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Effect of circuit strength training programme on waist-to-hip ratio of college students

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Abstract

The purpose of this study is to examine the amount of fat stored around the hips and thighs (waist-to-hip ratio) of college students in Ikere Ekiti, Nigeria, after a 12-week circuit strength training programme. The study adopted randomised pre-test post-test control group research design. Simple random sampling technique and fish bowl method with replacement were used. Anthropometric tape was the instrument used for the pre-test post-test data collection on the waist, girth and gluteal (hip girth) of participants. The two hypotheses formulated were tested with analysis of covariance statistics at a significant level of 0.05. It was observed that the intervention programme prevented the storage of fat around the hips and thighs of the experimental group from increasing to the level of high disease risk ≥ 1.00 for men and ≥ 0.85 for women. The study identified circuit strength training programme as a recipe to ameliorate hypokinetic conditions.

Keywords: Circuit strength training, resistance exercise, waist girth, waits-to-hip ratio.

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1. Introduction

Circuit training programme employs a series of exercise stations. The station consists of various combinations of brief aerobic, calisthenics, flexibility and weight training exercises. In carrying out the exercises at the stations, the individual moves rapidly from one station to the next and performs whatever exercise is to be done at that station within a specified time period. A typical circuit is made up of 8–12 stations. The exercise at each of the stations is repeated three times to make a circuit (ACSM, 2005; Heywood, 2003).

American College of Sports Medicine (2009) and the American Association of Cardiovascular and Pulmonary Rehabilitation (1995) identified strength training as an effective method of developing musculo-skeletal strength and prevention and rehabilitation of orthopaedic injuries. Waist-to-hip ratio is used for determining physical fitness and is calculated by dividing body weight in kilogram by body height in metres square, purposely used as a measurement of obesity and other cardiovascular diseases (De, 2016; Kavak, Pilmane & Kazoka, 2014; Lee, Huxley, Wildman & Woodward, 2008; Skrzypczak, Szwed, Chmara & Skrzypulec, 2007). When there is excess fat deposition around the waist, with a ratio > 80 in women and > 90 in men, it is a sign of health risk (Bisai, Bose, Ghosh & De, 2011; De, Das, Bose & Chakraborty, 2013; Kankana, 2017; WHO, 2011). This was corroborated by Yusuf et al. (2005) who reported results from an important study of over 27,000 people from 52 countries where they represented several major ethnic groups. They observed in their study that participants of all ages and ethnic groups had a significantly increased risk of heart attack when the waist-to-hip ratio was 0.90 or greater in men and 0.83 or greater in women. Kragelund and Omland (2005) accentuated this that as values of waist-to-hip ratio increase, the risk of heart attack increases progressively with no evidence of a threshold value.

Regional fat deposition differs in men and women as observed by (Nindl et al., 2001). The different parts of the body where the fat is deposited favour women in the arm region with a range of 27%–34% for women and 18%–19% for men. In terms of total fat mass, men are at advantage with 51% of fat deposited in the trunk and 45% deposited in the trunk of women. Women are at vantage position in terms of fat deposition in the leg with 39% for women and 35% for men, respectively. Women are also favoured in terms of fat deposition in the arms, 16% for women and 15% for men. There is no difference in the amount of storage fat between men and women, except that men store fat around the waist and women around the hips and thighs.

The amount of storage fat does not differ between men and women, except that men tend to store fat around the waist and women around the hips and thighs. However, the increased risks associated with obesity are the greater concern depending on the pattern of fat distribution in the body, e.g., in the torso and abdomen versus the hips, thighs and buttocks (Hoeger & Hoeger, 2007; Srikanthan, Seeman & Karlamangla, 2009). Torso and abdominal fat, referred to as visceral central or intra-abdominal fat, is related to health abnormalities including insulin resistance and abnormal blood lipid levels escalating the risk of diabetes mellitus and cardiovascular disease, respectively (Ness-Abramot & Aprovian, 2008).

Nigerians are ignorant of the benefits of a regular medical checkup for early medical intervention; they believe that it is a waste of time and money and that their medical status will not be made secret. Therefore, Nigerians should cultivate the idea of a regular medical checkup to reduce the increasing chronic diseases in Nigerians. One of the ways by which they can determine their fitness level is through the status of their waist-to-hip ratio.

There is an increasing rate of health problems in adult Nigerians such as obesity, diabetes, hypertension, heart diseases and low back pain which is due to the paucity of research on the waist-to-hip ratio of adult Nigerians. This study is, therefore, designed to find out the effects of a 12-week circuit strength training programme on the waist-to-hip ratio of college men and women in Nigeria.

