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Analysis of Blood Oxygen Saturation of Male Basketball Players in a Competitive Event.

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ABSTRACT

Basketball, a sport characterized by intense bursts of physical exertion, places immense physiological demands on athletes, with oxygen saturation serving as a key indicator of performance and well-being. This study aims to comprehensively analyse changes in blood oxygen saturation levels among male basketball players in a competitive match. We conducted a prospective observational study involving a cohort of 30 state or national level male basketball players within the age group of 18-28 years. These players were subjected for competitive match of 40 minutes with the restrictions like no substitution was done, no player was allowed to play the match more than once and no supplement other than water were allowed throughout the game. Pre-match and post-match blood oxygen saturation levels of all the 30 players were measured in percentage using pulse oximeter. Our findings reveal that players exhibited a mean pre-match saturation of 97.63%, which decreased to 95.53% post-match. There is a significant decrease in blood oxygen saturation levels in male basketball players by the end of their respective competitive matches ($p<0.001$). This study highlights that male basketball players experience a notable decline in blood oxygen saturation by the end of competitive matches, suggesting a substantial oxygen demand that may be influenced by various individual and situational factors. These findings have implications for athlete performance and health, emphasizing the need for tailored strategies to optimize oxygen delivery and enhance player endurance and recovery.

1. INTRODUCTION

The exploration of the physiological repercussions of physical activity is a fundamental component of sports physiology, an area that encompasses the intricate interplay between exercise and human health. Sports physiology delves into the intricate physiological dimensions of exercise and sports medicine, focusing on how the human body responds functionally to physical exertion and the mechanisms underlying its

adaptation.

One crucial aspect of this physiological landscape is the concept of oxygen saturation (SpO2), which pertains to the degree to which Hemoglobin groups are bound to oxygen. This metric serves as an indicator of the effective oxygen transport capacity and is expressed as a percentage of Hemoglobin saturation (SPO2%) [1], [2]. Furthermore, oxygen saturation, or SpO2, plays a pivotal role in the context of sports performance, especially during prolonged and high-intensity physical activities. As conditions such as decreased oxygen levels (PO2), altered pH levels, and increased body temperature come into play, Hemoglobin dynamically releases oxygen to meet localized oxygen demands in active tissues [3]. Oxygen is predominantly transported in the bloodstream, primarily bound to Hemoglobin, with only a fraction being in a dissolved form [4]. The capacity to effectively utilize oxygen, a key criterion in determining success, particularly in physically demanding activities that heavily rely on aerobic metabolism, essentially reflects the mitochondria's ability to function within musculoskeletal cells.

Typically, Hemoglobin exhibits a saturation level of around 98% with oxygen, a significantly higher oxygen-carrying capacity than the body typically necessitates. Consequently, the oxygen transport capacity of blood rarely constrains the performance of healthy individuals [5], [6].

However, while existing literature has shed light on the variations in oxygen saturation of Hemoglobin in arterial blood among sedentary individuals, a noteworthy gap in knowledge pertains to the impact of acute aerobic exercise on oxygen saturation in arterial blood. In this context, this study seeks to investigate the effects of acute aerobic exercise on oxygen saturation of Hemoglobin in arterial blood among young male basketball players.

2. METHODOLOGY

This study was designed as a prospective observational investigation conducted in Rohtak, Haryana, spanning the year 2022-2023. The research focused on a cohort of 30 male basketball players aged between 18 and 28 years. All participants in this study were collegiate-level basketball athletes from Haryana, India, and their participation was contingent on providing written informed consent.

All the 30 players were assessed for their blood oxygen saturation values during a 40 minutes competitive match of basketball. During competitive matches, the following specific conditions were imposed: no player substitutions were allowed, no player was allowed to play the match more than once and participants were restricted to consuming only water; no other supplements were permitted. We recorded the blood oxygen saturation levels of all 30 players, using a pulse oximeter [7], both before and after the matches. To acquire these measurements, either the index finger or the middle finger of each athlete was inserted into the pulse oximeter. The units of measurement employed in this study were percentage of oxygen saturation (SpO2) to Hemoglobin.

