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# Effect of Aerobic Exercises on Body Composition, Perceived Stress Level and Sleep Quality

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**Abstract**

Aerobic exercise is any activity that uses large muscle groups which can be maintained continuously and rhythmic in nature. This study sought to determine effects of aerobic exercise on body composition, perceived stress level and sleep quality of workers at Federal Medical Centre, Owo.

The quasi-experimental study randomly distributed 30 apparently healthy young adults into control and exercise groups. Institution ethical approval and participants' informed consent was obtained before the study. Data was obtained through perceived stress scale and Pittsburgh sleep quality index at baseline and after 6 weeks exercise. Participant's Body Mass Index and Waist Hip Ratio were also measured. Data were analyzed using descriptive statistics and inferential statistics. Alpha level was set at 0.05.

The result revealed no significant difference between the baseline measure (pre-test) of participants' Perceived Sleep Scale (PSS) (p=0.678); Pittsburgh Sleep Quality Inventory (PSQI) (p=1.000); Body Mass Index (BMI) (p=0.227) and Waist Hip Ratio (WHR) (p=0.219) in the exercise and control groups.

A significant difference was observed between the pre-test and post-test measures of BMI (p=0.019) and WHR (p=0.025) of participants in exercise group. However, no significant difference was observed in pre-test and post-test measures of PSS (p=0.739) and PSQI (p=0.157) of participants in exercise group.

No significant difference in all the tested variables between pre-test and post-test measures of participants in the control group (p>0.05). Similarly, no significant difference was observed in all the variables between control and exercise group at the end of 6 weeks of the study (p>0.05).

The findings from this study shows that participation in six weeks aerobic exercise program can significantly improve the body composition (BMI and WHR). However, six weeks of aerobic exercise has no significant effect on perceived stress and sleep quality of the participants in this study.

**Keywords:** Sleep Quality, Perceived Stress, Stress, Body Composition, Aerobic Exercises, Physical Activity

## Introduction

Aerobic exercise is any activity that uses large muscle groups which can be maintained continuously and rhythmic in nature (Wahid *et al*., 2016) [31]. The muscle groups activated rely on aerobic metabolism to extract energy in the form of adenosine triphosphate (ATP). Examples of aerobic exercise include cycling, hiking, dancing, walking, swimming and jogging (ACSM, 2013) [3]. The changes in body composition depend on various factors which include body mass, gender, genetic factor, age, diet. Body composition affects the manifestation of certain physical abilities to some degree and represents an important indirect indicator of health fitness level which is spontaneously changed upon exercise (Stojilijkovic *et al*., 2005) [29]. An active lifestyle impacts a positive change in the functions of muscle. When muscle system works, fat burns easily and more efficiently (Wargo & Kurath, 2012) [32]. Different studies have shown a positive effect of aerobic programs on the changes in body composition and anthropometric characteristics (Rahimi, 2006) [24]. Aerobic exercise has an effect on body composition as it causes body weight and body fat reduction when an adequate diet is followed (Milanovic *et al*., 2012).

Stress is defined as "any effect of change in internal and surrounding environment on living being which disrupt its homeostasis" (Shahsavarani *et al*., 2013) [26]. Studies have shown that people who exercise with moderate intensity exhibit half the amount of perceived stress as those who reported with no exercise. Also, aerobic exercise has been found to be associated with reduced level of perceived stress. Aerobic exercise has been seen as protective factor for chronic diseases such as

cardiovascular disease, diabetes, cancer and hypertension (Felez-Nobrega *et al*., 2020; Stefan, 2018) [15, 28].

Sleep is an important biorhythm, that is responsible for maintaining normal synaptic function and energy homeostasis (Bruning *et al*., 2019; Cirelli and Tononi, 2019), [6, 12] consolidation of learning and memory formation (Cirelli and Tononi, 2019) [12]. Adequate sleep has been described as the hours of daily sleep required by an individual to function maximally and feel well rested (Williams *et al*., 2013) [33]. A study reported the effectiveness of exercise on sleep quality of people in different age ranges across various chronic conditions (Roveda E *et al*., 2017) [25]. A systematic review reported a positive effect of physical activity on sleep quality and its duration among all age groups (Dolezal *et al*., 2017) [14].

Sleep disorders affect a considerable number of people globally and are increasing in prevalence (Jaiswal *et al*., 2017). [18] Findings have shown that people who lack satisfying and refreshing sleep experiences often report decreased alertness, poor cognitive performance, obesity poor self-esteem, lowered optimism and sociability, negative moods (Knutson, 2012; Boryana, 2015) [19, 5]. Study suggests perceived stress as an important determinant of reduced life satisfaction level. This implies that when individuals have high level of perceived stress, the perception can negatively affect their judgement about their own capacity to effectively deal with stressful life situations (Cho and Kim, 2014) [10].