1.1. Statement of the problem

Many college students do not take part in exercises, apart from walking to and fro from their halls of residence to their classrooms that are not far from each other. This activity is sedentary in nature which made some of them develop 'pear' shape or gynoid obesity, storage of fat around the hips and thighs compared with those who engaged in regular physical activities that are not obese. This sedentary way of life or inactivity has resulted in the development of coronary heart diseases among the participants. Diseases like hypertension, diabetes, osteoporosis, arthritis and other hypokinetic conditions. The conditions exacerbated to the extent of assisting some of them in walking to their classrooms. Therefore, the study is to determine the amount of fat stored around the hips and thighs (waist-to-hip ratio) of college students after a 12-week circuit strength training programme.

1.2. Purpose of the study

The purpose of the study is to examine the amount of fat stored around the hips and thighs (waist-to-hip ratio) of college students (men and women) after a 12-week circuit strength training programme.

1.3. Research hypotheses

1. There will be no significant difference in the waist-to-hip ratio of college men and women in the experimental group after a 12-week circuit strength training programme.
2. There will be no significant difference in the waist-to-hip ratio of men and women in the experimental and control groups after a 12-week circuit strength training programme.

2. Research methods

This study adopted randomised pre-test post-test control group research design, using a 2 × 2 factorial design, where the 2 × 2 design represents the following: two groups (experimental and control) and two genders (male and female). The experimental research design is shown below:

Experimental group:	0_1 X 0_2
Control group:	0_3 0_4

Where 0_1 and 0_3 are the pre-test for experimental and control groups, respectively while the post-test for the experimental and the control group are 0_2 and 0_4, respectively. X represents the treatment for the experimental group.

Participants who took part in the study are 87 males and females students of College of Education, Ikere-Ekiti, Nigeria. They were selected using the simple random sampling technique and fish bowl method without replacement so that each of the participants can be given equal opportunity to be chosen in the age range of 17–30 years. The participants were then randomly assigned to two groups: one experimental (men and women) and one control group (men and women). None of them ever participated in organised sporting activities throughout the previous year.

The nature of test and purpose of the study were explained to the students. Informed consent form in which a short description of the investigation was written was given to them. The forms were duly filled and signed by the students. There were 44 participants in the experimental group, that is, 21 men and 23 women. The control group also consisted of 43 participants, 21 men and 22 women. The two groups took part in pre- and post-training measurements while the experimental group alone was exposed to 12-weeks circuit strength training programme.

The participants were allowed to rest for 30 minutes on reporting for the test after which their waist and gluteal girths were measured. The physical activity programme was a 12-week circuit strength training exercises. The exercises were carried out three times per week. Initially, it lasted for 30 minutes and was gradually increased to 40 minutes between 8:00 am and 8:40 am on the school playing ground. The exercises were graduated from week 1 to week 12 by increasing the repetitions and sets. The exercise training was done in a circuit with instructions and supervision by the researcher and his trained assistants.

Before the commencement of the training programme, pre-exercise observations of the participants were carried out. The training session began with warm-up activities. The circuit-training lasted 20 minutes and the cool down stretch 4 minutes. The duration of the circuit training was increased to 40 minutes before the end of the programmes, 6 minutes for warm-up stretches or exercise, 30 minutes for strength-training and 4 minutes for cool-down stretch.

Participants in the experimental group were divided into 5 groups (10 participants in each group). The groups performed the circuit-strength training exercise at the different stations. Each group of participants exercises at each station and had 1-minute rest between stations. The participants move from one station to the other in a clockwise direction as soon as the time allotted to each station was over. They were required to go through the five stations of the circuit three times with 4 minutes rest between sets. During the rest between sets, participants engaged in breathing exercises and walking around. The circuit-strength training was performed three times a week on alternative days to allow for muscles recuperating.

The participants performed the following strength-training exercises in a circuit for 12 weeks: Rowing torso, Step-up, Modified push-up, Abdominal crunch, Heel raise, Modified dip, Leg abduction and adduction, Pull-up, Pelvic tilt and Arm curl.

2.1. Waist girth measurement

The participants were asked to be in a relaxed standing position with their arms folded across the thorax. Girth measurement was then taken at the level of the narrowest point between the lower coastal (10th rib) border and the iliac crest. The measurer positions the anthropometric tape in front at the target level. The participants were instructed to lower their arms to the relaxed position, breathed normally and the measurement was taken at the end of the normal expiration (end tidal).

2.2. Gluteal (hip girth measurement)

The participant assumed a relaxed-standing position with the arms folded across the chest with their feet together and the gluteal muscle relaxed. The gluteal girth was taken with the anthropometric tape at the level of the greatest protuberance of the buttocks.

2.3. Statistical analysis

Descriptive statistics of mean, range, standard deviation and inferential statistics of analysis of covariance (ANCOVA) was used for data analysis. The significance level for all statistical analysis was set at 0.05.

