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Research Article

Effect of Exercise on Blood Oxygen Saturation Level and Pulse Rate in Some Sportsmen/Women in Wukari, Nigeria

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Abstract

In some situations, such as during and after exercise, assessing people's blood oxygen saturation level and pulse rate is crucial to assessing their general health. Assessing blood oxygen saturation levels aids in determining whether a patient is hypoxic. Low oxygen levels could cause cardiac arrest or respiratory failure. This study aimed to evaluate the effect of moderate exercise on levels of blood oxygen saturation and pulse rate in some sportsmen/women in Wukari, Nigeria. A total of fifty-two (52) sportsmen and women who play badminton/volleyball were used for this study. They were aged 14 to 55 years. A Pulse Fingertip Oximeter was used for the determination of the level of blood oxygen saturation (SpO2) and pulse rate before and after moderate exercise in the 52 sportsmen/women (badminton/volleyball players) in Wukari, Nigeria. The result showed that the average level of blood oxygen saturation in the sportsmen/women in Wukari, Nigeria was 95% before exercise and 94% after exercise, while the average pulse rate was 78 bpm before the exercise and 106 bpm after exercise. There was an average decrease of 1(%) and an average percentage change of 1.05% in the level of blood oxygen saturation after exercise in the sportsmen/women in Wukari, Nigeria, while there was an average increase of 28(bpm) and an average percentage change of 35.90% in the pulse rate of the sportsmen/women after the exercise. Only 10(19.23%) out of the 52 sportsmen/women in Wukari, Nigeria had low SpO2 levels before the exercise, while 18(34.61%) had low SpO2 levels after the exercise. Only 2(3.85%) sportsmen had low pulse rates before exercise, while none had low pulse rates after the exercise. None of the sportsmen/women had high pulse rate before the exercise, but 8(15.38%) had high pulse rates after the exercise. This study concluded that the sportsmen/women evaluated had a normal average blood oxygen saturation (SpO2) level and pulse rate before engaging in the exercise. Thereafter, the exercise caused a slight decrease of 1.05% in the average level of blood oxygen saturation and an average increase of 35.90% in the pulse rate of the sportsmen/women in Wukari, Nigeria.

Keywords: blood oxygen saturation; hypoxemia; physical exercise; pulse; respiratory failure

Introduction

Since their invention in the 1970s, pulse oximeters have become essential for measuring blood oxygen levels in hospital wards, operating rooms, high-dependency and critical care units, and emergency departments. The safe surgery movement has promoted pulse oximeters [1]. During the COVID-19 pandemic, they gained attention for their ability to detect hypoxemia or low blood oxygen levels, even in patients at home [2]. Normal blood oxygen levels vary by altitude and are part of a continuum. For all age groups, the standard arterial blood oxygen saturation at sea level is generally believed to be 94% or higher (partial pressure of oxygen ~75–100 mm Hg). Typical arterial blood oxygen saturation in the 5th centile is roughly 92–96% at sea level and roughly 88–92% at 2500 m above sea level, according to data from healthy child and adult populations [3]. According to Jiang *et al*. [4], blood oxygen saturation (SpO_2) is a crucial metric for tracking patients with acute and long-term illnesses linked to low blood oxygen levels, such as heart failure, pneumonia, asthma, and chronic obstructive pulmonary disease (COPD).

To track oxygen saturation, pulse oximetry technology uses the difference in light absorption between oxygenated and deoxygenated haemoglobin. Compared to the more invasive arterial blood gas measurement method, which calls for skilled personnel and specialized analysis equipment, this technology is thought to be a trustworthy substitute. During the COVID-19 pandemic, pulse oximetry gained prominence in two ways. Home monitoring of oxygen saturation has become a crucial part of COVID-19 recovery at home because, first, COVID-19 infection can cause oxygen desaturations, which may not be noticeable for people at home early in the infection [5] or may necessitate new oxygen supplementation at hospital discharge [6,7]. Second, people with chronic respiratory conditions were depending more and more on at-home monitoring, including pulse oximetry, as a result of the shift to more telemedicine visits during the pandemic [8]. Lung disease is therefore increasingly being treated at home, either as a result of COVID-19 infection or because of the COVID-19 pandemic's limited in-person evaluations [9].

