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Original Research Article

Aerobic Dance Circuit Training Improves Body Fat Percentage of Obese Female College Undergraduates

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Abstract

Although the efficacy of aerobic dance has been reported, further insight into the influence of aerobic dance circuit training will provide specific therapy to tame obesity pandemic. Therefore, this study establishes that aerobic dance and circuit-training program (ADCT) improves the body fat percentage of obese female College of Education (COE) students while moderating for age and class of obesity. The study adopted the pretest-posttest control group quasi-experimental design. Seventy obese female undergraduate students (mean age = 21.10±2.46 years) of two COE were purposively selected. The obesity percentage distribution of the participants was class 1 (21.4%), class 2 (60.0%), class 3 (17.1%) and class 4 (1.4%). The participants were randomly assigned to ADCT (N=35) and control (N=35) groups. ADCT lasted 12 weeks, three days (evening), and 40 minutes per session. Body fat percentage was measured pre and post in two groups. Data were analysed using Cochran Q test and Analysis of covariance at 0.05 level of significance. There was significant mean difference in pre-and post-ADCT value of body fat percentage (16.89±4.10>14.96±3.70). There was no significant 3-way interaction effect between Treatment, Age and Class of obesity (F(13,57 = 5.912, P>0.05, ^{2} = .0.013). Aerobic dance circuit training reduced body fat percentage in obese students. Regular and monitored aerobic dance circuit training significantly improves the health and quality of life of obese female students regardless of age and class of obesity.

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Aerobic dance; body fat percentage; circuit training; colleges of education; obese female; undergraduates

Introduction

The threat of obesity as an epidemic and its unbridled international spread is raising apprehension on the global scene (Brown et al., 2021). Obesity is becoming more noticed among the youth in the entire world majorly identified as a critical public health problem in the 21st century because of surplus adiposity (Fulton et al., 2022; Ruze et al., 2023). Obesity could be referred to as an excessive fat accumulation in adipose tissues (Kojta eta al., 2020). Obesity is a disorder necessitated by anomalous or disproportionate fat amassed in the adipose tissue of the human body (Qasim et al., 2018). Consumption of food beyond the required measure needed by the body for energy and body building could be the pivot for accumulation of excessive fat

(Park & Seo, 2020). Obesity develops from surplus energy ingestion as well as the overuse of energy (Malnnis, 2000; Fabunmi, 2011).

A few illnesses such as 2 diabetes mellitus, hypertension, cardiorespiratory infections, cancer, rest apnea and gallstones, have been related to corpulence (Bray et al., 2018; Carmichael, 1999). Persons suffering from obesity have developed tissues that are fat provoke vascular resistant, thereby increasing the rate at which their heart exerts force to pump blood circulating round the body (Dempsey & Thyfault, 2018). Fat tissue accumulation impairs ventilatory function in adults and children (Lazarus et al., 1997). According to ventilatory mechanics and pulmonary functions, the excessive build-up of fat tends to cause dysfunctions of the numerous organs constituting the respiratory system, predominantly the muscles that actively participate in breathing. This may lead to changes in pulmonary functions due to the upsurge in respiratory effort and the compromise of gas transport (Santiago et al., 2008).

The startling increase of obesity in America and other European countries (James, 2008) has been extended to most countries of the world and has become a major problem. Nigeria and other developing countries of the world have adversely been enmeshed in the problem of obesity due to lifestyle adopted consequent to improvement on the standard of individual's living (Phelps et al., 2024; Oluwasanu et al., 2023; Onyenekwu et al., 2017). Ogden et al. (2012) opined that weight increment hazard had passed by 1% per annum for each 0.5kg increment in weight and decreases life expectancy by 7.1% a long time in men and 5.8% a long time in women.