Data analysis for this study was executed with the utilization of SPSS version 28.0. The initial steps involved calculating the mean and standard deviation to identify differences between pre-game and post-game blood oxygen saturation values. To statistically assess the variance between these two sets of values, a paired sample t-test was administered, with the level of significance set at 0.05.

3. FINDINGS

A total of 30 young male basketball players of state or national level, within the age category of 18-28 years were selected and their blood oxygen saturation levels were measured before and after competitive basketball

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match of 40 minutes. The mean oxygen saturation in the participants before and after the match/game were 97.63% and 95.53% respectively with standard deviation of 0.92 in pre-game group and 1.10 in post-game group.

Table-1: Descriptive statistics of the blood oxygen saturation scores pre-game and post-game.

Oxygen Saturation	No. of Participants	Mean	Standard Deviation
Pre-Game	30	97.63	0.92
Post-Game	30	95.53	1.10

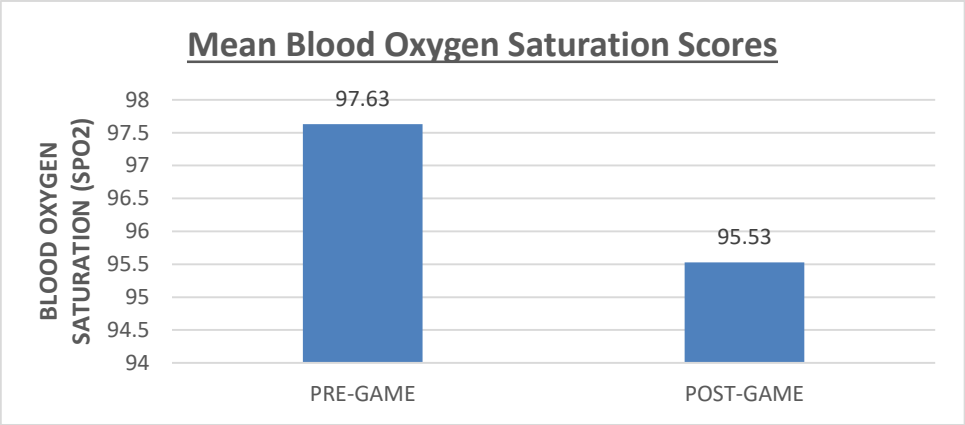

Figure 1: Mean blood oxygen saturation scores pre-game and post-game.

Although there is considerable difference between the mean scores of pre and post game blood oxygen saturation values, but to establish the statistical significance paired t-test was applied on the data. Table 2 shows the t-test results of pre and post game blood oxygen saturation scores. The mean of the difference of the pre and post game blood oxygen saturation scores was 2.10 with standard deviation of 0.75 and the p value of <0.001 at 0.05 level of significance.

Table 2: Paired t-test between pre and post-game blood oxygen saturation scores.

Oxygen Saturation	Mean	St. Deviation	St. Error	95% Confidence Interval		t-value	Degree of freedom	Significance (2- tailed)
				Lower	Upper			
Pre-Game	2.10	0.75	0.13	1.81	2.38	15.15	29	<0.001
Post-Game								

4. DISCUSSION

The present study aimed to investigate the changes in blood oxygen saturation (SpO2) levels among young male state or national basketball players during a competitive match. The findings of this research revealed a statistically significant decrease in SpO2 values following the match, which supports the previous studies and prompts a comprehensive discussion of the physiological and performance implications of these findings.

A study conducted by Huseyin Eroglu and colleagues in 2018 [8], involving participants engaging in 90 minutes of exercise six days a week at a school of physical education, found statistically significant differences in oxygen saturation and heart rates before and after exercise. Various studies on athletes with different performance levels showed similar results [9- 12]. In conclusion, it can be stated that acute aerobic exercise may lead to a reduction in oxygen saturation. The present study also showed similar findings and this could be attributed to the fact that acute aerobic exercise has the potential to reduce oxygen saturation.

