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Research Article

Changes in Anthropometric Parameters Following High Intensity Interval Training among Obese Undergraduates

Karl Eimuhi, E.[1*], Samuel Adodo, M.[2] & Elvis Agbonlahor[3]

[1]*Department of Human Kinetics & Sports Science, Faculty of Education, University of Benin, Benin City, Nigeria*

[2]*Professor of Exercise Physiology, Department of Human Kinetics & Sports Science, Faculty of Education, University of Benin, Benin City, Nigeria*

[3]*Director of Sports, and Associate Professor, University of Benin, Benin City, Nigeria*

[*]**Correspondence to:** Dr. Karl Eimuhi, E., Department of Human Kinetics & Sports Science, Faculty of Education, University of Benin, Benin City, Nigeria.

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Abstract

The study examined changes in anthropometric parameters following High Intensity Interval Training (HIIT) programme among obese undergraduates. The pre-test, post-test randomized experimental control group design was employed for the study. The population of the study comprised one hundred and twenty (120) obese undergraduates, out of which a total of twenty four (24) obese undergraduates made up the sample for the study. Simple random sampling technique was employed to the select the participants. The physical characteristics of the participants were descriptively analyzed using mean and standard deviation, while an independent sample t-test was used to test the hypotheses. Statistical significance was accepted at p value of <0.05. The results obtained indicated a decrease in Body Mass Index (29.9 ± 3.1 vs 30.3 ± 3.0), Waist Circumference (100.0 ± 4.5 vs 101.1 ± 4.6), Waist-Height-Ratio (57.5 ± 5.2 vs 58.2 ± 5.6), Body Fat Percentage (37.4 ± 10.5 vs 37.5 ± 10.8) and Visceral Fat (8.00 ± 2.2 vs 8.83 ± 1.6), when compared with pretest

assessment. However, an increase in Waist-Hip-Ratio (0.89 ± 0.03 vs 0.87 ± 0.03) was observed. Both observed changes in anthropometric assessments were not statistically significant. It was therefore concluded that the HIIT protocol did not elicit significant changes in the anthropometric parameters of the obese undergraduates. It was recommended that further research on interval-based approaches aimed at inducing fat loss among obese undergraduate population involving a practical, timely and efficient manner should be conducted, with key consideration to exercise intensity, volume, and mode.

Introduction

Overweight and obesity are serious public health concerns in developing and developed countries. Obesity occurs as a result of an imbalance between caloric intake and energy expenditure. It may be characterized by an excessive or irregular accumulation of body fat, which is detrimental to health. Reduced or excessive body weight serves as a key indicator of determining a person's health. However, an ideal body weight may not be a gold standard for fat measurement, as it does not reflect the fat percentage in an individual's body [1]. Body Mass Index (BMI) represents an index of a person's fatness, although with an inability to identify fat distribution. Increased levels of BMI may lead to higher risk of health complications. Assessment of waist circumference complements BMI measurement, and is useful in estimating central obesity. Waist-hip-ratio and waist-height-ratio measurements allow regional distribution of body fat and may be superior for cardiovascular risk prediction in terms of higher sensitivity, and boundary values [2]. Generally, anthropometric parameters including BMI, waist circumference, waist-hip-ratio, waist-height-ratio, visceral fat, body weight and body fat percentage are popular parameters used to measure and classify obesity status. Empirical studies conducted among university undergraduates in Nigeria reflect a high prevalence of obesity and overweight [3,4].

Obesity-related health conditions may be moderated by physical activity. Physical activity plays a critical role in lessening the risk of obesity and controlling body weight by modifying the balance between energy intake and expenditure [5]. Engaging in physical activities is beneficial as it prevents various health diseases such as cardiovascular disorders, diabetes and obesity. High Intensity Interval Training (HIIT) is characterized by exercises involving relatively brief, vigorous activity, intermixed by little-intensity recovery exercises [6]. A duration of thirty minutes and above may be considered appropriate. HIIT training bouts are usually executed at optimal effort with intensities at 80 to 100% of maximal heart rate, and elicits a higher exhaustion when juxtaposed with Moderate Intensity Continuous Training (MICT) [7]. However, Chin *et al,* 2019 [8], opined that short-term HIIT elicit improvements in intense exercise performance, and appear to be beneficial as an addition to an already high training volume. In contrast, the study conducted by Nazari et al, 2016 [9], revealed that long term/chronic effect of 12-week HIIT protocol potentiated a significant increase in anthropometric parameters.

