Impact of aerobics exercise training on the pulse oximetry of pregnant women in a Nigerian Teaching Hospital

Comment [1]: Words should capitalized as title of this article

Abstract

Substantial proportion of women stop exercising after 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. The purpose of the pulse oximetry was to check how well oxygen was delivered into the tissue of the pregnant women. It was used to monitor their health especially in this time of Covid-19, with all its attending stresses. The aim of this study was to investigate the impact of aerobics exercise training on the pulse oximetry of pregnant women. Sixty-four pregnant women who completed the study were simply randomized into experimental (n=38) and control (n=26) groups and their pre-intervention values of low back pain was taken and recorded. A ten week, three times weekly aerobic exercise (40 – 45minutes) training was administered on the experimental group. A post-intervention score was also taken from all participants and the data analyzed using mean and standard deviations. Analysis of covariance was used to determine the impact at 0.05 alpha level. Results showed the Aerobic Exercise Training impacted on the pulse oximetry of pregnant women in the experimental group which reduced from a mean score of 97.82±0.73 to 97.66±1.07 and the control group from 96.96±0.87 to 96.15±0.92 with a partial eta squared value of 0.202. From the foregoing, it was concluded that the Aerobic Exercise Training was impactful on the pulse oximetry of the pregnant women.

Keywords:
Aerobics, pulse oximetry, pregnancy.

Introduction

Pregnancy is a stressful condition with considerable altered physiological and metabolic functions [1]. Several authors have reported that oxygen consumption increases by 30-40% during pregnancy. The progressive rise is primarily due to the metabolic needs of the fetus, uterus, and the placenta and secondarily due to increased cardiac and respiratory work. Decreased Functional Residual Capacity with increased oxygen demand lowers oxygen reserve of the mother and nearly 70% of the healthy pregnant women are reported of having dyspnea or breathlessness during daily activity. [2]

Exercise is considered safe and beneficial during pregnancy (Du et Al, 2019). Pulse oximetry is a noninvasive method for monitoring a person's oxygen saturation. Peripheral oxygen saturation (SpO2) readings are typically within 2% accuracy (within 4% accuracy in 95% of cases) and more accurate (and invasive) reading of arterial oxygen saturation (SaO2) from arterial blood gas analysis [3].

Measurement of oxygen saturation on exertion is commonly used in the assessment of women with shortness of breath during pregnancy. However, for this to be a useful, objective test is required. It is important to know the oxygen saturation response to a defined cardiovascular challenge in normal pregnant women and to have a standard protocol to deliver an appropriate rise in heart rate. It has previously been found that in healthy non-smoking women, resting oxygen saturation remained at least 97% during pregnancy [4]. A study of 40 healthy women at a mean gestation of 25 weeks found that prolonged low-impact aerobic exercise at a level of 70% maximum predicted heart rate caused a small fall in oxygen saturation but this did not fall below 95% [5].

Pulse oximetry is a rapid, noninvasive method of estimating oxygenation and is continuous, allowing detection of sudden changes in a patient’s clinical status. Peripheral oxygen saturation (SpO2) readings are typically within 2% accuracy (within 4% accuracy in 95% of cases) of the more accurate (and invasive) reading of arterial oxygen saturation (SaO2) from arterial blood gas analysis [3]. Pulse oximeters are widely used in modern settings and are quickly replacing estimates of oxygen saturation derived from arterial blood gas measures. During exercise, pulse oximeters offer a distinct advantage to arterial blood gas (ABG) measure, as they measure saturation continuously and are more likely to detect a transient desaturation [6]. They are frequently used during both formal and informal testing and subsequent exercise training. Pulse oximeters are commonly used with an ear or finger probe. This probe consists of a red light emitting diode and an infra-red light emitting diode to aide a photodetector on the other side. This light is transmitted through the ear lobe or finger and received by the photodetector. The detector can sense the difference between pulsatile oxygenated arterial blood during systole and the background level of venous blood and the surrounding tissues during diastole. It does this by sensing the different red light absorption. The pulse oximeter then divides the absorption of the pulsatile component by the background component. From this figure, the oximeter uses an algorithm to calculate the estimate of arterial oxygen saturation of available haemoglobin [7].

