EFFECTS OF AEROBIC EXERCISES ON SELECTED ANTHROPOMETRIC CHARACTERISTICS OF PREGNANT WOMEN ATTENDING ANTENATAL CLINIC OF A NIGERIAN TEACHING HOSPITAL.

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Abstract

Background: A substantial number of women stop exercising when they discover they are pregnant, and only few begin participating in exercise activities during pregnancy. The adoption or continuation of a sedentary lifestyle during pregnancy may contribute to the development of certain disorders. In view of the global epidemic of sedentary behaviour and obesity-related pathology, prenatal physical activity was shown to be useful for the prevention and treatment of these conditions.

Aim: The aim of this study was to investigate the effect of aerobics on some physical fitness parameters of pregnant women attending the ante natal clinic of Rivers State University Teaching Hospital, Port Harcourt.

Methodology: Sixty-four pregnant women who completed the study were simply randomized into experimental (n=38) with age range 25 – 43years and control (n=26) with age range 19 – 41years; their pre-intervention values of hand grip strength, mid upper arm circumference and percentage body fat were taken and recorded. A ten week, three times weekly aerobic exercise (of 40– 45minutes duration) training was administered on the experimental group only. Post-intervention values was also taken from all participants and obtained data summarized using mean and standard deviations. Analysis of covariance was used to test the effects at 0.05 alpha level.

Results: Post-intervention Hand Grip Strength of the pregnant women was 35.87$\pm$4.09N (experimental group) and 23.62$\pm$4.09 N (for control). The mid upper arm circumference of the pregnant women in the experimental group changed from 29.15$\pm$2.85cm to 28.81$\pm$2.74cm, while that of the control group changed from 28.93$\pm$2.03cm to 29.35$\pm$2.06cm. The percentage body fat of the pregnant women in

the experimental group increased from 39.06±10.44% to 41.80±10.30% and in the control group from 40.21±5.69% to 45.25±5.68%.

Conclusion: It was concluded that Aerobic Exercise Training improved the physical fitness status of the pregnant women in Rivers State University Teaching Hospital.

Keywords: Aerobic Exercise; Physical Fitness Parameters; Pregnant Women

Introduction

Pregnancy is a combination of a series of physiological, psychological, and physical alterations. Particularly, musculoskeletal changes resulting from pregnancy are widely acknowledged, though, its magnitude is scarcely quantified. During pregnancy, the pregnant woman undergoes various anatomical and physiological changes in her body.[1]

Aerobic exercises is a form of physical exercise that combines rhythmic movements with stretching and strength training routines with the goal of improving all elements of fitness (flexibility, muscular strength, and cardio-vascular fitness). It may be performed with music and may be practiced in a group setting led by an instructor (fitness professional), although it can be done without musical accompaniment[2] Regular physical activity is associated with improved physiological, metabolic and psychological parameters, and with reduced risk of morbidity and mortality from diseases such as cardiovascular disease, hypertension, diabetes mellitus, obesity, osteoporosis, sarcopenia, cognitive disorders and some forms of cancer. Regardless of the specific physiological changes induced by pregnancy, which are primarily developed to meet increased metabolic demands of mother and fetus, pregnant women benefit from regular physical activity the same way as non-pregnant subjects.[3] Weight gain usually experienced during pregnancy results in postural changes that produce pain and musculoskeletal complaints in pregnant women[4]

Hand Grip Strength (HGS) has been reported as an indicator of the total body strength[5], an objective test for physical capability[6] and a valid predictor of work capacity[7] degree of disease/injury, and rehabilitation outcomes[8,9]. A good performance on the HGS is associated with high functional index of nutritional status[10,11], reduced risk of a series of ill health outcomes[12,13] and decreased functional limitations[6,7], disability[14,15] and morbidity and mortality rates especially among older populations[16].