The observed decrease in SpO2 levels in male basketball players in the present study can be attributed to a multitude of factors associated with the intensity and duration of the competitive match. It is well-established that high-intensity exercise, such as basketball, leads to increased oxygen demand by active muscles. During an intense game, players engage in rapid and explosive movements, including running, jumping, and changes in direction. Such activities require substantial energy, predominantly derived from aerobic metabolism, further elevating the demand for oxygen. The decreased SpO2 values observed post-match could reflect the substantial utilization of oxygen during the game, contributing to the drop in oxygen saturation in the bloodstream.

Furthermore, as the game progresses, players often experience increased levels of physical fatigue. Prolonged exertion can lead to accumulated lactic acid production, muscle fatigue, and diminished aerobic capacity. These factors might hinder the players' ability to maintain optimal oxygen saturation levels. Additionally, the psychological stress associated with competition can stimulate the sympathetic nervous system, leading to increased heart rate and potential vasoconstriction, both of which can influence SpO2 values negatively.

While the observed decrease in SpO2 values in the current study is consistent with previous research on athletes, it is essential to underscore the relevance of these findings within the context of basketball performance. Lower SpO2 levels can compromise aerobic capacity, leading to reduced endurance and potentially impacting overall game performance. The diminished oxygen supply to active muscles could affect players' speed, agility, and decision-making [13- 15], thereby influencing the team's success on the court.

It is important to acknowledge that the physiological adaptations to exercise, including changes in SpO2 levels, vary among individuals [16- 18]. Some players may exhibit greater resilience to the oxygen desaturation effects of a competitive match due to their superior aerobic conditioning and overall fitness [16], [19] In contrast, less-conditioned players might experience more pronounced decreases in SpO2 and subsequently greater performance declines. This inter-individual variability should be considered when designing training regimens and strategies to optimize players' performance during matches.

Despite implementing rigorous measures to maintain control over the study and mitigate any potential sources of direct or indirect external influence on the variables, several factors could be regarded as potential limitations of this research. These may include the lifestyle and dietary habits of the players, physiological variances among the participants, the level of effort exerted by the players, their specific playing positions, and their movement patterns during matches.

5. CONCLUSION

The current study provides valuable insights into the blood oxygen saturation dynamics of male basketball players during competitive matches. The statistically significant decrease in SpO2 values post-match underscores the physical and physiological demands of basketball and suggests that adequate aerobic conditioning and recovery strategies are imperative to mitigate performance decrements.

This study holds its potential to make several valuable contributions. Firstly, its results can empower coaches to develop tailored training plans aimed at enhancing individual player performance. These findings can also be instrumental in aiding coaches and talent scouts when it comes to selecting basketball players. Moreover, the study's outcomes can assist trainers in determining effective recovery strategies in line with the demands of the sport. In addition to its relevance in the realm of physical education and athletics, the research has the capacity to expand our understanding of these fields, offering fresh insights. Finally, the study may also bring

novel insights to individuals with coronary heart disease or lung conditions by shedding light on how basketball, as a physical activity, impacts blood oxygen levels, potentially informing exercise recommendations for improved health outcomes in these populations.

Future research should explore specific interventions and training methodologies that can help athletes maintain optimal SpO2 levels during competition. Understanding and addressing these physiological factors can contribute to the development of more effective strategies for enhancing the performance and well-being of basketball players, ultimately benefiting both individual athletes and their teams.

6. REFERENCES

[1] Plowman, S. A., & Smith, D. L. (2003). Exercise Physiology for Health and Fitness (Second Ed. b.). Francisco/ USA: Benjamin Cummings.

[2] Tiryaki, S. G. (2002). Exercise and Sports Physiology. Bolu: ATA Publication.

[3] Oguri, K., Fujimoto, H., Sugimori, H., Miyamoto, K., Tachi, T., Nagasaki, S., ... & Matsuoka, T. (2008). Pronounced muscle deoxygenation during supramaximal exercise under simulated hypoxia in sprint athletes. Journal of Sports Science & Medicine, 7(4), 512.

[4] Kemp, G. (2005). Kinetics of muscle oxygen use, oxygen content, and blood flow during exercise. Journal of Applied Physiology, 99(6), 2463-2469.