The most crucial tactics for preventing, protecting against, treating, and promoting health are physical activity and exercise. Exercise increases physical fitness which can have a variety of positive health effects. While people who are more physically active seem to have lower rates of all-cause mortality, the most significant risk factor for non-communicable diseases is insufficient physical activity. Physical activity is a broad term that includes graded weight-bearing exercises, aerobic and anaerobic exercises, play, sports, and leisure activities. By decreasing blood pressure, improving insulin sensitivity, decreasing obesity, increasing fibrolysis, improving lipid profiles, and improving parasympathetic autonomic tone, daily moderate exercise lowers cardiovascular risk. Physical exercise encompasses a wide variety of activities that promote health and wellness. Many people believe that exercise is only necessary to maintain or improve fitness. Exercise is defined as organized, planned activities that preserve or improve one or more aspects of physical fitness. A wide variety of activities that enhance health and well-being are included in physical activity. Exercise is often associated with simply maintaining or improving fitness [10].

Frequent exercise has significant health advantages. At any age or stage, one can begin engaging in physical activity and reap its benefits. For the majority of people, the advantages of physical activity far outweigh any possible risks, such as accidents, should they arise. Maintaining a healthy lifestyle and engaging in physical activity throughout the day are easy ways to reach the recommended level of activity [11]. Numerous studies have demonstrated the important role that regular physical activity plays in managing and preventing noncommunicable diseases (NCDs), including diabetes, heart disease, stroke, breast cancer, and colon cancer. Additionally, it aids in the prevention of osteoporosis, obesity, and hypertension. Any kind of physical activity enhances general well-being, quality of life, and mental health [12]. While the pulse rate indicates how well the heart is functioning, the SpO_2 level assessment indicates how saturated the red blood cells are with oxygen. Physicians and nurses can use these indices to get a sense of how a patient is being treated. Determining whether someone requires additional oxygen may also be aided by their oxygen level. Before starting some activities that call for this assessment, like physical exercise, most people do not take the time to check their SpO_2 level and pulse rate to see how fit they are. Additionally, most athletes do not measure their pulse rate and SpO_2 level after participating in specific sports to assess their level of fitness and decide whether to continue or not. This is because performing specific physical activities with a very high pulse rate and a very low SpO_2 level beforehand may be harmful to one's health and result in major complications. Without testing, people might not be aware of their pulse rate and blood oxygen saturation level, or whether they are fit or not. Information about the blood oxygen saturation level and pulse rate of athletes in Wukari, Taraba State, Nigeria, after physical activity is scarce. This justifies the investigation into the current study.

Materials and Methods

Study Location and Population

This current study was conducted in November, 2024 at the "Sports Recreation Centre", Wukari, Taraba State, Nigeria. A total of fifty-two (52) sportsmen and women who play badminton/volleyball were used for this study. They were aged 14 to 55 years.

Equipment/Apparatus Used

A Pulse Fingertip Oximeter was used for the determination of the level of blood oxygen saturation (SpO_2) and pulse rate before and after exercise in the 52 sportsmen/women (badminton/volleyball players) in Wukari, Nigeria.

Determination of Blood Oxygen Saturation (SpO_2) Level and Pulse Rate

Each of the badminton/volleyball players was tested with the Pulse Fingertip Oximeter. After arriving at the sporting centre, each player was allowed to rest for about 5 mins. While the player was in a stable position, his/her finger was cleaned, and the oximeter was clipped on the middle finger of his/her right hand and turned on. The result of SpO_2 level and pulse rate was displayed on the screen. A stable reading observed about 1 min on the display-screen was recorded as the initial result (result before exercise). After the initial testing, the players engaged in a moderate to strenuous game involving a set of matches (badminton/volleyball). Immediately after the exercise, each of the players was allowed to sit in a resting position for about 1 minute before being tested again for the final SpO_2 level and pulse rate. The final result was recorded as result after exercise.

Result Computation

From the results of SpO_2 level and pulse rate before and after exercise, average levels of blood oxygen saturation and pulse rate before and after exercise, average changes in levels of blood oxygen saturation and pulse rate after exercise, and the number and percentage of sportsmen/women with abnormal blood oxygen saturation (SpO_2) level and pulse rate before/after exercise in Wukari, Nigeria were computed.

