to promote overall health and fitness.

An ergonomic bicycle is a bicycle designed with features that prioritize comfort, efficiency, and safety for the rider. These features are tailored to accommodate the natural posture and biomechanics of the human body, aiming to reduce strain and discomfort during cycling (Pambul et al., 2022). The ergonomic bicycle can be used by professional athletes as well as those who wish to improve their cardiovascular health. For the professional athlete, ergonomic bicycle exercise can serve as a valuable cross-training activity to complement their primary sport, in addition, athletes can use the ergonomic bicycle for active recovery between intense training sessions, providing a low-impact yet effective way to maintain fitness while reducing the risk of overuse injuries. Regular use of ergonomic bicycle can offer numerous benefits for those who are not professional athletes, for instance, people can improve focus, concentration, and cognitive function by riding ergonomic bicycle. In addition, it can reduce stress levels, increase energy levels and promote better sleep. It is on this premise that this study was carried out to investigate the influence of exercise on anthropometric measurements using the ergonomic bicycle.

Statement of the Problem

Globally, there is a rise in individuals who are overweight and obese. An increase in the participation of regular exercise and prolonged sedentary lifestyle in addition to increased excess food intake has contributed to this rise in overweight and obese individuals. There is a need for preventive interventions as feasible solutions for these adverse outcomes; childhood and early adulthood are considered to be the ideal target periods for effective preventive interventions. It is known that children who are overweight tend to grow to become overweight adults, adverse health conditions that arise in childhood tend to carry over into adulthood if not adequately addressed, children and young adults are far more amenable to intervention strategies than grown adults. The researchers have observed that students including those in Ignatius Ajuru University of Education spend a lot of time in sedentary activities such as long hours in lectures halls for classes and in the library studying. They also tend to spend most of their leisure time in sedentary activities such as reclining on chairs and beds engaging in discussions and on social media platforms. Engaging in regular exercise is one of the possible

intervention strategies that can be utilized to counteract the negative effects of a sedentary lifestyle however, despite its known benefits, not many adolescents and adults participate in it. The researchers therefore sought to investigate the effects of a six-week ergonomic bicycle exercise programme on anthropometric measurements such as body weight, body mass index and body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Purpose of the Study

The purpose of this study was to assess the effects of a six-week ergonomic bicycle exercise programme on anthropometric measurements among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

The specific objectives are to;

1. determine the effect of a six-week ergonomic bicycle exercise programme on body weight among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.
2. assess the effect of a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.
3. evaluate the effect of a six-week ergonomic bicycle exercise programme on percentage body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Research Questions

The following research questions guided this study.

1. What is the effect of a six-week ergonomic bicycle exercise programme body weight among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?
2. What is the effect of a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?
3. What is the effect o of a six-week ergonomic bicycle exercise programme on percentage body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?

Hypotheses

The following hypotheses were stated to guide the study and tested at 0.05 level of significance.

1. Six-week ergonomic bicycle exercise programme has no significant effect on body weight among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.
2. Six-week ergonomic bicycle exercise programme has no significant effect on the body mass index among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.
3. Six-week ergonomic bicycle exercise programme has no significant effect on percentage body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Materials and Methods

This study adopted a quasi-experimental research design. This study was carried out in Ignatius Ajuru University of Education, Rumuolumeni, a state-owned university located in Rivers State, South-South Nigeria. The population for this study consisted of all the undergraduate students in Ignatius Ajuru University of Education, Rumuolumeni, Rivers State. At the time of the study, the estimated population was 20,484. A sample size of 392 students was determined using Taro Yamane's formula. Students were recruited for the study by personal contact and information on WhatsApp social media, 200 students turned up to participate in the study however 18 could not continue hence 182 students completed the exercise regime. The researcher was assisted by three research assistants.

Adequate explanation was given to the respondents and they were assured of absolute confidentiality of their measured medical records before commencing the exercise programme. Each session of exercise included 10-minutes warm-up, 20-minutes exercise session on the ergonomic bicycle and 10-minutes cool-down. The exercise sessions were done twice in a week for 6 weeks. Height was measured with a stadiometer, weight was measured with an electronic scale. Five circumferences i.e. calf (CC), mid upper arm (MUAC), chest (CCN), waist (WC) and hip (HC) were measured by measuring tape. Three skinfolds i.e. calf (CSK), biceps (BSK), triceps (TSK), sub-scapular (SBSK) and supra-iliac (SISK) were measured (0.1 mm) on the left side of the body by skinfold calliper. Measurements were recorded for each participant. During the 6-week period, participants were asked not to change their dietary habits, their exercise habits and to maintain normal activity.

Results

Research Question 1: What is the effect of a six-week ergonomic bicycle exercise programme on body weight among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?