[5] Wilmore, J. H., Costill, D. L., & Kenney, W. L. (2008). Physiology of Sport and Exercise (Fourth Ed. b.). USA: Human Kinetics.

[6] Powers, S. K., & Howeley, E. T. (1990). Exercise Physiology and Application to Fitness and Performance (Second Ed b.). Iowa: WCB Brown and Benchmark.

[7] Breuer, H. W., Groeben, H., Schöndeling, H., & Worth, H. (1990). Comparative analysis of arterial oxygen saturations during exercise by pulse oximetry, photometric measurements, and calculation procedures. International journal of sports medicine, 11(01), 22-25.

[8] Eroglu, H., Okyaz, B., & Türkçapar, Ü. (2018). The Effect of Acute Aerobic Exercise on Arterial Blood Oxygen Saturation of Athletes. Journal of Education and Training Studies, 6(9), 74-79.

[9] Rowell, L. B., Taylor, H. L., Wang, Y., & Carlson, W. S. (1964). Saturation of arterial blood with oxygen during maximal exercise. Journal of applied physiology, 19(2), 284-286.

[10] Gómez-Carmona, C. D., Bastida-Castillo, A., Rojas-Valverde, D., de la Cruz Sánchez, E., García-Rubio, J., Ibáñez, S. J., & Pino-Ortega, J. (2020). Lower-limb dynamics of muscle oxygen saturation during the back-squat exercise: Effects of training load and effort level. The Journal of Strength & Conditioning Research, 34(5), 1227-1236.

[11] Woorons, X., Mollard, P., Pichon, A., Duvallet, A., Richalet, J. P., & Lamberto, C. (2007). Prolonged expiration down to residual volume leads to severe arterial hypoxemia in athletes during submaximal exercise. Respiratory physiology & neurobiology, 158(1), 75-82.

[12] Stewart, I. B., & Pickering, R. L. (2007). Effect of prolonged exercise on arterial oxygen saturation in athletes susceptible to exercise-induced hypoxemia. Scandinavian Journal of Medicine & Science in Sports, 17(4), 445-451.

[13] Vogiatzis, I., Louvaris, Z., Habazettl, H., Athanasopoulos, D., Andrianopoulos, V., Cherouveim, E., Wagner, H., Roussos, C., Wagner, P. D., & Zakynthinos, S. (2011). Frontal cerebral cortex blood flow, oxygen delivery and oxygenation during normoxic and hypoxic exercise in athletes. The Journal of physiology, 589(16),4027–4039.

[14] Karayigit, R., Eser, M. C., Sahin, F. N., Sari, C., Sanchez-Gomez, A., Dominguez, R., & Koz, M. (2022). The Acute Effects of Normobaric Hypoxia on Strength, Muscular Endurance and Cognitive Function: Influence of Dose and Sex. Biology (Basel). 2022 Feb 15;11(2):309.

[15] Subudhi, A. W., Dimmen, A. C., & Roach, R. C. (2007). Effects of acute hypoxia on cerebral and muscle oxygenation during incremental exercise. Journal of Applied Physiology, 103(1), 177-183.

[16] Rand, P. W. (1976). Hemoglobin-oxygen affinity and tissue oxygen delivery. The Journal of the Maine Medical Association, 67(1), 9-12.

[17] Peltonen, J. E., Leppävuori, A. P., Kyrö, K. P., Mäkelä, P., & Rusko, H. K. (1999). Arterial haemoglobin oxygen saturation is affected by F1O2 at submaximal running velocities in elite athletes. Scandinavian journal of medicine & science in sports, 9(5), 265-271.

[18] Ventura, N., Hoppeler, H., Seiler, R., Binggeli, A., Mullis, P., & Vogt, M. (2003). The response of trained athletes to six weeks of endurance training in hypoxia or normoxia. International journal of sports medicine, 24(03), 166- 172.

[19] Schmidt, W., Dahners, H. W., Correa, R., Ramirez, R., Rojas, J., & Böning, D. (1990). Blood gas transport properties in endurance-trained athletes living at different altitudes. International journal of sports medicine, 11(01), 15-21.