Results

The results are presented in the figures and table below:

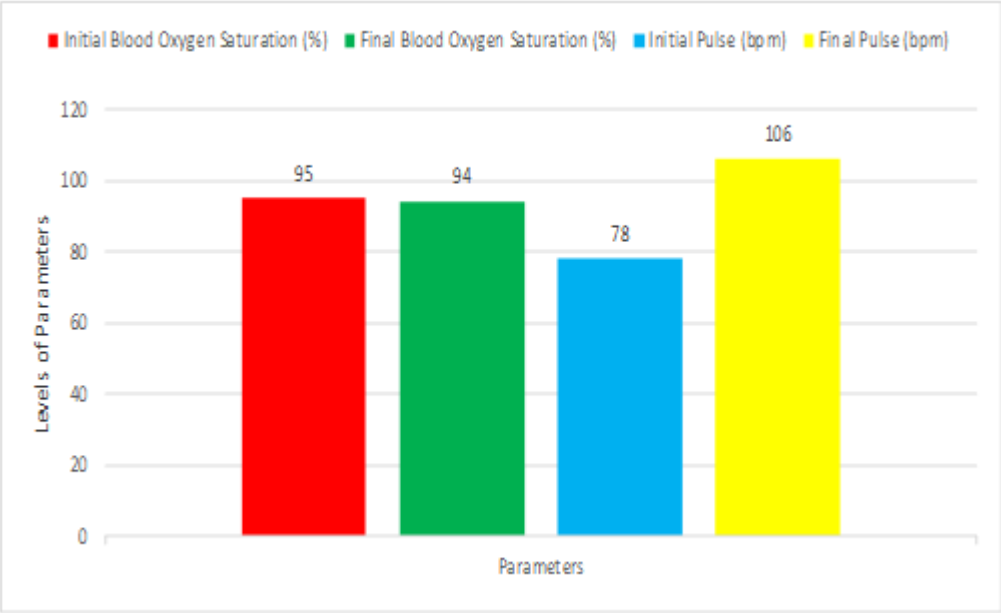

Figure 1: Average Levels of Blood Oxygen Saturation and Pulse Rate Before and After Exercise in Some Sportsmen/Women in Wukari, Nigeria

Figure 1 showed the average level of blood oxygen saturation in some sportsmen/women in Wukari, Nigeria to be 95% before exercise and 94% after exercise, while the average pulse rate was 78 bpm before the exercise and 106 bpm after exercise.

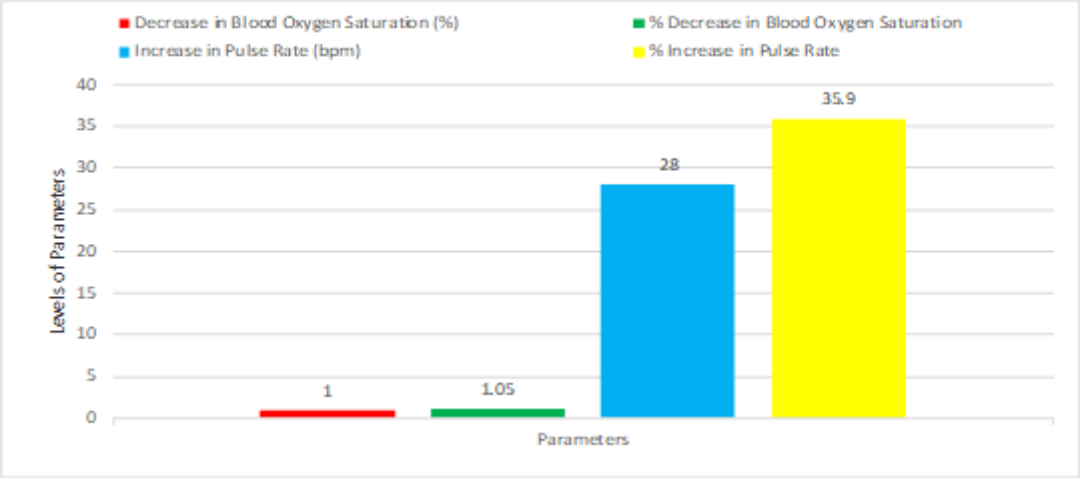

Figure 2: Average Changes in Levels of Blood Oxygen Saturation and Pulse Rate After Exercise in Some Sportsmen/Women in Wukari, Nigeria