Earlier studies conducted in Africa have generally provided evidence that women in low-income countries have a high physical workload that is sustained during pregnancy[17]. This high physical workload was believed to contribute to the high incidence of low birth weight[18]. However, there are only a few published studies on physical activity among pregnant women in low-income countries, and most are questionnaire-administered studies [19] There is ample and consistent evidence that promoting physical activity in women of reproductive age may be a promising approach for the prevention

of excessive weight gain, gestational diabetes mellitus and subsequent complications suffered by children born from pregnancies affected by gestational diabetes mellitus[20]. At least 30 min of moderate activity or 8000 steps/day equivalent to approximately 7.5 MET-h/week are recommended for beneficial results[21]. Meta-analysis studies suggested that women from developing countries perform similar amounts of physical activity as women from developed countries when assessed by doubled labelled water raising questions about actual physical workload. However, these data provide no insight into the patterns of physical activity. Thus, there is a need for more studies with objective methods for assessing physical activity among pregnant women in low-income countries.

Historically, pregnancy was regarded as a state of confinement. More recently, however, research has demonstrated many potential health benefits of aerobic and strength-conditioning exercise in pregnancy and the post-partum period. It is now considered safe, and even advisable, for otherwise healthy pregnant women to initiate or continue an active lifestyle during pregnancy[22].

Many anatomical and physiological changes take place during pregnancy and while there is no evidence to suggest that exercise in pregnancy is associated with any maternal or fetal adverse outcomes, it is prudent to adjust exercise regimen where necessary to avoid potential harm[23].

In normal healthy-weight humans, women have a higher percentage body fat than men, a difference that commences at puberty and continues throughout adult life, suggesting that the mechanism is related to sex steroids. Therefore, female puberty and early pregnancy could be seen as states of efficient fat storage of energy in preparation for fertility, fetal development and lactation providing an obvious biological advantage according to some studies[24].

However, a substantial proportion of women stop exercising after they discover they are pregnant, and only few begin participating in exercise activities during pregnancy. This study examined the effects of aerobics on some physical fitness parameters of pregnant women attending the antenatal clinic of the Rivers State University Teaching Hospital.

Materials and Methods

Materials:

Participants

The population for this study consisted of pregnant women who attended antenatal clinic at the Obstetrics and Gynaecology (O & G) Department of the Rivers State University Teaching Hospital, Port Harcourt. The research design adopted for this work was the pre test-post test experimental design. The population for this study consisted of Three Hundred and Eighteen (318) pregnant women (age range 19 – 43years) who were registered at the O&G departments of the hospital (parity 1 – 4) in the months of December 2020 and January, 2021. Seventy-Eight (78) pregnant women willingly volunteered for study following a health promotion talk / sensitization at the Obstetrics

and Gynaecology Department but Sixty-Four (64) completed the study. They were randomly assigned to experimental (n=38) and control (n=26) groups using the simple randomization method of tossing a coin.

The sample size for the study was determined using sample size determination for randomized controlled test.

$$n = 16\left[\frac{1}{Effect\ Size}\right]^2$$

n = Sample Size

Effect Size = 0.53

$$n = 16\left[\frac{1}{0.53}\right]^2$$

$$= 56.96$$

$$= 57.$$

Instruments

1. The Omron Karda Scan Body Composition Monitor (HBF–522, OMRON HEALTHCARE Co Ltd. Japan) was used to measure body weight and the percentage body fat of the participants.
2. A hand held dynamometer QF-Qingfeng (made in China) was used to measure the hand grip strength (HGS) of the participants.
3. A tape measure FIBER-GLASS (Made in China, non-stretch)) of 60 INCH/150CM was used to measure the mid arm circumference in centimeter of the pregnant women.

Methods:

Inclusion and Exclusion Criteria

The inclusion criteria for this study was that the age of pregnancy not more than Twenty-Six (26) weeks at the commencement of the study. This was to enable the participants conclude the study while still pregnant and that there was no history of cardiovascular diseases among the participants which could endanger them and their fetus(es).

The exclusion criteria for this study were pregnant women with other medical conditions such as cervical incompetence, placenta previa, multiple pregnancies and all pregnant women on bed rest.

Research Design

The design adopted for this research is randomized pre test-post test control group design. The differences in the pre-test and post-test values represented the impact of the ten (10) weeks aerobics training on the experimental group.

Procedure for Data Collection

Ethical approval was granted by the Research Ethics Committee of the Rivers State University Teaching Hospital, Port Harcourt, Rivers State, Nigeria (RSUTH/REC/2021048). Informed consent was also obtained from the participants. The participants were volunteers who were randomly assigned into two groups – the

experimental (n=38) and control (n=26) groups. All participants went through the rigors for obtaining the baseline data of Name, age, pregnancy age, number of previous pregnancies and occupation. Also the variables – percentage body fat, mid upper arm circumference and hand grip strength were measured using their various instruments and their results recorded.

