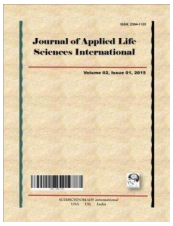

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Modulations of 8-Week Aerobic Dance Exercise on Selected Anthropometric Indicators in Overweight and Obese Females

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Authors' contributions

This work was carried out in collaboration between all authors. Authors RNA and JA carried out the bench work. Authors AAA and PEO designed the study and wrote the protocol. Author AJO managed the literature searches. Author OMO wrote and monitored the first draft of the manuscript. Author JCI managed and supervised the experimental process. All authors read and approved the final manuscript.

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ABSTRACT

One of the major problems of a quiescent or sedentary lifestyle is Obesity. Such lifestyle encourages and poses increased threat to the development of myriads of disabling medical conditions like muscle weakness, postural deficiencies, diabetes, compromised aerobic capacities,

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hypertension and coronary heart diseases. The goal of this study was to investigate in overweight and obese women, the effect of an 8-week aerobic dance exercise on selected anthropometric indicators including weight, waist circumference (WC), hip circumference (HC), Waist-Hip ratio (WHR) and body mass index (BMI). To approach this, a total of 61 participants (32 experimental and 39 control groups) with age ranging between 18 and 30 years were ethically recruited for the exercise. While experimental group underwent 8 weeks (4 times/week) of supervised aerobic dance session, control group never partook in any structured physical activity. Aerobic capacities [VO_{2max} and HR] and body composition [Weight, WC, HC, WHR, percentage of body fat (BF) and muscle mass (MM)] of participants were measured at pre, mid and post interventions. Analysis of variance (ANOVA) returned a significant decrease ($p < .05$) for Weight, BF, WC, HC, WHR and BMI. A significant increase ($p < .05$) was however observed for MM in experimental group, proving to be insignificant in aerobic capacity and body composition indices of control group.

Keywords: Obesity; physical activity; hip circumference; waist circumference; muscle mass.

1. INTRODUCTION

A quiescent lifestyle is threatening to the health of every individual at every point. Such lifestyle encourages and exposes one to an increased risk of obesity, muscle weakness, postural deficiencies, compromised aerobic capacities, hypertension, and coronary heart diseases. Thus, obesity remains one of the major problems of a quiescent or sedentary lifestyle that demands global attention from "the creams" of research community.

According to the World Health Organization, at least 2.8 million adults die each year of overweight or obesity and their related ailments. In addition, 44% of diabetes burden, 23% of ischemic heart disease burden and between 7% to 41% of certain cancers are attributable to overweight and obesity [1-2]. The prevalence of overweight and obesity has increased to epidemic proportions in developed countries, and is now dramatically on the rise for underdeveloped and developing countries, especially in urban settings [2].

Frequent physical activities have been found to cause considerable changes in the promotion of health-related fitness, and in the reduction of factors that may pose a risk of developing any manner of disabling medical conditions which may occur in people who live a sedentary lifestyle [3-4]. In recent times, studies have confirmed the applauding effects of different kinds of aerobic physical activities on the changes in body composition and anthropometric parameters [5-9]. Aerobic dance is a form of physical activity that is not threatening to health and is known for its limited rates of injury. It can be used as a form of exercise across all age groups. Currently, aerobic dance is primarily gaining attention in that, it encompasses many styles of movements and can be performed in many physical environmental settings on a flat and even surface [10]. Thus, aerobic dancing may be a form of physical activity that is likely to be adopted as part of a lifestyle for physical activities/benefits than other more structured and/or expensive exercise modes. This serves as an orientation for this study.

1.1 Aim of Study

This study aimed at investigating the effect of eight weeks of aerobic dance exercise on the aerobic capacities and selected anthropometric indicators of overweight and obese females.

2. METHODOLOGY

2.1 Research Design

A pre-test post-test experimental design was used.

2.2 Study Location

The study was conducted at the gymnasium of the Department of Medical Rehabilitation, Faculty of Health Science and Technology, University of Nigeria, Enugu Campus, Nigeria.

2.3 Study Population

The study targeted a population of overweight or obese females.