Figure 2 showed there was an average decrease of 1(%) and an average percentage change of 1.05% in the level of blood oxygen saturation after exercise in some sportsmen/women in Wukari, Nigeria, while there was an average increase of 28(bpm) and an average percentage change of 35.90% in the pulse rate of the sportsmen/women after the exercise.

	Number of Individuals	Percentage of Individuals (%)
Number of individuals with low SpO_2 level before exercise	10.00	19.23
Number of individuals with low SpO_2 level after exercise	18.00	34.61
Number of individuals with low pulse rate before exercise	2.00	3.85
Number of individuals with low pulse rate after exercise	0.00	0.00
Number of individuals with high pulse rate before exercise	0.00	0.00
Number of individuals with high pulse rate after exercise	8.00	15.38

Table 1: Number and Percentage of Sportsmen/Women with Abnormal Blood Oxygen Saturation (SpO_2) level and Pulse Rate Before/After Exercise in Wukari, Nigeria

Table 1 showed that 10 (19.23%) out of the 52 sportsmen/women in Wukari, Nigeria had low SpO_2 level before exercise, while 18 (34.61%) had low SpO_2 level after the exercise. Only 2 (3.85%) sportsmen had low pulse rate before exercise, while none had low pulse rate after the exercise. None of the sportsmen/women had high pulse rate before the exercise, but 8 (15.38%) had high pulse rate after the exercise.

Discussion

Assessment of blood oxygen saturation level and pulse rate is essential in determining the good health status of an individual under certain conditions such as during and after exercise. Detecting blood oxygen saturation levels helps to know if a patient is experiencing hypoxia. This is because it is possible to have a condition in which a patient appears and feels normal but has dangerously low SpO_2 [13]. It is also important during critical health conditions that may warrant oxygen administration or cardiovascular-related ill conditions. In this current study, the result (Figure 1) showed that the average level of blood oxygen saturation (SpO_2) in the sportsmen/women who play badminton/volleyball in Wukari, Nigeria was 95% before the game (exercise) and 94% after exercise. This showed that the average SpO_2 level of the sportsmen/women before and after the exercise is within the normal level and as such, the individuals tested may not be having any form of acute or long-term illness like heart failure or pulmonary-related problems that may be linked to their blood oxygen saturation levels. This is because according to Jiang *et al*. [4], blood oxygen saturation is a crucial metric for tracking patients with acute and long-term illnesses linked to low blood oxygen levels, such as heart failure, pneumonia, asthma, and chronic obstructive pulmonary disease. However, the average SpO_2 level after the exercise when compared with the level before the exercise showed a reduction of 1, which represents a decrease in SpO_2 level by 1.05% (Figure 2) following the exercise. This implies that blood oxygen saturation level may be reduced by about 1.05% following an immediate exercise such as playing badminton or volleyball. However, this reduction does not cause an alarm since the average blood oxygen saturation level is still within the normal level that indicates normal health. The exercise did not induce hypoxia. A research has reported that a significant drop in the blood's oxygen content may result in serious hypoxemia and respiratory failure may result from severe hypoxia [14].

Among the fifty-two (52) individuals who are sportsmen/women (who play badminton/volleyball) in Wukari, Nigeria tested, ten (10) of which representing about 19.23% (Table 1) of the population tested had a SpO_2 level lower than 94% which is regarded as the normal lower limit for normal health by some medical practicians. Another school of thought believes that humans typically have arterial blood oxygen saturation levels between 96% and 100% [15]. It has been reported by a study that when a trained person's arterial oxygen saturation falls below 93% while exercising, this is known as exercise-induced arterial hypoxemia. Fit, healthy people of all ages and genders experience it [16]. This implies that the results recorded in this study are normal. Although the SpO_2 of the ten individuals was not extremely low (but slightly below 94%), so many factors/conditions may have contributed to their slightly low blood oxygen saturation levels. These conditions may include the fact that some of the sportsmen/women trekked to the sports centre, some drove their cars, while some drove their motorbikes or bicycles to the sports centre where the exercise took place. Although the individuals were allowed a few minutes to rest before the initial SpO_2 test, it is important to note that the above-stated conditions are other forms of exercise that may have contributed to the initial SpO_2 level results.