Percentage body fat was measured using the Omron Karda Scan Body Composition Monitor (HBF-511). The participants mounted on it bare footed and the indicated body weight and the percentage fat were noted.

The right mid upper arm circumference was measured by locating the acromial process (tip of shoulder) and the olecranon (tip of elbow). Measurement was done from the posterior aspect of the arm between these two (2) points. The length was divided into two (2) and the mid-point marked and read off. The tape measure sliding snugly on the skin follows the contour at this point. Measurement was recorded in centimeters (cm) using decimal point. The process was repeated three (3) times and the average taken.

For hand grip strength measurement, each participant squeezed the hand-held dynamometer with all their strength with their right hand while the indicator is facing upwards/outwards and the reading taken in newton (N). This was done three (3) times and the average score recorded.

The training protocol

The exercise protocol (which lasted about 40 – 45 minutes each session) was carried out thrice weekly in the physiotherapy gymnasium of the physiotherapy department. A post-test data was obtained from both the experimental and control groups at the end of the ten (10) weeks of the training program.

The training protocol used for this study was researcher-designed but followed the recommendations of the American College of Sports Medicine (ACSM), 2014.[25] The class of pregnant women were instructed to perform the following:

Warm Up

i. Move around the gym

ii. On a spot, Swing arms forwards & backwards x 5

iii. Side and Upward Swings x 5

iv. Put hands on waist and rotate slowly x5

v. Hold unto the parallel bars, Swing right legs forward and backwards x 5

vi. Then Swing the Left also x5

Exercise i: Hopping on the spot slowly for 2 minutes

Exercise ii: Alternate leg raises in standing (at least 6" above the floor) x 5 each leg

Exercise iii: Reach out to something far above your height (can use chalk as marker) tip-toe x 5

Exercise iv: With clenched fist and outstretched arms, swing arms beyond your frontal midline x5 each hand.

Exercise v: In sitting on an armless chair with a (1.5 kg wt), swing arms from the back mode to above your heads and return x 10.

Exercise vi – in Sitting

Head/ Neck Movements:

i. Forward looking, bring your chin to touch your chest and return x 5

ii. Forward looking, look up to see a bit beyond the centre of your head and return x 5

iii. Forward looking, turn your head/neck to the right as far as you can go and return x 5

iv. Forward looking, turn your head/Neck to the left as far as you can go and return x 5

Exercise vii – in Lying

Supine (Face up)

i. With both legs together, separate them as far possible as you can go and return x 5.

ii. Alternate Straight leg raises to about 45^0 above the floor 5 x each (in the last 5wks, increase to 10 x each leg)

iii. Bicycling in the air (better done with the rhythm of a metronome) for 2 – 3 minutes.

Exercise viii – Side Lying

i. Right side lying: raise the left leg from the hip x5

ii. Left side lying: raise the right leg from the hip x5

(In the last 5wks, increase to 10 x each leg)

Exercise ix – Kegels

Still lying on your left side, try and hold back as if trying to prevent urine/faeces from coming out, hold it to the count of 10; rest for 1 minute, and hold again to the count of 15.

Exercise x – Cool Down

i. Gentle Spot hopping, while raising and dropping both upper limbs.

ii. Deep breathing exercises

Data Analysis

All statistical analyses were done using Statistical Package for Social Science (SPSS) for windows version twenty-One (21). Data were summarized using descriptive statistics such as Mean (x) and Standard Deviation (SD). The efficacy was the aerobic exercise training was tested using inferential statistics Analysis of Covariance at 0.05 alpha level. Cohen criterion for interpretation of the partial eta value was used to interpret the effect size of the exercise on the pregnant women with 0.20 – 0.49 as small effect, 0.50 – 0.79 as medium effect and ≥0.80 as large effect. [26].