Understanding the effect of aerobic exercise on body composition, perceived stress and sleep quality is very important but there seems to be a dearth of research on the effect of aerobic exercise on body composition, perceived stress and sleep quality in Nigeria. This study was therefore designed to fill the gap in literature on the effect of aerobic exercise on body composition, perceived stress and sleep quality.

## Materials and Methodology

This quasi-experimental study was approved by the Health Research Ethics Committee of the Federal Medical Centre, Owo, Ondo state, Nigeria, and all participants gave their informed consent. The participants were apparently healthy young adults who are health workers from Federal Medical Centre, Owo.

Prior to the start of the experiment, an independent person who was not part of the project carried out a simple randomization for assigning participants into the two groups (Exercise and control groups) using a computer random generator. The group allocation was concealed using an opaque sealed envelope. One set of 15 participants were assigned to the aerobic exercise group while another set of 15 participants were assigned to the Control (no exercise) group. A minimum sample size of 30 (15 per group) participated in the study (adopted from a study done by Perkins, McGuigan and Stokes, 2019).

Data on perceived stress and sleep quality were obtained at baseline and at the end of 6 weeks of the experimental study using the Perceived Stress Scale and Pittsburgh Sleep Quality Index questionnaire respectively. Data on Participant's Body Mass Index and Waist Hip Ratio were also obtained through appropriate measuring instrument and procedures at baseline and at the end of 6 weeks of the study.

### Instrument for Data Collection

**The Pittsburgh Sleep Quality Inventory (PSQI):** It is the most commonly used measure of subjective self-report sleep quality. The PSQI consisted of 24 questions or items to be rated, relating to the past month (0–3 for 20 items while 4 items were open-ended), 19 of which were self-reported and 5 of which required secondary feedback from a room or bed partner. Only 19 items (15 rated 0–3 and 4 open-ended) were used for the evaluation of sleep quality as perceived by the individuals. The open-ended items were also scored as categorical values (rated 0–3) as per the range of values reported by the patients. These 19 self-reported items were then used to generate scores, which ranged from 0 (no difficulty) to 3 (severe difficulty), representing the PSQI's seven components: Sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4), sleep disturbance (C5), use of sleep medications (C6), and daytime disturbance (C7). The scores for each component were summed to get a total score, also termed the global score (range 0–21), providing an efficient summary of the respondent's sleep experience and quality (Buysse *et al*, 1989) [8].

**Perceived Stress Scale 1983:** The Perceived Stress Scale (PSS) is a classic stress assessment instrument. The tool, while originally developed in 1983, remains a popular choice for helping us understand how different situations affect our feelings and our perceived stress. Seven out of the fourteen items of PSS-14 are considered negative (1, 2, 3, 8, 11, 12, 14) and the remaining seven as positive (4, 5, 6, 7, 9, 10, 13), representing perceived helplessness and self-efficacy, respectively. Each item was rated on a five-point Likert-type scale (0 = never to 4 = very often). Total scores are calculated after reversing positive items' scores and then summing up all scores. Total scores for PSS-14 range from 0 to 56 (from 0 to 40 and from 0 to 16, for PSS-10 and PSS-4, respectively). A higher score indicates greater stress (Andreou *et al*, 2011) [4].

**Weighing scale:** Weighing scale incorporated with height meter made by Gulflex Medical and Scientific England was used to ascertain the weight in the nearest 0.5kg (kilogram) and height in the nearest meter (m)of the participants.

**Tape measure:** Tape measure (Butterfly, China) was used to measure the waist and hip circumference of participants.

**The Intervention- exercise group -** Interventions was conducted over 6 weeks, thrice per week, lasting 60 minutes. Sessions were supervised by the researcher and participants were instructed to report any adverse event, related or not to exercises. Participants were required not to alter their normal activities of daily living or take part in any additional form of physical activity or physiotherapy while the study lasted. Participants in this group were supervised individually and performed the following exercises as outlined in the following three phases: Warm-up (3 – 5 minutes), main exercise phase (50 minutes) and cool down (3 – 5minutes). The warm up and cool down exercises consist of light exercises such as alternate arms and legs movement, trunk stretching exercises in standing and breathing exercises.