2.4 Sample and Sampling Technique

Though power analysis showed that getting a low effect size (0.2) at a power of .09 and .05 level of significance depends on a minimum sample size of 46 participants, a total of sixty one (61)

subjects (32 experimental and 39 control groups) were recruited for the study using simple random sampling technique.

2.5 Selection Criteria

Young overweight and obese adult females of between 18 and 30 years of old with no known history of osteoarthritis, rheumatoid arthritis, or cardiopulmonary disorders of any form were selected for the study. Strictly, such participants were sure to be resident in Enugu metropolis.

Adults below 18 and above 30 years with injuries or any known history of cardiovascular and/or cardiorespiratory disorders were excluded from the study. Such individuals must not have undertaken a form of knee or abdominal surgery as well.

2.6 Resources and Sources

Humans

A total of sixty one (61) participants, all overweight or obese females of between 18 and 30 years old were recruited for the study. Participants were sure to be residents of Enugu metropolis in Enugu, Nigeria.

Instruments for Data Collection

Data collection instruments includes measuring tape (Shanghai, China, blue), stop watch (Kadio, KD-1063), weighing balance, music player, locally constructed standiometer (to measure the height of participants in cm), body fat analyser (GTIN 5038673232706, BRAND Prima 180kg, MPN 23270C), an Electronic Body Fat Scale for weight measurement, Speakers, stethoscope, and sphygmomanometer (Omaron, M2 basic blood pressure monitor) were also used.

Ethical Permission

The study was approved by the research and ethics committee of the University of Nigeria. Written informed consent was obtained from each participant before investigation. Only those who met the inclusion criteria where eligible to participate

Anthropometric Measurements

First, subjects' height (in cm) and weight (in kg) were respectively measured with standiometer and weighing balance. Next, the percentage of body fat, muscle mass, and body mass index were obtained with the aid of the body fat analyser. To obtain this, the electrodes of the body fat analyser were fixed on the arms, leg, and abdomen to assess the percentage body fat, muscle mass (MM), and body mass index (BMI). This occurred with instructional guides from the manufacturer's manual.

Vital signs, including pulse rate (in beats per minute) were checked by palpating the radial pulse, using stopwatch (for one minute). Respiratory rate (in counts per minute) was then checked for one full minute, while counting the inspiration or expiration values with a stopwatch. Blood pressure was then measured (in millimetres of mercury) using a sphygmomanometer and stethoscope. All these were checked before and after commencement of the exercise. Before the commencement of aerobic dance exercise programme, volunteers who met the inclusion criteria underwent a pre-training test that involved doing different dance styles for the study. This was taught to them by a dance coach. Only those who could do the various dance styles for 20 minutes at a stretch without undue fatigue and obtain score between 12 and 14 (moderate intensity) on Borg Scale (for rating perceived exertion 6 to 20 grade scale) were allowed to participate in the study.

The protocol involved a 5 minutes warm-up exercise before the dance and at the end of the dance exercise, with a 5 minutes cool down exercise. The dance styles included:

Abdominal March: Which worked by marching in a place with the arm alternatively swinging front and back.

Abdominal Squeezing March: Contracting the abdominals by pushing the shoulder and the hip forward and backwards alternatively, at the same time accompanied by a march.

Hip Roll: Which is performed in a standing position with the arms out and palms placed on the hips facing down. This is accompanied by a little knee bend and foot slightly apart, then lowering them to one side with the abdominals "sucked in" tight. An alternating movement on each side is then performed.

Body Roll: Here, the entire body goes through a wavelike motion from side to side focusing on hips.

Alternate side crunch: this involved Standing upright with the feet about hip width apart and the

knees somewhat bent. The arm is placed in an alternate fashion with one of hand behind or at the side of the head and the other hand in the alternate position. Whichever hand that is placed on the head is the side on which the stand crunch is to begin.

Body Roll Squat: Performed by keeping the hips back and not letting the knees extend beyond the toes. Speed and momentum are used for side to side roll. A vertebra at a time, and push through the heels to stand back up.