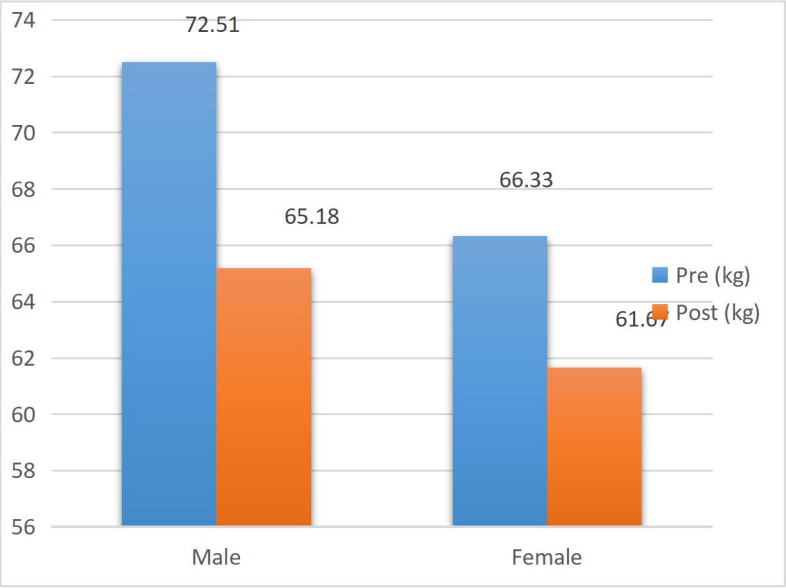

Figure 1: Effect of a Six-week ergonomic bicycle exercise programme on Body Weight

Figure 1 presents the result on a six-week ergonomic bicycle exercise programme on body weight among undergraduate students of Ignatius Ajuru University of Education, Port

Harcourt, Rivers State. The result showed the mean body weight of male undergraduate students was 72.51kg and that of the female student was 66.33kg prior to their participation in ergonomic bicycle exercise. At the end of six weeks, the result showed the mean body weight for male student was 65.18kg while that of the female student was 61.67kg.

Research Question 2: What is the effect of a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?

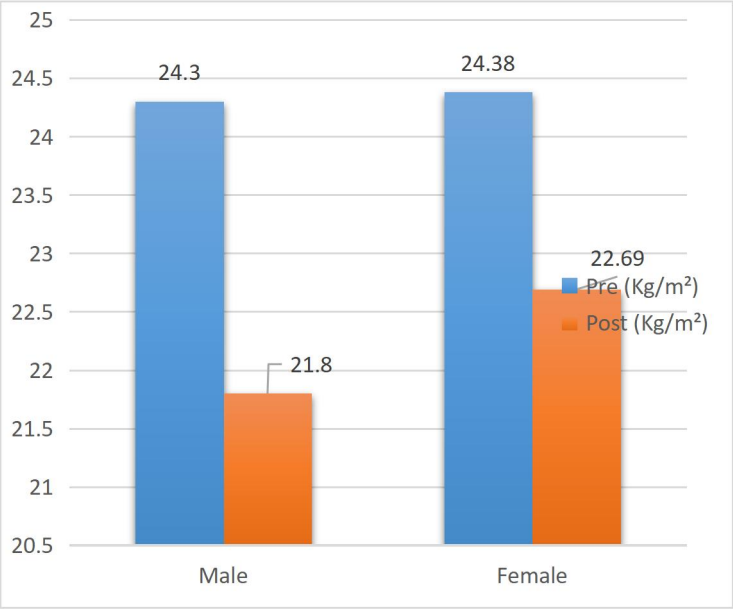

Figure 2: Effect of a Six-week ergonomic bicycle exercise programme on Body Mass Index

Figure 2 presents the result on a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The result showed that prior to the six-weeks exercise programme, the mean body mass index for male undergraduate student was 24.30kg/m^2 and that of the female undergraduate student was 24.38kg/m^2. At the end of the six-week ergonomic bicycle exercise programme, the body mass index for male undergraduate student was 21.80kg/m^2, while that of the female undergraduate student was 22.69kg/m^2.

Research Question 3: What is the effect of a six-week ergonomic bicycle exercise programme on percentage body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt?