HIIT improves human physical performance [10], and can efficiently stimulate lipid and glucose metabolism [11]. Despite, the fact that HIIT has been acknowledged for its advantageous effects on body anthropometry and cardio-metabolic health, its use among obese university students remains unclear. Divergent views still exist as to whether a single session with high exercise bout duration of HIIT can sufficiently initiate

anthropometric alterations among obese students. Furthermore, inconsistency in findings have existed regarding alterations in anthropometric parameters among obese cohort. This study was instituted to examine changes in anthropometric parameters following HIIT among obese undergraduates.

Hypotheses

The following hypotheses were formulated to guide the study.

• There will be no significant difference in the body weight of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the body mass index of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the waist circumference of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the waist-hip-ratio of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the waist-height-ratio of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the body fat percentage of obese undergraduates following HIIT programme in the experimental and control groups.

• There will be no significant difference in the visceral fat of obese undergraduates following HIIT programme in the experimental and control groups.

Methodology

This study adopted the pretest - posttest control group experimental design. A sample size of twenty (24) students from a population of one hundred and twenty (120) obese undergraduates of the University of Benin in the 2019/2020 academic session were selected. The cohort belonged to an Obesity Fitness Group (OFG), which regularly participate in exercise sessions at the University of Benin. The selected sample constituted 20% of the total population. The selection was through a simple random sampling technique. The sampled participants were then randomly assigned to the experimental and control groups. This involved serializing the 24 selected obese students and respectively assigning numbers to the participants where all even numbered students were assigned to experimental group and all odd numbered students were assigned to the control group. This yielded 12 obese undergraduates in each of experimental and control group.

An ethical approval was obtained from the Ethical Clearance Committee of the Ministry of Health, Edo State, Nigeria (HA.737/120).

Anthropometric Measurements

The subjects were briefed on the study's objectives and familiarized with the anthropometric assessments

and equipment. Data were collected by conducting pre-test measurements of anthropometric parameters before the commencement of the High Intensity Interval Training (HIIT) programme, which was in an acute form. Post-test measurements were conducted immediately after the intervention duration has elapsed using the same procedures. Specifically, the participants' heights were measured while standing with bare foot using a calibrated stadiometer. The subject's percentage body fat, visceral fat and body weight indices were estimated using an Omron Body Composition Monitor (Omron Healthcare, 2019) [19], wearing minimal clothing. Waist circumference was assessed at midway level between the lowest rib and the cristae iliaca on three occasions using anthropometric tape (Seca 201, Hamburg, Germany). The Waist-Hip-Ratio and Waist-Height-Ratio were assessed in line with the guidelines proposed by Eston *et al*, (2009) [12]. All measurements were carried out three times in each specific site by the researchers, and the average of the assessments was employed as the final reading.

The physiological instruments used in this study have been validated by the Medical Laboratory Scientist outside Nigeria (Appannah *et al.*, 2009) [20]. However, two experts in Exercise Physiology re-validated and certified the instruments as appropriate for data gathering in the present study. Internal consistency type of reliability was adopted in the present study. A pilot study was carried out to confirm the suitability of the HIIT protocol and instrument, to which eight (8) independent subjects were selected, with four (4) each per group. The multilevel modeling method was adopted in obtaining the data that was subjected to Interclass Correlation Coefficient (ICC). A Correlation Coefficient of 0.76 was obtained and considered a high reliability. Hence, this justified the aptness of employing the instrument and protocol for this study.