Results

In terms of the hand grip strength, Table 1 shows that the pre-test experimental group had a mean of 29.16±6.34N with a mean difference of 5.97N when compared with the control. Following the training, the post-test experimental group had a mean value of 35.87±4.09N, and a mean difference of 12.25N when compared with the post-test control value of 23.62±4.04N. This mean difference when compared with the pre-test value elucidated the possible effect of the aerobics training on the hand grip strength of the participants. Also, the partial eta square statistics was calculated to determine the effect of the aerobics training on the hand grip strength of the participants. Table 2 shows the Analysis of CoVariance (ANCOVA) test which compared the effect of Aerobic Exercise Training on grip strength of the participants. The participants' grip strength reading on the pre-intervention was used as the covariate. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slope and reliable measurement of covariance. After adjusting for pre-intervention grip strength reading, aerobic exercise had a

significant effect on grip strength (F(1,61)=166.32,p=0.000, partial eta square=.732).

For mid-upper arm circumference, the results of the study (Table 3) showed that at baseline (pre-test), the experimental group had a mean score of 29.15±2.85cm. At post-test, the experimental group had a mean score of 28.81±2.74cm and when compared with the control whose mean value was 29.35±2.06cm; the mean difference at pre- and post-tests were 0.22cm and -53cm respectively. The post-test mean being less indicated that the aerobic training had an effect on the mid arm circumference of pregnant women in Rivers State University Teaching Hospital. Table 4 shows a One-way between groups Analysis of CoVariance (ANCOVA) test was which compared the effect of Aerobic Exercise Training on mid upper arm circumference of the participants. The dependent variable consisted of readings of mid upper arm circumference after the intervention. The participants' mid upper arm circumference score on the pre-intervention was used as the covariate. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slope and reliable measurement of covariance. After adjusting for pre-intervention mid upper arm circumference value, aerobic exercise had a significant effect on mid upper arm circumference (F(1,61)=.67.92,p=0.00, partial eta square =.527).

For percentage body fat, the result obtained from the study showed (Table 5) that the pre-test experimental mean value was 39.06±10.44% with a mean difference of -1.15%. The post intervention mean score was higher at 41.80±10.30% with a mean difference of -4.45%. The post intervention mean score was higher than the pre-intervention, hence the aerobic exercise had effect on the percentage body fat of the pregnant women. Notice also, that the elevated mean score was in the negative direction, which showed that there was a reduction in the percentage body fat of the experimental group. One-way between groups Analysis of CoVariance (ANCOVA) was conducted to compare the effect of Aerobic Exercise Training on Percentage Fat among the participants (Table 6). The dependent variable consisted of readings of percentage fat after the intervention. The participants' percentage fat on the pre-intervention was used as the covariate. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slope and reliable measurement of covariance. After adjusting for pre-intervention percentage fat reading, aerobic exercise had a significant effect on weight (F(1,61)=83.10,p=0.00, partial eta square=.577).

Table 1: Mean and Standard Deviation on the effect of Aerobic Exercise Training on Hand Grip Strength among Pregnant Women in Rivers State University Teaching Hospital.

Grip strength	Group	N	MEAN	SD	Mean difference
Pre intervention	Experimental	38	29.1579	6.34	5.97
Pre intervention	Control	26	23.19	4.16	
Post intervention	Experimental	38	35.8684	4.09	12.25
Post intervention	Control	26	23.62	4.04	

Table 2: One-way Analysis of CoVariance (ANCOVA) on the effect of Aerobic Exercise Training on Hand Grip Strength among Pregnant Women in Rivers State University Teaching Hospital.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	3014.46[a]	2	1507.23	278.80	.000	.901	
Intercept	521.84	1	521.84	96.53	.000	.613	Reject Ho
Pre-GripStr	696.72	1	696.72	128.87	.000	.679	
Group	899.18	1	899.18	166.32	.000*	.732	
Error	329.78	61	5.41				
Total	**64415.00**	**64**					
Corrected Total	**3344.23**	**63**					

a. R Squared = .901 (Adjusted R Squared = .898)

P<0.05, *Significant

Table 3: Mean and Standard Deviation on the effect of Ae robic Exercise Training on Mid Upper Arm Circumference among pregnant women in Rivers State University Teaching Hospital.