According to WHO (2000), approximately 2.3 billion population of the world would be overweight in 2015. However, 2.5 billion adults (18 years and older) were overweight of which 890 million were living with obesity, over 390 million children and adolescents aged 5–19 years were overweight in 2022, including 160 million who were living with obesity (WHO, 2024). The report of WHO holds that 1.4 billion adults from 20 years of age and beyond are either overweight or obese. From the 1.4 billion stated, at least, 200 million men and 300 million women are likely to be obese. A projection has also been made that by 2030, the population of overweight and obese persons in the world would be 2.16 billion and 1.12 billion respectively (Kelly et al., 2008; WHO, 2024).

An imbalance in energy intake and expenditure where extra calories consumed are not converted into energy is a major contributing factor to obesity. Long time spent on screen observing (TV), video amusement pa, computer utilize, and portable phone diversion factors of obesity in developing countries including Nigeria create problems. Moreover, the advent of fast foods and fatty snacks at lunch may be analysed as circumstances offshoots from globalization, innovation propels, and broad financial development (Blay, 2021; Foxet al., 2019). According to Onyechi and Okolo (2008), the prevalence of obesity among undergraduates in university of Nigeria, Nsuka was 21% students' population where 8.1% were males and 13.1% females as result of sedentary screen-based behaviors. Recent literature review and meta- analysis conducted in Nigeria indicted a rising trend of overweight (26.0%) and obesity (15.0%) over the years (Ramalan et al., 2023).

Many interventions have been suggested on the ways to reduce or stop the prevalence of youth obesity without consensus (Cardel et al., 2020; Salam et al., 2020), but strong suggestions have been to prevent and manage the menace. Many physical activities interventions have been

used to enhance the health of this age group (van Sluijs et al., 2021: Yuksel et al. 2020). Many of these interventions aimed at obese and inactive youth with a focus on improving overall lifestyles, such as nutrition and addressing physical inactivity (Niemro, et al., 2023; Yuksel et al., 2020; Blay, 2021; Fox et al., 2019). These reports emphasized that an obese individual needs to follow a strict planned aerobic exercise programme to help them burn calories. Niemro et al. (2023) added their voice to the use of two methods that can effectively decrease adipose tissues that include dietary modification and energy expenditure modification through exercise.

Circuit training is a series of exercises done in order of stations and at a fast pace with only a short break period between exercises and a bit longer rest between stations (Kumar, 2013). Aerobic dance exercise is a physical exercise performed to the rhythm of music and performed in a group setting, led by an instructor (fitness professional). The combination of these two training methods is termed in this study as aerobic dance circuit training (ADCT). Thus, ADCT in this study is a training programme that consists of series of aerobic dance exercises performed to improve cardiorespiratory variables and to reduce fat. It is designed as a physical exercise that combines rhythmic aerobic exercise to pre-set music with stretching and strength training routine in a circuit manner (circuit training). Obese individuals need to engage in exciting, interesting and fun packed physical activities such as aerobic dance exercise and circuit training (ADCT). It has been initially established that ADCT is among the aerobic exercises that depend primarily on the aerobic energy-generating processes (Ajayi et al., 2020). Therefore, this study establishes ADCT programme improves the body fat percent of obese female college of education students while moderating for age and class of obesity.

Methods and Materials

Research Design

The research design for this study was a pretest-posttest control group quasi-experimental design using 2x2x4 factorial matrix.

Participants

Seventy obese female youths took part in this study. Purposive sampling technique was used to select the participants for the study because of the peculiar characteristics required BMI ≥25.0 as the yardstick to qualify. Purposive sampling technique was used to select two institutions in Oyo town: Emmanuel Alayande College of Education, Oyo and Federal College of Education (Special), Oyo. This restriction helped to minimize to the barest minimum the effect of nutrition on body composition variables in this study. The participants were randomly assigned into two (2) groups (35 participants per group), an experimental group and control group. The experimental group went through the 12 weeks aerobic dance circuit training session while control group was placed on placebo (12 weeks lesson of lifestyle education). Participants were included in the study given that obese female students in colleges of education (NCE) in Oyo town, had no medical reports contra-indicating exercise participation, were not engaging in any aerobic exercise programme four weeks before, during and after the recruitment, and had BMI ≥ 30kg/$m^{2..}$ Those obese with cardiorespiratory disease and other metabolic conditions, heart rate suddenly rose above 100 bpm-pretest and had the tendency towards fainting or dizziness.