Training Protocol

The HIIT protocol performing 10-minute warm up session including jogging, stretching, and running for a 5-minute 50% to 85% of maximum heart rate (training started with 50% of intensity) at commencement of each session. The participants performed 20-minute strength training for large muscles of the upper and lower body, which included windmills, burpees, sit-ups, heel raise, side jumps, alternate lateral tilting and alternate leg-arm kicking at 50% to 80% of one repetition maximum (training commenced with 50% of intensity and increased steadily). Three (3) sets of 10 repetitions (with 1-minute rest interval between sets and 2-minute rest interval between exercises) were performed. Training sessions were concluded using a 10-minute cooling-down session by slow walk. It has been demonstrated that this type of exercise protocol corresponded to acute HIIT [9]. The recommended protocol of High Intensity Interval Training (HIIT) was validated by Machado *et al*, (2017) [13]. The control group participants were not subjected to the High Intensity Interval Training (HIIT) protocol, rather each of the exercises for the experimental group was also executed by the control group, although without following the repetition, rest interval and no increment or overload was applied. This means that the tempo or intensity with which they started was the same till the end of the training programme.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) - IBM version 20, was employed to analyze the data. Descriptive statistics of mean and standard deviation was employed to describe the anthropometric profile of the sample collected. The formulated hypotheses were tested using inferential statistics of independent sample t-test to determine the differences between the intervention and control groups. The alpha level was set at 0.05 level of significance.

Results

Table 1: *Physical Characteristics of the Subjects (n=24)*

Variable	Group		
	Measuring	Control (n=12)	Experimental (n=12)
Age (yrs)	Pre-training	26.3 ± 9.4	27.5 ± 4.1
Height (cm)	Pre-training	1.69 ± 0.1	1.74 ± 0.1

*Values expressed as Mean ± SD

Table 1 presents means and standard deviations of physical characteristics of the experimental and control groups.

Table 2: *Descriptive Statistics Showing the Anthropometric Profile of the experimental and control participants*

Variable	Experimental (n=12)		Control (n=12)	
	Pre	Post	Pre	Post
Body Mass Index (Kg/m²)	30.3 ± 3.0	29.9 ± 3.1	30.6 ± 4.5	30.6 ± 4.2
Waist Circumference (cm)	101.1 ± 4.6	100.0 ± 4.5	99.1 ± 9.8	100.8 ± 8.8
Waist-Hip-Ratio (cm)	0.87 ± 0.03	0.89 ± 0.03	0.88 ± 0.05	0.90 ± 0.04
Waist-Height-Ratio (cm)	58.2 ± 5.6	57.5 ± 5.2	59.0 ± 7.7	60.0 ± 7.5
Body Fat Percentage (%)	37.5 ± 10.8	37.4 ± 10.5	39.6 ± 10.6	38.8 ±11.4
Visceral Fat	8.83 ± 1.6	8.00 ± 2.2	10.0 ± 2.0	9.8 ± 2.1

*Values expressed as Mean ± SD

Table 2 reflects that for the experimental group, a decrease in body weight, body mass index, waist circumference, waist-height-ratio, visceral fat and body fat percentage prior with means and standard deviations, were observed at posttest assessment when compared with pretest assessment. In contrast, a slight increase in waist-hip-ratio with a mean and standard deviation of 0.87 ± 0.03 and 0.89 ± 0.03 was observed at posttest assessment when compared with pretest assessment respectively.

Table 3: *Independent Samples t-test of the Experimental and Control Groups*

Variables		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Body Weight	Equal variances assumed	.009	.094	1.472	22	.155	5.36667	1.1434	-12.929	2.19656
	Equal variances not assumed			1.472	21.886	.155	5.36667	1.1434	-12.929	2.19656
BMI	Equal variances assumed	8.281	.009	.352	22	.728	.5333	1.5166	-2.6119	3.6786
	Equal variances not assumed			.352	20.384	.729	.5333	1.5166	-2.6265	3.6931
Waist Circumference	Equal variances assumed	7.618	.011	.292	22	.773	.83333	2.8519	-5.0813	6.74800
	Equal variances not assumed			.292	16.317	.774	.83333	2.8519	-5.2030	6.86976
Waist-Hip-Ratio	Equal variances assumed	.366	.552	1.043	22	.308	.01667	.01599	-.01649	.04982
	Equal variances not assumed			1.043	20.937	.309	.01667	.01599	-.01658	.04992
Waist-Height-Ratio	Equal variances assumed	3.634	.070	.965	22	.345	2.55000	2.6428	-2.9309	8.03090
	Equal variances not assumed			.965	19.580	.346	2.55000	2.6428	-2.9704	8.07045