The main aerobic exercises included the following exercises in order of mention: 20 minutes of treadmill exercise, 10 minutes of rope skipping exercises, 10 minutes of bicycle cycling and 10 minutes of stair climbing. Each of the exercises were performed at participants' comfortable speed

and pace continuously for the allotted time with a resting period of 3-5 minutes between different exercises. The exercise was carried out 3 times a week at the physiotherapy department in the evening after adequate hydration and caloric intake of the participants.

**The Control group:** Participnts in the control group were not subjected to any form of exercises, they were to continue with what they were doing prior to recruitment. Data on measured variables were collected at baseline and at the end of 6 weeks of the study.

## Data Analysis

Data obtained were analyzed using the statistical package for the social sciences (SPSS) version 26. Descriptive statistics of frequency and percentage was used to summarized the Socio-demographic and anthropometric data of the participants. Inferential statistics of Wilcoxon signed rank test was used to test significant difference between pre-test and post-test variables for both groups while Mann-Whiteney U test was used for test of significance between the two independent groups. Alpha level was set at 0.05 alpha.

## Results

Table 1 shows the socio-demographic characteristics of the participants. The result showed 26-30years had the highest frequency (43.3%). 63.3% of the participants are malewhile 36.7% were female. Majority of the participants are Christians (96.7%) by religion.

**Table 1:** Socio-demographic characteristics of participants

| Variables | Frequency(n) | Percentage (%) |
|---|---|---|
| **Age** | | |
| **20-25years** | 9 | 30.0 |
| **26-30years** | 13 | 43.3 |
| **31-36years** | 5 | 16.7 |
| **37-42years** | 2 | 6.7 |
| **54-58years** | 1 | 3.3 |
| **Gender** | | |
| **Female** | 11 | 36.7 |
| **Male** | 19 | 63.3 |
| **Religion** | | |
| **Christianity** | 29 | 96.7 |
| **Islamic** | 1 | 3.3 |

Presented in Table 2 is the perceived stress, sleep quality, BMI and WHR of participants in the control and exercise groups. Result showed that 46.7% of participants in the control group had low stress, 40% had moderate stress and 13.3% had high stress at baseline, 40% of participants in the control group had low stress and 60% had moderate stress during post-test. About 33.3% of participants in the exercise group had low stress, 60% had moderate stress and 6.7% of high stress at baseline. During the post-test about 33.3% had low stress and 66.7% had moderate stress in the exercise group. The result also showed 46.7% had good sleep quality and 53.3% had poor sleep quality during pre-test in the control group. About 66.7% had good sleep quality and 33.3% had poor sleep quality in the control group during post-test. About 46.7% had good sleep quality and 53.3% had poor sleep quality during pre-test in the exercise group. About 66.7% had good sleep quality and 33.3% had poor sleep quality during post-test in the exercise group. The result also showed 33.3% were within normal weight, 40.0% were overweight and 26.7% were obese in the control group during pre-test. About 60.0% were within normal weight, 20.0% were overweight and 20.0% were obese in the exercise group during pre-test while 60.0% were of normal weight and 40.0% overweight at post test measurement. The result showed 33.3% had 0.65-0.84 of WHR, 60.0% had 0.85-1.04 and 6.7% had 1.05-1.24 of WHR during pre-test in the control group. About 46.7% had 0.65-0.84 of WHR, 46.7% had 0.85-1.04 and 6.6% had 1.05-1.24 during post-test in the control group. In the exercise group about 46.7% had WHR of 0.65-0.84, 46.7% had WHR of 0.85-1.04 and 6.6% had WHR of 1.05-1.24 during pre-test while 60.0% had WHR of 0.65-0.84 and 40.0% had WHR of 0.85-1.04 during the post-test.

**Table 2:** Table of perceived stress, sleep quality, BMI and WHR of participants

| Variables | Control group N=15 | | Exercise group N=15 | |
|---|---|---|---|---|
| **PSS** | Pre | Post | Pre | Post |
| **Low** | 7(46.7) | 6(40.0) | 5(33.3) | 5(33.3) |
| **Moderate** | 6(40.0) | 9(60.0) | 9(60.0) | 10(66.7) |
| **High** | 2(13.3) | 0(0.0) | 1(6.7) | 0(0.0) |
| **PSQI** | | | | |
| **Good sleep** | 7(46.7) | 10(66.7) | 7(46.7) | 10(66.7) |
| **Poor sleep** | 8(53.3) | 5(33.3) | 8(53.3) | 5(33.3) |
| **BMI** | | | | |
| **Normal weight** | 5(33.3) | 5(33.3) | 9(60.0) | 9(60.0) |
| **Overweight** | 6(40.0) | 6(40.0) | 3(20.0) | 6(40.0) |
| **Obese** | 4(26.7) | 4(26.7) | 3(20.0) | 0(0.0) |
| **WHR** | | | | |
| **0.65-0.84** | 5(33.3) | 7(46.7) | 7(46.7) | 9(60.0) |
| **0.85-1.04** | 9(60.0) | 7(46.7) | 7(46.7) | 6(40.0) |
| **1.05-1.24** | 1(6.7) | 1(6.6) | 1(6.6) | 0(0.0) |