The number of individuals tested whose blood oxygen saturation level was lower than 94% after the exercise was 18 which represents about 34.61% of the total population tested. This result showed that it is possible for moderate to strenuous exercise to cause a slight or moderate reduction in blood oxygen saturation level. This slight reduction may be due to the body's high demand and use of oxygen during exercise. During exercise, it is expected that the contraction of muscles and bodily cells' demand for blood oxygen may change. An adequate level of blood oxygen may be required by some bodily cells to adequately perform their respective functions. This agrees with the report that moderate-intensity exercise can induce 40%–60% of maximal oxygen uptake, which is the heart's most advantageous effect on the cardiovascular system [17]. If the sportsmen/women who had slightly low blood oxygen saturation levels after the exercise were allowed for a recovery time after the exercise, it is believed that their blood oxygen saturation levels would become normal.

The average pulse rate of the sportsmen/women who play badminton/volleyball in Wukari, Nigeria before the game (exercise) was within the normal range. This means that before the exercise, they are all normal in regard to the normal pulse rate of a healthy individual. The regular exercise they do may help them to keep fit and maintain the normal functioning of their heart. This is in agreement with the report that maintaining a healthy lifestyle and engaging in physical activity throughout the day are easy ways to reach the recommended level of activity [11]. The findings of the study (Figure 1) showed that the average pulse rate of the sportsmen/women was 78 bpm before the exercise and 106 bpm after the exercise. This implies that there was an average increase of 28(bpm) and an average percentage change of 35.90% (Figure 2) in the pulse rate of the sportsmen/women after the exercise when compared with their pulse rate before the exercise. This showed that physical exercise such as playing badminton or volleyball tends to increase the rate of heartbeat. This finding agrees with the report that heart rate tends to rise in response to bodily movement, and this tendency is directly correlated with exercise intensity [18]. Another study corroborated this by reporting that heart rate tends to increase in response to the movement of the body, which increases cardiac output, transports substrates and oxygen to the tissues, and removes waste products and CO_2 from them [19]. This may be because there may be more demand for blood and its constituents by various bodily cells, tissues, and organs for homeostasis among other reasons during the exercise. Besides, exercises can increase the range of motion [20]. It is believed that the heart will be required to carryout more functions with more pressure to sustain the body during exercise. This therefore contributes to the increased pulse rate experienced during the exercise.

Following the pulse rate of the sportsmen/women before and after the games (badminton/volleyball), only 2(3.85%) sportsmen had a slightly low pulse rate before exercise, while none had a low pulse rate after the exercise. None of the sportsmen/women had a high pulse rate before the exercise, but 8(15.38%) had a high pulse rate after the exercise. This result corroborates the fact that all the individuals tested may be in good health condition in regards to pulse rate as an index of cardiovascular health. This is because exercise has been known to improve certain health conditions and has been reported to often been associated with simply maintaining or improving fitness [10]. The maximum pulse rate recorded during the test by an individual after the exercise was 136 bpm. This suggests that exercises engaged by sportsmen/women may have a way of impacting positively in their cardiovascular health. This study agrees with the report of Saqib *et al.* [12] which stated that any kind of physical activity enhances general well-being, quality of life, and mental health.

Conclusion

The findings of the study showed that the average level of blood oxygen saturation of the sportsmen/women in Wukari, Nigeria was 95% before exercise and 94% after exercise, while the average pulse rate was 78 bpm before the exercise and 106 bpm after exercise. The sportsmen/women evaluated had a normal average blood oxygen saturation (SpO_2) level and pulse rate before engaging in exercise. Thereafter, the exercise caused a slight decrease of 1.05% in the average level of blood oxygen saturation and an average increase of 35.90% in the pulse rate of the sportsmen/women in Wukari, Nigeria.

Conflict of Interest: The authors declare no conflict of interest.

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