3. Results

3.1. Descriptive statistics for men and women in the experimental and control groups

Table 1. Descriptive statistics for the waist-to-hip ratio of the experimental and control groups

Variables	*N*	Pre-test		Post-test		*X* Gain
		X	SD	*X*	SD	score
Experimental						
Men	21	0.8498	0.02624	0.8519	0.02693	0.0021
Women	23	0.8205	0.04062	0.8291	0.04695	0.0086
Control						
Men	21	0.8531	0.03159	0.8603	0.03439	0.0072
Women	22	0.8270	0.04327	0.8330	0.04612	0.006

Table 1 reveals that the participants in the experimental group who were exposed to the intervention programme had a lower mean gain for men than their counterparts in the control group and higher mean gain for women in the experimental group than their counterparts in the control group. Both gains were negligible. This was deduced from the pre-test mean scores (0.8531; 0.8270; 0.8498 and 0.8205) and the post-test mean scores (0.8603; 0.8330; 0.8519 and 0.8291) obtained by the experimental and control groups, respectively. The mean gain of 0.003 for men in the experimental group lower than that of men 0.0072 in the control group was owing to the effect of the intervention programme on the experimental group and inactivity on the control group. For women, the mean gain of 0.0086 in the experimental group is higher than that of the control group 0.006; this was owing to the effect of the intervention programme and inactivity. The findings are in line with literature; exercise brings about increase in body fat for women and an increase in muscle mass for men with the corresponding decrease in body fat for men. The participants in the experimental group benefited from the intervention programme.

3.2. Hypothesis

There will be no significant difference in the waist-to-hip ratio of college men and women in the experimental group after a 12-week circuit strength training programme.

Table 2. ANCOVA on the waist-to-hip ratio of college men and women in the experimental group following a 12-week circuit strength training programme

Source of variance	Sum of squares	df	Mean square	*F*	F_c	Sig.
Main effects	0.05809	2	0.02905	111.850		0.000
Covariates	0.05763	1	0.05753	221.906		0.000
Sex	0.0004656	1	0.0004656	1.793	4.08*	0.188
Residual	0.01065	41	0.0002597			
Explained	0.06874	43				
Total	31.113	44				

$F_{(critical)} = 4.08$

* = not significant

Table 2 shows the ANCOVA for the waist-to-hip ratio of men and women in the experimental groups. The table reveals that the calculated *F*-value $F_{(1,43)} = 1.79$ and $P > 0.05$ was not significant at 0.05 alpha level. This indicates no significant difference in the waist-to-hip ratio of college men and women in the experimental group. For this reason, the hypothesis was not rejected.

3.3. Hypothesis

There will be no significant difference in the waist-to-hip ratio of experimental and control groups.

Table 3. ANCOVA on the waist-to-hip ratio of the experimental and control groups

Source of variance	Sum of squares	df	Mean square	*F*	F_c	Sig.
Main effects	0.08796	4	0.02199	31.081		0.000
Covariates	0.8749	1	0.08749	123.659		0.000
Sex	0.00008693	1	0.00008693	123	3.96*	0.727
Residual	0.05801	82	0.0007075			
Explained	0.146	86				
Total	61.990	87				

$F_{(critical)} = 3.96$

* = not significant

Table 3 shows the ANCOVA for the waist-to-hip ratio of the experimental and control groups. The table reveals that the calculated *F*-value $F_{(1,86)} = 123$, and $P > 0.05$ was not significant at 0.05 alpha level. This indicates no significant difference in the waist-to-hip ratio of the experimental and control groups. Therefore, the hypothesis was not rejected.

4. Discussion

Table 1 shows the descriptive statistics for the waist-to-hip ratio of participants pre and post values. The experimental group (men) post-test mean value for waist-to-hip ratio was 0.85. This mean value was lower than the waist-to-hip ratio of ≥ 0.95. This value was higher than the grand mean of 0.84 for the experimental groups (men and women). The post-test mean value of women in the experimental group of 0.83 and the pre-test value of 0.82 falls within the range of 0.81–0.84 classified as low in terms of disease risk (Hoeger & Hoeger, 2007). The values were lower than the grand mean value of 0.84 for the experimental groups (men and women).

This finding was in line with that of Hoeger and Hoeger (2007) who stated that the amount of storage fat does not differ between men and women except that men tend to store fat around the waist and women around the hips and thighs. The constant mean values pre and post 0.85 for men and the slight increase for women from 0.82 to 0.83 could be attributed to the effect of the circuit-strength training which prevented the fat values to increase to the level of high disease risk ≥ 1.00 for men and ≥ 0.85 for women (Hoeger & Hoeger, 2007; Welborn & Dhaliwal, 2007).