Presented in Table 3 is the Mann Whiteney U test of significance for perceived stress, sleep quality, BMI and WHR of participants in control and exercise groups at baseline. The result shows there was no significant difference in perceived stress between participants in the control and exercise groups during the pre-test (p=0.678), similarly, there was no significant difference in sleep quality between participants in the two groups during the pre-test (p=1.000). The result also shows no significant difference in the BMI between participants in the control and exercise groups during the pre-test (p=0.227), similarly, no significant difference was observed in WHR between participants in the control and exercise group during the pre-test (p=0.219).

**Table 3:** Table of Mann-Whiteney U test of significance for perceived stress, sleep quality, BMI and WHR of participants in control and exercise groups (Pre exercise)

| | Control group Pre-exercise Mean rank | Exercise group Pre-exercise Mean rank | Man-Whiteney U | Z value | P value |
|---|---|---|---|---|---|
| **PSS** | 14.90 | 16.10 | 103.5 | -0.415 | 0.678 |
| **PSQI** | 15.50 | 15.50 | 112.5 | 0.000 | 1.000 |
| **BMI** | 17.30 | 13.70 | 85.5 | -1.208 | 0.227 |
| **WHR** | 17.47 | 13.53 | 83.0 | -1.228 | 0.219 |

Presented in Table 4 is the Mann Whiteney U test of significance for perceived stress, sleep quality, BMI and WHR of participants in control and exercise groups at 6 weeks interval. The result shows no significant difference in

perceived stress (p=0.710), sleep quality (p=0.695), BMI (p=0.056) and WHR (p=0.096) between participants in the control and exercise groups after 6 weeks of study.

**Table 4:** Table of Mann-Whiteney U test of significance for perceived stress, sleep quality, BMI and WHR of participants in Control and exercise groups (at 6 weeks interval)

| | Control group Mean rank at 6 weeks | Exercise group Mean rank At 6 weeks | Man-Whiteney U | Z value | P value |
|---|---|---|---|---|---|
| **PSS** | 15.00 | 16.00 | 105 | -0.372 | 0.710 |
| **PSQI** | 15.00 | 16.00 | 105 | -0.392 | 0.695 |
| **BMI** | 18.30 | 12.70 | 70.5 | -1.909 | 0.056 |
| **WHR** | 18.17 | 12.83 | 72.5 | -1.662 | 0.096 |

Presented in Table 5 is the Wilcoxon signed ranks test of perceived stress, sleep quality, BMI and WHR between participants' pre and post in control and exercise groups. The result shows there was no significant difference in the perceived stress between participants' pre and post in the control and exercise groups (p=0.655, p=0.739). Also, there was no significant difference in sleep quality between participants' pre and post in the two groups (p=0.180, p=0.157). Findings from this study revealed no significant difference in BMI between participants' pre and post in the control group (p=0.386) however, there was a significant difference observed in BMI between participants' pre and post measurement in the exercise group (p=0.019). For the WHR, the result revealed no significant difference between participants' pre and post in the control group (p=0.675) however, there was a significant difference observed in WHR between participants' pre and post in exercise group (p=0.025).

**Table 5:** Table of Wilcoxon signed ranks test of significance difference in perceived stress, sleep quality, BMI and WHR of participants in control and experimental group after 6 weeks of intervention

| Variables | Control group (N=15) (Mean rank difference in pre and post test measures) | Exercise group (N=15) (Mean rank difference in pre and post test measures) | Z score | | P-value | |
|---|---|---|---|---|---|---|
| | | | Control | Exercise | Control | Exercise |
| **PSS** | 0.00 | 0.00 | -0.447 | -0.333 | 0.655 | 0.739 |
| **PSQI** | 0.00 | 0.00 | -1.342 | -1.414 | 0.180 | 0.157 |
| **BMI** | 3.40 | 3.90 | -0.866 | -2.341 | 0.386 | 0.019 |
| **WHR** | 0.45 | 4.91 | -0.420 | -2.245 | 0.675 | 0.025 |