Body Fat Percentage	Equal variances assumed	.008	.928	.181	22	.858	.81667	4.5060	-8.5283	10.1616
	Equal variances not assumed			.181	21.866	.858	.81667	4.5060	-8.5316	10.1650
Visceral Fat	Equal variances assumed	.115	.738	2.049	22	.053	1.83333	.89471	-.02218	3.6888
	Equal variances not assumed			2.049	21.921	.053	1.83333	.89471	-.02257	3.6892

*Significant difference ($p<0.05$) between the control and experimental group

In Table 3, differences in the body weight, body mass index, waist circumference, waist-hip-ratio, waist-height-ratio, visceral fat and body fat percentage prior to and following an acute HIIT programme was determined using an Independent Sample t-test. No significant difference in the control and intervention groups was observed. Thus, the hypothesis which states that there is no significant change in the of the experimental and control obese undergraduates following HIIT programme was accepted. It therefore implies that HIIT had no substantial effect on the anthropometric parameters of the University of Benin obese undergraduates.

Discussion

The study evaluated changes in anthropometric parameters following HIIT protocol among obese undergraduates. The outcome of this study indicated a decrease in the body weight, body mass index, waist circumference, waist-height-ratio, visceral fat and body fat percentage following an HIIT intervention among the obese undergraduates. However, the observed decrease was not statistically significant. The findings of this study corroborate the study of Airin *et al*, (2014) [14], although with a statistical significant decrease. The observed statistical significance could be attributed to large sampling size employed in the research. Also, the duration of the HIIT protocol involving Six weeks could have contributed to the statistical significance. In tandem with this study, was the findings presented by Zhang, *et al*, (2015) [16], which reflected fat reduction in parts of the body and that fat metabolism correlates with the intensity of preceding exercises. They further asserted that heightened fat utilization after exercise due to elevated exercise-intensities may partially relate to growth hormone secretion, which in-turn regulate body composition and metabolism.

The findings of this study presented an increase in waist-hip-ratio, although with no statistically significant difference. In contrast, the study by Astorino *et al* (2018) [15], presented a significant decrease in waist-hip-ratio following HIIT protocol. This contrasting finding may be due to the technique used to access percentage body fat, as dual-energy X-ray absorptiometry was typically utilized in measuring changes in body composition in response to training. In addition, WHO (2008) [17] asserted that a critical issue in

interpreting waist-hip-ratio is the protocol employed in obtaining the assessments and measurements standardization within a study, which varies across studies especially when assessed by several persons. Inconsistency with the waist-hip-ratio of this findings may be due to specific characteristics of HIIT, which widely vary across studies, leading to divergent rates and subsequent variation in energy expenditure. Interestingly, similar to this study, Nofuji (2008) [18] findings presented no statistically significant changes in the anthropometric variables studied.

Conclusion

Based on the findings of this study, the following conclusions were made:

• HIIT protocol initiated a decrease in body weight, body mass index, waist circumference, waist-height-ratio, visceral fat and body fat percentage of the obese undergraduates.

• HIIT protocol did not elicit any significant change in the anthropometric parameters of the obese undergraduates.

• HIIT presents a potent practical approach to weight-control among obese persons.

Recommendations

Based on the findings, the following recommendations were made:

• Prioritization of national exercise programs for the prevention and treatment of obesity and related complications should be ensured.

• Further research with larger sample size is essential to elicit statistical significance using the HIIT intervention among university obese population.

• Interval based approaches aimed at inducing fat loss among obese population in a practical, timely and efficient manner should be conducted with key consideration to exercise intensity, volume, and mode.

• Obese students should be sensitized to the various benefits of HIIT programs as they relate to the general health and well-being of individuals.

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