Instrumentation

The instruments used for data collection were bathroom weighing scale (Smart wireless digital bathroom weight scale with smartphone app bluetooth, SKU:

GE779SE44G9MDNAFAMZ) used to measure body weight to nearest 0.1 kilogram; Ponderax skinfold caliper (Harrow, England, Object Number: 2006-123) used to measure percent body fat at the abdominal, suprailliac, and triceps sites; Sport timer alarm stop-watch (Model GTQ 324) used to time the rhythmic aerobic activities; Pacific DVD player used to provide the variety of aerobic dance music; plastic cones was used to demarcate each exercise station; digital metronome was used to determine increment and level of intensity on the variety tempo of the aerobic dance; and heart rate monitors was used to monitor exercise intensity.

Training Programme

The participants were asked to sign the informed consent form showing their interest to be part of this research work and their readiness to cooperate with the researcher after which the following data (information) were collected before (Pre) and after (Post) training programmes. This aerobic dance circuit training (ADCT) consisted of series of exercises inter spaced and performed at each station with minimal 60 seconds rest in between. Exercises were performed at a safe level of moderate intensity between 40% (week 1) and 70% (week 12) of age predicted MaxHR. The Aerobic dance circuit training programme was performed by all participants for the entire twelve (12) weeks period. The instructors lead the exercise at each station. The body movements were simplified and made easy to involve the use of both upper and lower extremities and the back. The participants were distributed to six stations. The frequency was 3 times/week for twelve weeks; each session consisted of 3 minutes warm up, 3 minutes cool down and 30-60 minutes of aerobic dance with brief rest periods to move from one station to the next station. The choreography exercise consisted of arm, leg, waist-hip and progressive step-aerobic movements performed with music.

The control group participants were placed on placebo of teaching them lifestyle education which consisted of series of activities such as, nutrition and health education, concept of obesity, healthy lifestyles, importance of exercise, important of physical fitness activities and body composition. The training objectives were to identify factors influencing attitudes and practices of obese regarding diet, causes of obesity, concept of HELP (Health, Everyone, Lifetime and Personal physiology), to examine the importance of engaging in physical activities and how to measure body mass index (BMI). The lectures were done 20 minutes per contact and 3 times in a week lesson (Monday, Wednesday and Friday).

Statistical Analysis

Descriptive statistics of means, range, standard deviation, frequency, percentage, pie chart, and bar chart analysis were used to for the physical characteristics of the participants and research questions. Cochran Q test and Analysis of covariance (ANCOVA) were used to analyze hypotheses. Adjusted marginal means was used to show the direction of differences in variables measured. ANCOVA allows for the adjustment of the percent body fat for covariates, which provides a clearer picture of the ADCT effects by reducing the error variance. This is particularly important because of experimental designs where certain variables like height, class of obesity and age cannot be controlled but can be measured alongside the body fat percent. The adjusted marginal means derived from ANCOVA offers a comparison of group means that has been statistically adjusted for the covariates, providing a more accurate representation of the treatment effects. The model fitting process for ANCOVA involves checking for the

homogeneity of regression slopes, which ensures that the relationship between the covariate and the dependent variable is consistent across all levels of the independent variable. When the assumption was met, the ANCOVA proceeded with adjusting the means of the dependent variable for the covariates. The fitting process also includes the calculation of the adjusted means and the associated F-tests to determine if there are any statistically significant differences between group means after controlling for the covariates. For the Cochran Q test, the process involves arranging the data in blocks and applying the test statistic to determine if the observed proportions of success differ significantly across the groups. If the test indicates significant differences, further post-hoc analysis was conducted to identify where differences lie. Both methods provided valuable insights into the data and supported the decision-making process regarding the significance of hypotheses set at the specified alpha level of 0.05.