Mid Upper Arm Circumference	Group	N	MEAN	SD	Mean difference
Pre intervention	Experimental	38	29.1474	2.85	.22
Pre intervention	Control	26	28.93	2.03	
Post intervention	Experimental	38	28.8132	2.74	-.53
Post intervention	Control	26	29.35	2.06	

Table 4: ANCOVA on the effect of Aerobic Exercise Training on Mid Upper Arm Circumference among Pregnant Women in Rivers State University Teaching Hospital.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	380.97[a]	2	190.48	1508.12	.000	.980	Ho
Intercept	.48	1	.48	3.78	.056	.058	Rejected
Pre-MUAC	376.58	1	376.58	2981.52	.000	.980	
Group	8.58	1	8.58	67.92	.000*	.527	
Error	7.71	61	.13				
Total	54322.93	64					
Corrected Total	388.67	63					

a. R Squared = .980 (Adjusted R Squared = .980)

P<0.05, *Significant

Table 5: Mean and Standard Deviation on the effect of Aerobic Exercise Tr aining on Percentage Fat among women in Rivers State University Teaching Hospital.

Percentage Fat	Group	N	MEAN	SD	Mean difference
Pre intervention	Experimental	38	39.06	10.44	-1.15
Pre intervention	Control	26	40.21	5.69	
Post intervention	Experimental	38	41.80	10.30	-4.45
Post intervention	Control	26	45.25	5.68	

Table 6: ANCOVA on the effect of Aerobic Exercise Training on Percentage Fat among Women in Rivers State University Teaching Hospital.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	4913.20[a]	2	2456.602	1196.04	.000	.975	Ho
Intercept	84.39	1	84.39	41.09	.000	.402	Rejected
Pre-% Fat	4606.97	1	4606.97	2242.99	.000	.974	
Group	170.68	1	170.68	83.10	.000*	.577	
Error	125.29	61	2.05				
Total	126752.26	64					
Corrected Total	5038.49	63					

a. R Squared = .975 (Adjusted R Squared = .974)

P<0.05, *Significant

Discussion

The result of this study indicated a significant effect of the aerobics training on hand grip strength of pregnant women in line with Seong and others who investigated the association between aerobic exercise and hand grip strength in adults[27]. It is important to remark that there is dearth of information and research on the influence of aerobics on the hand grip strength of pregnant women despite the toll of pregnancy on the musculoskeletal system and the lower hand grip strength recorded in pregnant females when compared with non-pregnant females.[28] Also, in the study of the effects of aerobic exercise and strength training on the hand grip strength and functional fitness in the middle aged and elderly women, Zhang and others concluded that aerobic exercise and strength training can enhance the middle aged and elderly women's hand grip strength and improve their functional fitness confirming the results of this study.[29] Hand grip strength is a predictor of upper extremity function, and changes in muscle strength and physical function and capabilities to undertake activities of daily living.[30]

Mid upper arm circumference is a screening tool for obesity, and can be used in combination of other arm anthropometry to derive the arm indices; arm muscle area (AMA), arm fat area (AFA), and arm fat index (AFI).[31,32] There is paucity of research papers to validate this finding but suffice to say that Aerobic Exercise Training significantly impacted mid upper arm circumference of pregnant women and also helped to identify and moderate their arm girth.

Results also indicated a moderate effect (0.577%) of moderate aerobic training on percentage body fat of pregnant women. The result of the present study showed a significant difference in the body fat percentage score of the participants in the training

group when compared with the control group. The findings of this study are consistent with the report of McDonald and others whose findings suggested that aerobic exercise has a beneficial impact on neonatal skin fold thickness and percent body fat at one month of age delivered of women who exercised. Participation in the recommended levels of aerobic exercise (150 minutes, moderate-intensity per week) throughout the prenatal period may serve as an effective strategy to reduce the risk of overweight or obesity in the early post-natal period.[33] The findings of this study were inconsistent to that of Cavalcante and others who evaluated water aerobic exercises, maternal body composition and prenatal outcome after a program for low risk pregnant women. They found no significant differences between the groups regarding maternal weight gain, BMI or percentage body fat during pregnancy.[34] Similarly, Dekker and others found that exercise did not alter the maternal lipid profile. This was possible due to the low level of physical activity achieved in the obese women in the exercise intervention arm.[35]

Conclusion

Participating in a planned aerobic exercise training can lead to an overall improvement in the some anthropometric measures of pregnant women (mid upper arm circumference, and percentage body fat) while hand grip strength improved significantly following ten weeks of moderate intensity Aerobic Exercise Training regimen.

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article

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