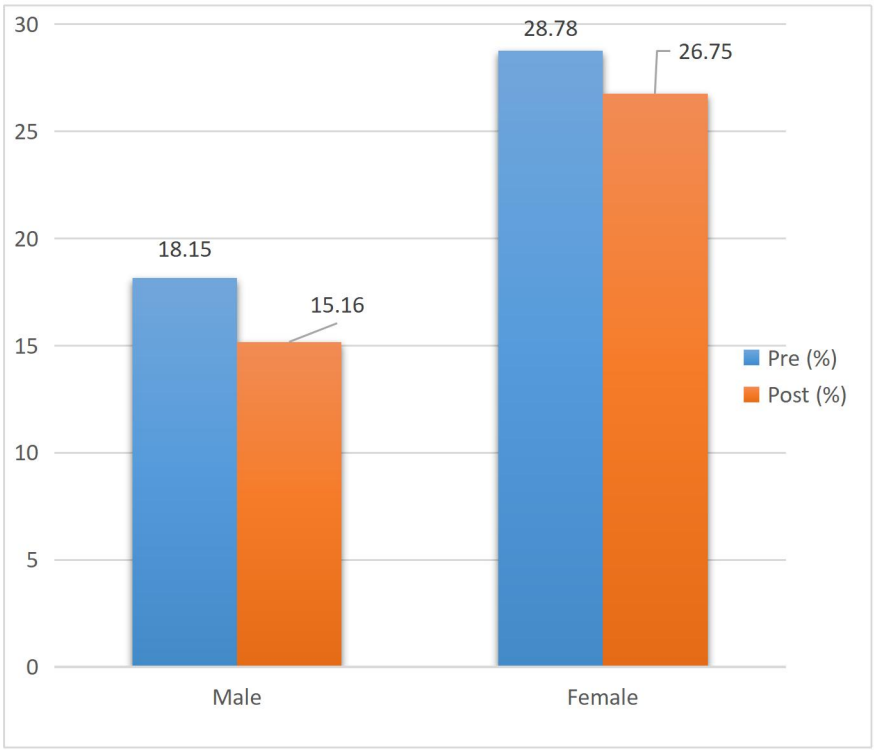

Figure 3: Effect of a Six-week ergonomic bicycle exercise programme on Percentage Body Fat

Figure 3 presents the result on effect of six-week ergonomic bicycle exercise programme on percentage body fat among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The result on showed the percentage body fat of male undergraduate student was 18.15%, while that of the female undergraduate student was 28.78%. After the six weeks exercise participation riding the stationary ergonomic bicycle, the result showed the percentage body fat for male undergraduate student was 15.16%, while that of their female counterpart stood at 26.75%.

Hypothesis 1: Six-week ergonomic bicycle exercise programme has no significant effect on body weight among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Table 1: Paired samples t-test on effect of a six-week ergonomic bicycle exercise programme on body mass among undergraduate students

Body weight (Kg)	N	Mean	Std Dev.	Df	t-value	p-value	Decision
Post 6-week exercise programme	182	63.1758	12.80849	181	-12.287	0.000	Significant
Pre 6-week exercise programme	182	68.9780	17.70615				

Table 1 presents the summary of paired samples t-test on effect of a six-week ergonomic bicycle exercise programme on body mass among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The result showed that a six-week ergonomic bicycle exercise programme has significant effect (t= -12.287; p= 0.000) on body mass among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. Therefore, the null hypothesis was rejected at 0.05 alpha level of significance.

Hypothesis 2: A six-week ergonomic bicycle exercise programme has no significant effect on the body mass index among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Table 2: Paired samples t-test on effect of a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students

BMI (Kg/m^2)	N	Mean	Std Dev.	Df	t-value	p-value	Decision
Post 6-weeks exercise programme	182	22.3068	4.88430	181	-12.077	0.000	Significant
Pre 6-weeks exercise programme	182	24.3467	6.55174				

Table 4.2 presents the summary of Paired Samples t-test on effect of a six-week ergonomic bicycle exercise programme on body mass index among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The result showed that six-week ergonomic bicycle exercise programme has significant effect (t= -12.077; 0.000) on body mass index among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. Therefore, the null hypothesis was rejected at 0.05 alpha level of significance.

Hypothesis 3: A six-week ergonomic bicycle exercise programme has no significant effect on percentage body fat among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Table 3: Paired samples t-test on effect of a six-week ergonomic bicycle exercise programme on percentage body fats among undergraduate students

Percentage body fat	N	Mean	Std Dev.	Df	t-value	p-value	Decision
Post 6-weeks exercise programme	182	21.7792	8.32939	181	-12.079	0.000	Significant
Pre 6-weeks exercise programme	182	24.2275	9.59710				

Table 3 presents the summary of paired samples t-test on effect of a six-week ergonomic bicycle exercise programme on percentage body fat among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. The result showed that a six-week ergonomic bicycle exercise programme has significant effect (t= -12.079; p= 0.000) on percentage body fats among undergraduate students of Ignatius Ajuru University of Education, Port Harcourt, Rivers State. Therefore, the null hypothesis was rejected at 0.05 alpha level of significance.