Abdominal Twist: Standing upright and keeping the shoulder and lower back pressed backwards with feet slightly apart, abducting the arms to the sides with the elbow flexed and the palms facing the ground. Twisting the spine takes the bent arm to the alternate side, back to the centre and then twist to the other side.

Pump Squat: The hip and the knee flexed accompanied with pumping the arms and controlling the movement of the shoulder and the elbow. This was achieved by dropping both arms simultaneously, one in between the legs and the other behind the gluteus. This is done in a squatting position with a bouncing effect on the knee joint.

The dance duration for the first 2 weeks was 30 minutes in length with the warm up and cool down exercise time included. The aerobic dance section was 4 times per week, and the duration of dance was increased gradually starting from the second week till the eight week 10 minutes biweekly.

Steady vital signs throughout the duration of a dancing session were obtained. Once the vital signs were steadied, participants then continued with other dance styles. While this lasted, body composition parameters of participants were measured at 2 week interval throughout the duration of the study. The abdominal march dance style was adopted by participants trying to go above her perceived rate of exertion during the dancing section instead of stopping as this helped maintain steady vital signs throughout the duration of that dancing session. Once the vital signs were steady and the participant can cope, she then continued with other dance styles. Participants were advised to continue with their usual diets for the duration of the experiment. This was necessary to avoid confounding effects on the dependent variables that could arise from a controlled diet. Also, various studies have reported a significant reduction in weight due to some weeks of exercise without any form of diet control as in the case of the present study.

The control group did not engage in the aerobic dance exercise, but rather, they continued with their normal daily activities and their body composition parameters and aerobic capacities were assessed at 2 weeks intervals for the duration of the study.

2.7 Statistical Analysis

Evaluation of statistical significance was done using one-way Analysis of Variance (ANOVA). Statistical measure of association (correlation) between anthropometric parameters was carried out with Wilks' Lambda. p-value < .05 was considered statistically significant.

3. RESULTS

The dance duration for the first 2 weeks was 30 minutes with the warm up and cool down exercise time inclusive. The aerobic dance section was 4 times per week and the duration of the dance exercise increased by 10 minutes every 2 weeks for the duration of this study.

Considering week4 vs week8 pairwise comparisons, only WHR was seen to be insignificant (at $p < .05$) in its value for the mean difference. It was also seen that for the pairwise comparison for week1 vs week8, only weight ($p < .05$) and BMI ($p < .05$) had a significant value for their mean difference. Across the whole pairwise comparison, only weight and BMI had a significant change.

3.1 Description

Table 1 presents the demographic, anthropometric, body composition and aerobic parameters of the participants of both control and experimental groups. As shown, the mean values of control group were; age 21.14±1.60 years, height; 1.62±.05 meters, weight; 75,82±11.01 kg, waist circumference; 92.00±7.48 cm Hip Circumference 105.76±6.19 cm, waist hip ratio 0.87±0.07, BMI 29.12±4.63 kg/m2, percentage Body fat 38.20±8.46%, Muscle mass 20.62±3.50 kg, VO2max 3.51±0.23 L/min and heart rate 78.52±10.31 bpm, while experimental group had; age 20.06±1.50 years, height 1.64±0.07 meters,

weight 72.88±10.01 kg, muscle mass 26.32±3.28 kg, percentage body fat 33.08±6.51%, waist circumference 79.79±7.91cm , hip circumference 100.83±7.81cm, waist-hip ratio 0.79±0.05, BMI 27.07±2.38 kg/m2, VO2max 3.51±0.19L/min and heart rate 76.50±7.36bpm. The summary of repeated ANOVA with a wilks' Lambda correlation for anthropometric parameters of the control group is shown in Table 2. The results show that there was a significant difference

Table 1. Showing anthropometric and body composition parameters of participants n = 61

Variable	Control (n = 29) X ± SD	Experimental (n = 32) X ± SD
Age (years)	21.14±1.60	20.06±1.50
Height (meters)	1.62±.05	1.64±0.07
Weight (kg)	75.82±11.01	72.88±10.01
WC (cm)	92.00±7.48	79.79±7.91
HC (cm)	105.76±6.19	100.83±7.81
WHR	0.87±0.07	0.79±.05
BMI (kg/m^2)	29.12±4.63	27.07±2.38
BF (%)	38.20±8.46	33.08±6.51
MM (kg)	20.62±3.50	26.32±3.28
VO2max (L/min)	3.51±0.23	3.51±0.19
HR (bpm)	78.52±10.31	76.50±7.36