Ethical Consideration

The study was subjected to ethical consideration and subsequent approval was given from the Social Science and Humanities Research Ethics Committee (SSHREC) of the University of Ibadan. Both electronic and hard copies of the research proposal indicated the participants' dossier and introductory letter from Head; Human Kinetics and Health Education Department, University of Ibadan were submitted to the Chairman of SSHREC for consideration and approval. Only participants that filled informed consent form for this study were used. Confidentiality of the participants was assured without making reference to their names and other personal data. Similarly, participants on request were given permission to take water, visit the rest room, to pick towel to clean up the swept on their bodies.

Results

Table 1 shows that 44(62.9%) of the participants were aged 19-24 years, 85.8% weighed between 71-90kg, 45.0% were between 156-165cm tall and class 1 obese 42(60.0%).

Table 1

Descriptive Statistics of Demographic Information of the Participants

Variables		Frequency	Percent
Age group	19-24yrs	44	62.9
	25-30yrs	26	37.1
Weight (kg) group	61-70	9	12.9
	71-80	30	42.9
	81-90	30	42.9
	90+	1	1.4
Height (cm) group	145-155	13	18.6
	156-165	45	64.3
	166+	12	17.1
Obesity Class	Overweight (25-29.9)	15	21.4
	Obesity 1 (30-34.9)	42	60.0
	Obesity 11 (35-39.90)	12	17.1
	Obesity 111 (40+)	1	1.4

Table 2

ANCOVA showing the Main and Interaction Effects of Treatment on Age and Class of Obesity

Sources	Sum of Squares	df	Mean Square	F	Pvalue	Eta. Sq
Corrected model main effect:	893.328	13	68.718	11.623	.000	.362
Treatment group	183.615	1	183.615	31.057	.000	.105
Age	68.514	1	68.514	11.589	.001	.042
Class of obesity	26.396	3	8.799	1.488	.218	.017
2-way interactions:						
Treatment x age	22.678	1	22.678	3.836	.051	.014
Treatment x class of obesity	9.550	3	3.183	.538	.656	.006
Age x class of obesity	6.109	2	3.054	.517	.597	.004
3-way interactions:						
Treatment x age x class of obesity	20.714	2	10.357	1.752	.175	.013
Error	1572.651	57	27.590			
Total	2465.979	69				

Table 2 shows significant effect of treatment on %bf (F1, 57=31.057, P<0.05, η^2=.105). The Eta Square of .105 shows that about 11% of the variation in participants scores were attributed to the treatment. There was no significant interaction effect of treatment and age on %bf ($F_{(1,57)}$ =3.836, p>.05,η2=.014). The Eta Square value of .014 shows that about 1.4% of the participants' scores were accounted for by treatment and age. There was no significant interaction effect of treatment and class of obesity on %bf ($F_{(3,57)}$ =.538, p>.05,η2=.006). The Eta Square value of .006 shows that about 10% of the participants' scores were accounted for by treatment and class of obesity. There was no significant interaction effect of age and class of obesity on %bf ($F_{(2,57)}$ =.517, p>.05,η2=.004). The Eta Square value of .004 shows that about 5% of the participants' scores were accounted for by age and class of obesity. There was no significant interaction effect of ADCT, age and class of obesity on %bf (F(2,57) =1.752, p>.05,η2=.013). The Eta Square value of .013 shows that about 3% of the participants' scores were accounted for by treatment, age and class of obesity.