None of body stresses can be as much as or close to heavy exercise stress. Indeed, some of heavy exercises can easily become lethal when they are continued for a long time [8]. The study of physiological effects of exercise, which has numerous benefits for human health, is the subject of sports physiology. Sports physiology deals with the physiological aspects of exercise and sports medicine, how body functionally responds to exercise, adaptation of body to short and long exercise, and physiological basis of this adaptation [9]. Oxygen saturation measurement

with pulse oximeter is important in presence of abnormal respiratory rate or bluish skin color change. Hypoxia is a state or condition in which oxygen saturation is below 95% [10]. During exercise testing, it is often desirable to monitor arterial oxygen saturation of hemoglobin (SaO2), especially in the context of pulmonary or cardiovascular disease or when subjects are breathing hypoxic gas mixtures as part of research protocols. Pulse oximeters, because they are noninvasive and obviate the need for arterial catheterization, are often used in this context [11]. The differences in oximeters used [12] and in the intensity of exercise [13] may explain these discrepancies. In previous studies, eight oximeters have been evaluated accurately during exercise under hypoxic conditions and found the Satlite pulse oximeter (Datex, Finland) to be the most reliable for oxygen saturation values above 75% [12]. However, no evaluation of the accuracy has been done for oxygen saturation levels lower than 70% during exercise, which is a common situation at very high altitude [14,15,16]. Consequently, the widespread use of pulse oximetry during exercise at very high altitude requires the validation of oximeters under such extreme conditions.

A substantial proportion of women stop exercising after they discover they are pregnant, and only few begin participating in exercise activities during pregnancy. It is thus in this light that the researcher sought to examine the impact of aerobics exercise training on the pulse oximetry of pregnant women.

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.

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

n = Sample Size

Effect Size = 0.53

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

$= 56.96$

$= 57$

Instruments

A pulse oximeter Jziki (Jziki-301) was used to measure the percentage oxygen perfusion 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, how many pregnancies previously and occupation.

Comment [2]: name

The variable – pulse oximetry was measured using the pulse oximeter Jziki (Jziki-301) through placing the right middle finger of each participant on it. The purpose of the pulse oximetry was to check how well oxygen was delivered into the tissue of the pregnant women. It was used to monitor their health especially in this time of Covid-19, with all its attending stresses.

The training protocol

The exercise protocol was carried out thrice weekly in the physiotherapy gymnasium of the physiotherapy department of the Rivers State University Teaching Hospital, Port Harcourt. The exercise lasted for about 40 – 45 minutes each session. At the end of the ten (10) weeks, a post-test data was obtained from both the experimental and control groups.

The training protocol used for this study was researcher-designed but followed the recommendations of the American College of Sports Medicine (ACSM), 2014. 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)

Comment [3]: Spaces in between lines are not consistent with the rest. Should be single spacing too.

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 analyzed using descriptive statistics such as Mean (x) and Standard Deviation (SD). The efficacy 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 [17].

Result

The results of the study in Table 1 indicates that the baseline (pretest) mean score of the experimental group was 97.82±0.73 with a mean difference of 0.85 when compared with the control group with a mean score of 96.96±0.87. Following the Aerobic Exercise Training for ten

(10) weeks, a mean score of 97.66±1.07 was obtained in the experimental group. When juxtaposed with the control group with a mean value of 96.15±0.92 and a mean difference of 1.50 was obtained. It means that the Aerobic Exercise Training impacted the pulse oximetry of the pregnant women.

Table 1: Mean and Standard Deviation on the impact of aerobics exercise training on the Pulse Oximetry of pregnant women in Rivers State University Teaching Hospital, Rivers State, Nigeria.

Oximetry	Group	N	MEAN	STD	Mean difference	Decision
Pre intervention	Experimental	38	97.82	.73	.85	
Pre intervention	Control	26	96.96	.87		
Post intervention	Experimental	38	97.66	1.07	1.50	
Post intervention	Control	26	96.15	.92		

Comment [4]: If no data required then the column can be deleted.

In table 2, a One-way between groups Analysis of CoVariance (ANCOVA) was conducted to compare the impact of aerobic exercise training on the pulse oximetry of pregnant women in Rivers State. The dependent variable consisted of readings of pulse oximetry after the intervention. The participants' pulse oximetry 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 pulse oximetry reading, aerobic exercise had a significant impact on pulse oximetry ($F(1,61)=15.44, p=0.00$, partial eta square=.202). Therefore, it is concluded that aerobic exercise has significant impact on pulse oximetry of pregnant women in Rivers State University Teaching Hospital, Rivers State, Nigeria.

Table 2: ANCOVA on the impact of aerobics exercise training on the Pulse Oximetry of pregnant women in Rivers State University Teaching Hospital, Rivers State, Nigeria

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	45.02[a]	2	22.51	25.50	.000	.455	**Ho Rejected**
Intercept	9.06	1	9.06	10.27	.002	.144	
Pre-Oximetry	10.10	1	10.10	11.44	.001	.158	
Group	13.63	1	13.63	15.44	.000*	.202	
Error	53.84	61	.88				
Total	602857.00	64					
Corrected Total	98.86	63					

a. R Squared = .455 (Adjusted R Squared = .438)

Comment [5]: It is recommended to state the Ho (hypothesis) in this article at earlier stage as reference to the finding in this table 2. (What hypothesis is rejected in this table?)