X=Mean, SD= standard deviation, WC= waist circumference, HC= hip circumference, WHR=waist-hip ratio, BMI=body mass index, BF=body fat, MM=muscle mass, VO_{2max}*=maximal oxygen consumed, HR= heart rate.*

Table 2. Showing anthropometric measurements at successive 2 week intervals among control group

Variables	Week 1 X ± SD	Week 4 X ± SD	Week 8 X ± SD	F ratio	P-value
Weight (kg)	75.82±11.01	76.65±10.99	76.24±11.00	376.02	0.001*
WC (cm)	92.00±7.48	92.18±7.47	92.39±7.39	1.396	0.265
HC (cm)	105.76±6.19	105.49±6.21	105.88±6.47	4.047	0.029*
WHR	0.87±0.07	0.88±0.07	0.87±0.07	4.083	0.028*
BMI (kg/m^2)	29.12±4.63	29.47±4.62	29.31±4.63	191.130	0.001*

X: mean, SD: standard deviation, WC: waist circumference, HC: hip circumference, WHR: waist-hip ratio, BMI: body mass index

Table 3. LSD post Hoc tests showing sources of the differences in weight, HC, WHR and BMI of overweight and obese female for the control group

Variables	Week	Mean difference	Standard error	P-value
Weight				
	Week1 vs Week4	-0.827	0.043	0.001*
	Week4 vs Week8	0.414	0.021	0.001*
	Week1 vs Week8	-0.414	0.021	0.001*
HC				
	Week1 vs Week4	0.266	0.116	0.030*
	Week4 vs Week8	-0.383	0.181	0.044*
	Week1 vs Week8	-0.117	0.200	0.562
WHR				
	Week1 vs Week4	-0.004	0.002	0.012*
	Week4 vs Week8	0.001	0.002	0.614
	Week1 vs Week8	-0.003	0.003	0.302
BMI				
	Week1 vs Week4	-0.345	0.020	0.001*
	Week4 vs Week8	0.157	0.008	0.001*
	Week1 vs Week8	-0.188	0.016	0.001*

Significant at p < .05, vs: versus, WC: waist circumference, HC: hip circumference, WHR: waist-hip ratio, BMI: body mass index

Table 4. Showing ANOVA result for anthropometric parameters across weeks for experimental group

Variables	Week 1 X ± SD	Week 4 X ± SD	Week 8 X ± SD	F ratio	P-value
Weight	72.88±10.01	70.18±9.41	68.29±9.21	210.181	0.001*
WC	79.79±7.91	78.87±7.79	78.00±7.78	215.030	0.001*
HC	100.83±7.81	100.03±7.67	99.54±7.63	86.666	0.001*
WHR	0.79±.05	0.79±.05	0.78±.05	28.700	0.001*
BMI	27.07±2.38	26.08±2.27	25.38±2.22	263.326	0.001*

Level of significance at p < .05,X: mean, SD: standard deviation, WC: waist circumference, HC: hip circumference, WHR: waist-hip ratio, BMI: body mass index.

Table 5. LSD post hoc test showing the sources of the differences in weight, WC, HC, WHR and BMI for the experimental group

Variables	Week	Mean difference	Standard error	P-value
Weight				
	Week1 vs Week4	2.703	0.171	0.001*
	Week4 vs Week8	1.888	0.111	0.001*
	Week1 vs Week8	4.591	0.225	0.001*
WC				
	Week1 vs Week4	0.919	0.066	0.001*
	Week4 vs Week8	0.869	0.096	0.001*
	Week1 vs Week8	1.788	0.093	0.001*
HC				
	Week1 vs Week4	0.797	0.077	0.001*
	Week4 vs Week8	0.494	0.091	0.001*
	Week1 vs Week8	1.291	0.102	0.001*
WHR				
	Week1 vs Week4	0.003	0.001	0.003*
	Week4 vs Week8	0.005	0.001	0.001*
	Week1 vs Week8	0.008	0.001	0.001*
BMI				
	Week1 vs Week4	0.993	.056	0.001*
	Week4 vs Week8	0.702	0.041	0.001*
	Week1 vs Week8	1.695	0.073	0.001*