Discussion of Findings

Anthropometric data are the measurements of the human body composition such as height, weight, body mass index (BMI), circumferences of limbs or body parts, length of limbs, among others, which are used to study human variation, growth, development, and health (Cadadel & Kiel, 2022). The rising rates of chronic non-communicable diseases such as heart attack, hypertension, and diabetes among undergraduate students necessitated the investigation on effects of 6-weeks participation in exercise riding the stationary ergonomic

bicycle on anthropometric measurements among undergraduate students in Ignatius Ajuru University of Education, Port Harcourt.

Finding on Figure 1 revealed the mean body weight of male undergraduate students was 72.51kg and that of the female student was 66.33kg prior to six weeks exercise intervention. It was observed that after six weeks exercise programme, the mean body weight of male undergraduate students was 65.18kg while that of the female counterparts was 61.67kg at the end of the exercise. In addition, the paired samples t-test analysis revealed undergraduate students who engaged in the six weeks ergonomic bicycle exercise programme is 12.28 times (t= -12.287; p= 0.000) more likely to reduce and manage excess body weight. This implied that ergonomic bicycle exercise could be deployed for efficient body weight management. The finding concurred with Kaya et al., (2018) who reported that six weeks spinning cycling training significantly reduced body weight among overweight women. A similar study by Ajala et al., (2020) on effect of aerobic exercise on cardiorespiratory variables and body composition among college student obese youths and adolescents also revealed a significant reduction in body weight after twelve weeks of aerobic exercise; and Bellicha et al., (2021) also reported significant weight loss among overweight and obese adults that engaged in twelve weeks aerobic exercise. Thus, ergonomic bicycles should be made available and accessible to students to help reduce sedentarism and the associated excessive weight gain.

Findings on Figure 2 showed the mean body mass index for male undergraduate student was 24.30kg/m^2 and 24.38kg/m^2 for female undergraduate students prior to their engagement in the six weeks ergonomic bicycle exercise programme. At the end of the six weeks ergonomic bicycle exercise programme, the body mass index for male undergraduate student was 21.80kg/m^2, while that of the female undergraduate student was 22.69kg/m^2. In addition, the tested hypothesis revealed that undergraduate students who engaged in six weeks ergonomic bicycle exercise is 12.07 times (t= -12.077; p= 0.000) more likely to experience reduction in their body mass index than when they were never engaged in the exercise. The finding gave credence to Yoon et al., (2017) who earlier reported significant reduction in BMI among middle school students that participated in a sixteen-weeks bicycle exercise. Previous study by Kim et al., (2015) revealed that six-weeks indoor cycling yielded significant reduction in body mass index postintervention, and concluded that indoor cycling is an effective modality to improving body composition. Kaya et al., (2018) posited that cycling workouts is an effective method to lose weight and recommended getting ergonomic for obese and overweight individual for quick weight management.

Findings on Figure 3 showed the mean percentage body fat for male undergraduate student was 18.15%, and 28.78% for female undergraduate students, prior participation in a six-week ergonomic exercise programme. Post-intervention result revealed a mean percentage body fat 15.16% for the male students, while that of the female stood at 26.75%. Also, the tested hypothesis revealed that the six-week ergonomic bicycle exercise programme is 12.07 times (t= -12.079; p= 0.000) more likely to percentage body fats among undergraduate students of Ignatius Ajuru University of Education. The reduction in percentage body fat could be associated increased metabolic rate triggered by the exercise that led to the burning of excess body fats. This finding aligned with Ratajczak et al., (2020) who observed significant reduction in total cholesterol level among obese women that participated in indoor cycling programme. Similarly, Zúñiga-Moreno et al., (2022) observed a significant reduction in fat mass when they

compared the post-intervention fat mass with that of the baseline among cyclists. Guirado et al., (2021) stress the benefits of cycling workstation among tertiary employees and suggested the provision of indoor ergonomic bicycle in offices to aid workers partake of the associated health benefits.

Conclusion

Based on the findings of the study, it was concluded that participation in exercise riding the stationary ergonomic bicycle has significant effects on body mass, body mass index and percentage body fat among undergraduate students of Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State.

Recommendations

The following recommendations were made based on the major findings of this study;

1. The university management should provide ergonomic bicycle in the campus and at the same time grant the students unlimited access to these fitness facilities.
2. Students should be encouraged to prioritise physical exercise while university management provide needed opportunities for students to incorporate ergonomic bicycle exercise into their daily routines for proper weight management and promotion of healthy living.
3. Policy makers should propose and implement time-efficient initiatives that do not overwhelm students' academic busy schedules, and encourage participation is routine exercise.

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