The control group (men) pretest mean value was 0.85 and the standard deviation was 0.03. The post-test mean value was 0.86 and a standard deviation of 0.03. The control group (women) pre-test mean value was 0.83, with a standard deviation of 0.04. The post-test mean value was 0.83 and a standard deviation of 0.05. The control group (men) post-test mean value for waist-to-hip ratio was 0.86. This mean value was lower than the waist-to-hip ratio of ≤ 0.95 classified as very low in terms of disease risk (Hoeger & Hoeger, 2007; Welborn & Dhaliwal, 2007). The pre-test mean value of 0.85 was lower than ≥ 0.95.

This value was higher than the grand mean of 0.84 for the control groups (men and women). Comparatively, there was a slight increase in the post-test means of control group men and women and that of the post-test means of experimental group men. The increase was not statistically significant. The increase in the control group waist-to-hip ratio could be attributed to inactivity while that of experimental group men increase, although not statistically significant but was in line with literature that men tend to store fat around the waist (Hoeger & Hoeger, 2007). Comparatively, the post-test mean value of control group 0.86 was higher than that of the experimental group 0.85. That of the control group could be attributed to the inactivity while that of the experimental group could

be attributed to the effect of circuit-strength training which makes it lower than that of the control group after 12 weeks.

The constant mean value of 0.85 pre and post for the experimental group could be attributed to the effect of the circuit strength training programme which made the value constant. Instead of decreasing, it was constant in the sense that the waist is where the fat is deposited in men, regional deposition site (Hoeger & Hoeger, 2007). Instead of increasing leading to the level of high disease risk of ≥ 1.00 for men, the training programme prevented it to increase. The slight increase for women experimental group from 0.82 which was not statistically significant could be attributed to the effect of the intervention programme which prevented it to increase to ≥ 0.85 for women, the level of high disease risk. Also, women are known to store fat in the body instead of losing fat. This fat is deposited in sex-related sex-specific deposits (Hoeger & Hoeger, 2007). This fat is used for child-bearing and other hormone-related functions.

That the control group men slight increase in pre-test mean could be attributed to inactivity. If this sedentary way of life continues, it would lead to a high risk of disease.

The increase observed in the post-test mean value of the control group men and experimental group women was in line with the literature. This was owing to the effect of the circuit training programme on the experimental group of women which increases the body fat with the corresponding decrease in muscle mass. The increase in the control group men body fat was owing to inactivity (Hoeger & Hoeger, 2007; Ness-Abramot & Aprovian, 2008; Srikanthan, Seeman & Karlamangla, 2009). No difference observed in the pre- and post-test mean value of the experimental group of men and the control group of women. This was also in line with literature in that the training programme prevents an increase in the body fat of the experimental group of men with a corresponding increase in muscle mass and vice versa for the control group of women (Hoeger & Hoeger, 2007). The insignificant difference between the experimental groups (men and women) was owing to the interaction effect of treatment between the groups. The effect of treatment was the same for the experimental groups. This was corroborated by (Deschenes & Kraemar, 2002) that the insignificant difference in the variables was owing to the effect of the circuit-strength training whereby the exercise stimulus is the same. The result of this study is at variance with Mengistic (2013) and Billy et al. (2017), who observed a reduction in the waist-to-hip ratio of participants after high-intensity circuit-training. The difference observed in the studies may be owing to the different modes of training, duration and types of exercises adopted. The insignificant difference observed in the variables was in line with the literature as opined by Wilmore and Costill (2004) that body composition changes take place slowly in human exercise studies and the magnitude of the change is small.

Literature is scarce on the effects of circuit-strength training on the waist-to-hip ratio of adult Nigerians. Therefore, the comparison could not be made based on other research results. It was, therefore inferred; that the observed changes in waist-to-hip ratio were the result of the circuit-strength training adopted for the study.

5. Conclusion

A 12-week circuit strength training programme comprising resistance exercises at moderate-intensity for 30 minutes which was later increased to 40 minutes was performed 3 days in a week. It showed improvements in the cardiovascular risk profile of the college men and women participants in the experimental group compared to participants in the control group. It was observed that circuit strength training programme of 12 weeks duration prevented waist-to-hip ratio of participants in the experimental group to increase to levels considered to be at risk, ≥ 1.00 for men and ≥ 0.85 for women.

6. Recommendations

College men and women should participate in moderate intensity-strength training exercises 2–3 days per week so as to prevent the onset of cardiovascular diseases caused by too much disposition of fat at the waist and hip region. Adult Nigerians should do regular medical checkup for early detection of cardiovascular diseases. Other training methods should be used to determine the effects on the waist-to-hip ratio of college men and women. Further studies need to be done on circuit strength training effects on body composition variables in college students.

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