Discussion

The result of this study in Table 1 and 2 revealed a small effect of (.202) of aerobics exercise training on the pulse oximetry of pregnant women which was statistically significant at 0.05 alpha level. This impact could be due to the 10 weeks of aerobics exercise training given to the experimental group which is different from the regular physical activity which was not geared towards achieving any bodily fitness goals. The aerobics exercise training acted as a moderator elevator of the pulse oximetry of the participants in the experimental group. This study conforms with that of [18] who looked at 40 pregnant women grouped in two performed aerobic exercise in a form of walking for 20 min on the treadmill at 60–75% of the maximum heart rate (MHR) of each woman, three times per week in addition to deep breathing exercises in form of diaphragmatic and lateral costal breathing revealed a statistically significant difference in the oxygen saturation of pregnant women. This study also is in tandem with the results of [5], in which 40 healthy women at a mean gestation of 25 weeks found that prolonged low-impact aerobic exercise at a level of 70% maximum predicted heart rate caused a small fall in oxygen saturation but this did not fall below 95% [5]. However, these small studies do not provide a normal range for the oxygen saturation response to moderate exertion after 24 weeks' gestation. This study demonstrates that oxygen saturation in healthy women during the second and third trimesters of pregnancy is normally greater than or equal to 95% at sea level, in keeping with the normal value in men. On moderate exertion, defined as a rise in heart rate to 60–80% of maximum predicted heart rate, the oxygen saturation fell as seen previously [5] but the fall was only 0.3% and does not appear to be clinically significant. These data suggest that a healthy pregnant woman, without significant cardiac or respiratory disease, is unlikely to have an oxygen saturation of less than 95% on moderate exertion. The normal physiological alterations that occur during pregnancy are very important for fetus survival and labour preparation. During pregnancy, the lung volumes and capacities are changed as there was enlargement of the uterus, and the diaphragm was raised about 4cm [19]. The normal range of SaO_2 is well established at sea level, with resting SaO_2 being 95% or greater. Although extreme exertion in highly motivated athletes may lower SaO_2, [20], moderate exercise does not cause a fall in SaO_2 [21]. A fall in SpO_2 of greater than 4% on exertion suggests a significant gas exchange abnormality [21]. Pulse oximeters are usually calibrated to a range of saturation from 70% to 100% with an accuracy of 2% to 4%, which means that pulse oximeter reader lower than 70%, may not be accurate compared to the gold standard invasive blood gas measurements [21]. Pregnancy is related with significant respiratory changes, it expands O_2 utilization by 15 to 20%, a huge part of this increment is related with necessities of the feto-placental unit, and the expanded work by the maternal organs (heart, kidneys, and lungs) [22]. That expanding in the ventilation because of increase of tidal volume. This ventilation expansion is superior to increase in oxygen consumption and this brought about both hyperventilation and an expanded ventilator comparable for oxygen (the ventilation in liters needed for every 100mL of the consumed oxygen) [23]. The use of pulse oximetry on exertion has long been recommended in pregnant women but there is no standard exercise protocol to deliver an appropriate cardiovascular challenge in pregnant women [24]. Some women with serious cardiac or respiratory disease will have oxygen saturations below 95% at rest, in others exercise may be necessary to demonstrate a fall in oxygen saturation. There is no agreed intensity of exercise required to reveal an abnormality. It is likely that more intense exercise will have a higher yield, but many pregnant women will not wish to undergo high-intensity exercise. Moderate exercise is safe in pregnancy [25] and it has been recommended that a maximal heart rate of 60–70% maximum predicted is appropriate for women who were previously sedentary and 60–90% maximum predicted for

those who were fit prior to pregnancy [26]. The value of 60–80% maximum predicted heart rate was chosen as the target in this study in order to provide a significant cardiovascular challenge, likely to reveal any abnormality, while avoiding over-exertion [27].

Comment [6]: Can break the whole discussion into 3 to 4 separate paragraphs.

Conclusion

This study demonstrated some impact following 10 weeks aerobics exercise training on the pulse oximetry of pregnant women in Rivers State University Teaching Hospital, Rivers State, Nigeria.

This exercise regimen is simple, realistic and easy to teach others and imbibe, so that the pregnant woman can do them on her own without necessarily being in a group. As they engage in it, their oxygen utilization which is of great benefit for both mother and unborn baby would be enhanced.

Comment [7]: Can make these statements in one paragraph for the conclusion.

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