Figure 1

Line Graph showing the Mean Scores of % BF of the Experimental and Control Groups at the Baseline, 4th, 8th, and 12th Week

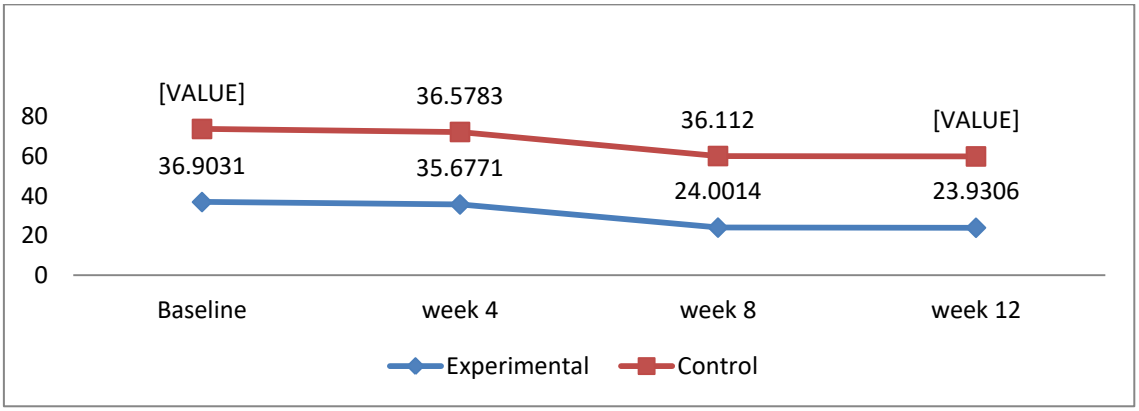

Figure 1 indicates that the treatment was effective between week 4, week 8 and week 12 but there was no significant effect between the baseline and week 4. This may be because of the conditioning principle of exercise.

Discussion

This study establishes the effects of aerobic dance and circuit training programme on body fat percentage of obese female college of education students while moderating for age and class of obesity. Our findings indicate that 62.9% of the participants were in the age range of 19-24 years. Studies have shown that most females in this age group have attained their full adult height, however their weight may still fluctuate based on their lifestyle (Alharbi, 2023), dietary habits (Jacob & Panwar, 2023), and degree of physical activity (Sember et al., 2020). Female muscle mass often reaches its highest point during this age group, whereas body fat distribution might vary. In this age group, it has been affirmed that females commonly have a higher concentration of body fat in the hips, thighs, and breasts, which is influenced by hormones (Lopes et al., 2022; Ortega et al., 2021). It has also been indicated that female between the ages of 19 and 24 often have a greater basal metabolic rate than older age groups because they have more muscle mass and are more physically active (Yang et al., 2021). Bogataj et al. (2021) affirmed that energy needs in female within this age group fluctuate depending on the degree of physical activity, body composition, and metabolic rate.

In the main effect, our study outcomes showed that there was significant difference in the pretest and posttest scores of body fat percentage following the aerobic dance and circuit training programme (ADCT). It implies that the intervention led to a significant decrease in measured body composition indices. The results of this study also revealed that there were decreases in the participants' body composition at the baseline 36.8913±1.62, 4^{th} week 36.1277±1.45, 8^{th} week 30.0567±1.66 and post intervention 29.9617±0.09. The findings are in line with previous study which opinioned inadequate exercise as major cause of obesity (Akinpelu et al., 2008). The study by Amano et al. (2001) who reported on application of 12-weeks aerobic dance exercise components of 30 minutes; three days/week on obesity (female and male) subjects, also found out a significant decreased between an average body fat percentage after exercise programme.

It was observed in this study that the experimental group body fat percentage decreased from the 4^{th} week to the 8^{th} week and decreased slightly from 8^{th} week to 12^{th} week. This is in line with the studies by Corbin and Pangrazi (1999); and Okunneye et al. (2010) that there was reduction in body weight and body fat composition following a 12-weeks step aerobic dance exercise programme among undergraduate female students. In another study that administered 6 weeks aerobic dance exercise on 7 women with age average of 21.0±0.8 years, it was reported that there was a reduction in body mass of 2.2%, %bf of 1.3%, BMI of 3.4 percent after the training programme (Niemiro et al., 2019; Szmedra et al., 1998). It was observed that body fat percentage values for female participants when compared to a standard norm value was inadequate given that 4 out of 12(13.57%) participants within the age bracket of 15-28 years had an adequate body fat while 8 out of 26(68.42%) participants had adequate body fat. Other participants had inadequate body fat in both categories based on the comparison made.