## Discussion

This study aims to determine the effect of aerobic exercise on the perceived stress, sleep quality and body composition among health workers at Federal Medical Centre Owo. This study shows no significant difference in Perceived stress between control and exercise groups during pre-test and post-test measurement which is contradicted by Daniel Angielczyk (2023) [13] that reported aerobic exercise to have a positive impact on the perceived stress level among nursing students. From their study, they reported a significant decrease in perceived stress level following exercise session in the exercise group and also a significant difference between pre and post for both groups. This could be due to variation in the study population and cultural differences as the study was carried out among nursing student whereas this present study was performed among staff of federal medical centre Owo. Similarly, Hiedary *et al* (2011) [17] reported that, participants performing aerobic exercise have a reduced stress level and a better ability to control stressful conditions. The variation in result could be due to difference in the number of participants as the reported study had 120 participants who were randomly distributed into two experimental groups and two control groups with 30 participants each whereas this present study had only 30 participants randomly distributed into one control and exercise groups with 15 participants each.

The present study shows no significant difference in the sleep quality within the control, exercise groups and between control and experimental group after 6 weeks of the study. These findings however contradict the result of Sharma *et al* (2024) [27] that reported no significant difference in sleep quality at baseline between experimental and control groups but there was a significant reduction in both groups at the end of third and sixth week of intervention which shows an improvement within the group. This is also supported by Cai *et al* (2014) [9] that reported substantial improvement in sleep quality in the exercise group compared to the control group. The study also reported that aerobic exercise has an effect on sleep through promotion of sleep onset which was established by hormonal management that involves the release of cortisol and melatonin before and after the exercise. Buchanan *et al* (2017) [7] also reported significant but moderate improvements in sleep quality after aerobic exercise as opposed to routine activities. Tadayon *et al* (2016) [30] reported the exercise group outperformed the control group in terms of improvement in sleep quality after 12 weeks of exercise intervention. So, the exercise group had a sleep quality score that was significantly higher than the control group. The variation in this study could be due to the difference in the number of weeks of exercise, number of participants and population as the reported study recruited 112 menopausal women whom were randomly distributed into control and exercise group for 12 weeks of aerobic exercise whereas this present study recruited 30 participants including both male and female adults whom were randomly distributed into control and exercise group for 6 weeks of aerobic exercise.

The findings from this study showed, there was a significant difference in BMI of participants between pre-test and post-test in the exercise group. Significant reduction was also noted in the BMI of the exercise group after 6 weeks of exercise. This indicates a positive impact of aerobic exercise on BMI of participants in this study. This is supported by Nawaz *et al* (2020) [21] which found that aerobic exercise has positive effect on overweight females ranging from age 22-27 years. The study also found that normal exercise helps to keep the body fit and in a normal weight. The study also proposed that human body needs a five-day practice out of seven days, independent of the age group in which an

individual belongs. Daily aerobic exercise can used to control body weight and can help to fortify the heart (Agarwal, 2012) [1]. Aerobic exercise can boost the metabolic rate which is important in maintaining weight loss and improving overall body composition. Even though aerobic exercise majorly targets the fitness of the cardiovascular system it can also help to preserve the lean muscle mass (Akwa *et al*., 2017; Park, Kwak & Ji 2015) [2, 23]. This study also observed a significant difference in WHR between participants' pre and post in exercise group. This means that aerobic exercise has been found to impact positively on body fat control of the participants in this study. This is in line with the study done by Nawaz *et al* (2020) [21] which reported positive effects of aerobic exercise upon the body fat control of overweight females. Halle *et al* (1999) [16] also reported that taking part in any exercise and use of balanced diet help in losing body fat than depending on the calorie restriction. Aerobic exercise can reduce the effect of diseases like blood pressure and cholesterol level which in turn prevent heart attacks (Ciolac *et al*., 2008) [11].

## Conclusion

Aerobic exercise has been found to be beneficial to human health. This study showed that participation in six weeks aerobic exercise program can significantly improve the body composition of participants by decreasing the ratio of body fat percentage and the body mass index. However, findings from this study revealed that six weeks of aerobic exercise produced no significant effect on perceived stress and sleep quality of the participants.

## Recommendation

Incorporating aerobic exercise at work-place can significantly improve the body composition of employees which can also help to improve their health and overall quality of life. It is recommended that there should be sensitization program on the benefits of participating in aerobic exercise. Employers should also be encouraged to create time and good atmosphere for participation in aerobic exercise at work place.

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