*Key: *significant at p < .05, vs: versus, WC: waist circumference, HC: hip circumference, WHR: waist-hip ratio, BMI: body mass index*

(p < .05) in the mean values of weight, HC, WHR and BMI across the weeks. But, more level of significance was noticed for weight and BMI across the week. There was no significant difference (p > .05) in the mean value for WC across the weeks. To ascertain the sources of the differences in Table 2, an LSD Post Hoc analysis was carried out.

Table 3 shows that the mean differences of pairwise comparisons of week1 vs week4, week4 vs week8 and week1 vs week8 for weight (p < .05), WC (p < .05), HC (p < .05), WHR (p < .05) and BMI (p < .05) all had a significant difference. Thus for anthropometric parameters, the aerobic exercise effect was significantly detected across all the week pairs when compared.

Table 4 summarizes repeated ANOVA with a wilks' Lambda correlation for anthropometric parameters of the experimental group. The results show that there was a significant difference in the mean values of weight, WC (p < .05), HC (p < .05), WHR (p < .05) and BMI (p < .05) across the weeks. To ascertain the sources of the differences in Table 4, an LSD Post Hoc analysis was carried out.

4. DISCUSSION

Results from this study show a significant reduction in weight ($p < .05$) after 8 weeks of aerobic dance and agrees with the findings of Cuninon and Lourenco, 2005 [11] and Ross et al. 2000 [7,8,12] who found that diet and exercise produced a 20% loss in weight compared to diet alone. The study is also in line with John et al., 2003[13] who suggested that significant weight loss was achieved through a combination of exercise and diet.

The results also showed a significant reduction in WC ($p < .05$), HC ($p < .05$), WHR ($p < .05$) and BMI ($p < .05$) after 8 weeks of aerobic dance training and agrees with Fatma, 2009 [14] who found a significant difference in their subjects' BMI, body composition parameters, waist, hip ratio, waist circumference, and body fat percentages after eight weeks of aerobic dance exercise program.

In contrast to the findings of this study are those of Nassis et al., 2005 [15] who found 12 weeks of aerobic training to have improved insulin sensitivity in overweight and obese females without changes in body weights and/or percentage body fat.

Also, from this study, a decline in percentage body fat was seen at significant levels ($p < .05$) after 8-weeks of aerobic exercise. On the other hand, a significant increase in muscle mass was seen at significant level ($p < .05$). This finding was found to be in agreement with the study of Maffiuletti et al., 2007 [16] who found that body mass reduction diet and physical exercise significantly improved body composition, muscle function and motor performance of females aged 12-17 years.

The findings of Hanfy and Gabr, 2013 [17] on the "effect of aerobic exercise on reduction of obesity in girls after puberty" also strongly agree with that of this study [17].

This study, however, disagrees with that of Gert-Jan et al., 2010 [18] who found that aerobic exercises do not affect a 24-hour energy expenditure and fat oxidation in obese subjects after 12 weeks of moderate exercise[18]

4.1 Societal Benefits of Study

Results from this study reveal aerobic and body composition changes/responses. This helps in determining whether aerobic dance exercise is as effective as other aerobic exercises in improving aerobic capacity and body composition parameters of overweight and obese females after 8 weeks.

5. CONCLUSION

This study has shown that aerobic dance exercise has a significant positive effect on selected body anthropometric indices among women. Hence, aerobic dance programs are recommended for everyday use as a program of choice for weight reduction, weight maintenance and aerobic capacity improvements.

6. RECOMMENDATIONS

It is recommended that:

1. Aerobic dancing is incorporated into physical therapy plans for the effective reduction of anthropometric variables in obese/overweight individuals.
2. Awareness of dancing as an aerobic exercise should be encouraged.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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