Implications for Health Promotion

Aerobic dance circuit training is a dynamic and stimulating exercise that integrates dance movements with systematic circuit training. This training programme is especially advantageous for overweight female college students, since it specifically targets the problem of excessive body fat, which is a crucial determinant of general health, wellness, and optimal performance. Hence, the implications of this programme for health promotion are multifaceted.

First and foremost, aerobic dancing is a pleasurable kind of physical activity that may enhance the likelihood of consistently engaging in exercise, which is essential for long-term weight reduction, overall health enhancement, and productive optimal performance. In addition, the circuit training programme provides a thorough exercise programme that may improve cardiovascular fitness, muscular strength, and endurance, which are vital aspects of physical fitness, as well as increase presenteeism at work.

In addition, aerobic dance circuit training (ADCT) significantly increases energy expenditure, potentially reducing the percentage of body fat. This reduction in body fat percentage contributes to lowering the likelihood of developing health problems connected to obesity, such as diabetes, hypertension, and heart disease. Aerobic dancing programmes also include a social component that may enhance mental health by promoting a sense of companionship and inclusiveness among individuals, which is critical for emotional well-being. Moreover, the integration of dance allows for the expression of culture and adapts to various forms of music and dance, making it a versatile tool for promoting health among diverse groups.

Ultimately, ADCT provides a comprehensive method for promoting health among overweight female college students. It does not only facilitate a reduction in body fat and enhance physical fitness but also promotes mental well-being and social welfare. Therefore, we recommend incorporating ADCT as a crucial component of health promotion programmes aimed at the general population, particularly the female students of these higher institutions. Introducing such initiatives on campuses of higher institutions might significantly influence positive health behaviours, increase unity, reduce suicidal thought, and guide female students towards a lifetime of well-being.

Strengths and Limitations of the Study

The strength of this study is that its findings can be used to support the development of African norm for this particular population. The training programme can be clinically prescribed as exercise programme to manage body composition and improve cardiorespiratory functions in obese individual. The outcomes of the study are available fitness instructors to adopt and adapt the use of aerobic dance circuit training to the already existing training programme for obesity management. It also serves as awareness to experiment aerobic dance with other training principle such as interval training. The research stands as baseline study that can be replicated and improved upon using larger sample size at other educational levels and country.

A major limitation of the study hinged on the inability of the researchers to have total control over the participants' diet and other physical activities engaged in, outside the training. Another limitation may be associated with the inability of the participants to maintain a consistent level in coping with training intensity although they were encouraged.

Conclusion

Based on the findings of the study, it was concluded that the 12-weeks aerobic dance circuit training programme elicited significant changes in the values of body fat percentage for health promotion of obese female college students. There was no significant interaction between the effect of treatment and age on body fat percentage. There was no significant interaction effect of treatment and class of obesity on body fat percentage. There was no significant interaction effect of age and class of obesity on body fat percentage. There will be no significant interaction effect of treatment, age and class of obesity on body fat percentage. Based on the outcome of this research work, it was recommended that obese female college students should endeavour to take part in regular aerobic dance circuit exercise for improved health benefits. Exercise trainers, coaches and exercise physiologists should consider the principle of exercise frequency, intensity, type and time and other factors which will decrease the body composition as used in this study when planning the exercise programme. Aerobic dance circuit training exercise can usually be accommodated with less stress by people of all ages and fitness levels. This is one of the unique characteristics of aerobic dance circuit training, in that the same step can be modified by the participants to meet the needs of her individual workout. The result of this study can be used to develop African norm for this group in other to promote healthy living of obesity.

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None.

Conflict of Interest

No conflict of interests declared.

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Not applicable.

Data Availability

Data will be available upon request.

Author's Contribution

OAA and MOM conceptualized and designed the research study. OAA collected the data. OAA and MOM analyzed and interpreted the data. OAA prepared the manuscript draft. MOM critically revised the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript. All authors are responsible for the scientific content and integrity of the manuscript.

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