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Influence of blood groups on maximum oxygen consumption and explosive power among high-level basketball players in Palestine

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ABSTRACT

The study aimed to identify the influence of blood groups on maximum oxygen consumption (VO2max) and explosive power in high-level basketball players in Palestine. The researchers used a descriptive-analytical approach. The study was conducted on a healthy random sample of 44 players, whose age, height, and body mass were 25.81 ± 5.79 years, 187.79 ± 9.52 cm, and 89.97 ± 15.61 kg, respectively. The players were tested using the vertical jump test and the Cooper 12-minute run test. The results of the study revealed that the mean explosive power was 47.27 cm, and the mean maximum oxygen consumption (VO2max) was 42.04 mL/kg/min. In addition, blood group had a statistically significant effect on both maximum oxygen consumption and explosive power, with blood type B showing higher explosive power and blood type O showing higher VO2max ($p < 0.05$). Blood group appears to influence physiological performance in high-level basketball players, with blood type O associated with higher aerobic capacity (VO2max) and blood type B associated with greater explosive power. These findings suggest that blood type may be a factor to consider in athlete assessment and training.

KEYWORDS

Blood Groups; Explosive Power; Maximum Oxygen Consumption; Basketball; Palestine

1. INTRODUCTION

Basketball is an intermittent team sport consisting of a large number of short, high-intensity specific actions, including accelerations and decelerations, continuous changes of direction, physical contacts, jumps, and execution of sport-specific skills (Pernigoni et al., 2021; Figueira et al., 2022), as it includes walking, running, jogging, jumping...etc. movements associated with skill performance during play.

If we look at the nature of performance in the game, it requires both oxygen work, which is represented by maximum oxygen consumption (VO2max), due to the continuity of the match and the need for the efficiency of the heart and lungs in supplying the working muscles with oxygen, and non-oxygen work, which is represented by oxygen capacity and is present in the majority of movements such as running, jumping, and performing skills in the game. The intensity varies; Crisafulli et al. (2002) indicated that the basketball player covers a distance ranging between 4500–5000 meters during a match. Hernández et al. (2018) emphasized that the basketball player traverses approximately 4500–5000 meters throughout a match, with significant contributions from both anaerobic and aerobic metabolic pathways. Moreover, Abdelkarim et al. (2010) indicated that the distance covered by Tunisian basketball players in a match reached 7558 meters, distributed according to intensity: high (1743 meters), medium (1619 meters), and low (2477 meters). This requires both oxygen and non-oxygen work to produce energy. Narazaki et al. (2009) pointed out that playing time during a match consists of running (34.1%), walking (56.8%), and standing (9%), and VO2max values in previous studies of basketball players ranged between 40–75 ml/kg/minute (Matković et al., 2005).

With regard to anaerobic work, basketball players perform approximately (1000) movements, each of which lasts (3-6) seconds at the maximum possible, and thus the reliance is mainly on the ATP-PC system in producing energy anaerobically. By analyzing the matches, it was shown that jumping is most commonly used during the match, whether vertical, as in shooting from a jump, continuing to score, putting the ball under the basket, and contesting with the opposing player, or horizontal, as in intercepting passes between players of the opposing team and running at full speed. Narazaki et al. (2009) pointed out that the average vertical jump of a basketball player in a match reaches (35) times, and this emphasizes the importance of the explosive ability of basketball players. A study by Aksović et al. (2020) also showed that due to the high level of performance among players and the closeness in level, explosive ability is what distinguishes the performance of a player compared to others. Therefore, many studies have been concerned with preparing special training programs to develop the explosive ability of basketball players of different ages and for both genders. It also shows the importance of explosive ability and connection with other important physical requirements for success in basketball, such as short-distance running, agility, anaerobic capacity, and muscular strength (Alemdaroğlu, 2012).

The study of blood groups is one of the topics of interest to researchers in the medical and psychological fields, for example, but not limited to, the medical field. Given the connection of blood groups to the genetic aspects of individuals, many researchers are currently interested in studying the relationship between blood types and COVID-19. Studies such as Munoz et al. (2021); El-Shitany et al. (2021) showed that blood type O provides the best immunity and ability to confront COVID-19, while individuals with blood type A have the lowest immunity. The same is true in the psychological field, as studies conducted in psychology have indicated an effect of blood type on some psychological traits. For example, a study by Boujla & Bahra (2017) examined blood types and their relationship to optimism and pessimism among a sample of middle school students. Al-Zoubi (2018) studied blood types and the Big Five personality factors, and Beheshtia et al. (2015) also examined blood types and the Big Five personality factors among students. Barakat (2007) investigated blood types and their relationship to some emotional personality traits among a sample of university students. Additionally, Al-Alami (2011) indicated a relationship between blood types, depression, and aggression. In the sports field, for example, Lippi et al. (2017) found that blood type O explained 62.2% of performance in running a half marathon.

Through the researchers' review of previous studies related to blood types in the psychological and medical fields, they noticed a variation in the effect of blood types on psychological and therapeutic variables. Blood types are closely linked to genetics in individuals, and if we look at the physiological and physical capabilities of athletes, we find that most of them depend on readiness. Genetics among players, but it is relative, and sayings have appeared that emphasize this factor by physiologists, including: "Sprinter is born and then made" (Fox & Foss, 1989), and the saying: "If you want to win a gold medal in the Olympics, you must choose your parents well." (Wilmore & Costill, 2016), and in emphasis on the importance of genetics, Klissouras (1973) pointed out that the percentage of the influence of genetics on the maximum oxygen consumption reached (73%).

While muscle fiber composition significantly impacts physical abilities, current scientific literature does not establish a direct correlation between blood types and muscle fiber distribution or performance in aerobic and anaerobic activities. Therefore, this study aims to identify the influence of blood groups on the maximum oxygen consumption VO2Max and explosive power of high-level basketball players in Palestine.

2. METHODS

2.1. Design and Participants

The researchers used the descriptive analytical approach due to its suitability to the aim of the study. The study population consisted of 150 basketball players from the highest levels in Palestine during the 2019/2020 sports season. The study was conducted on a healthy random sample of 44 players, whose age, height, and body mass were 25.81 ± 5.79 years, 187.79 ± 9.52 cm, and 89.97 ± 15.61 kg, respectively. They represented approximately 30% of the study population. The values of the skewness coefficient were between ±3, indicating that the study sample followed a normal distribution.

2.2. Procedures

- A mechanical scale (type: Seca Scale) equipped with a stadiometer device was used to measure body mass and height. Body mass was measured while wearing only shorts, to the nearest 500 grams, and height was measured without shoes, to the nearest 1 cm.
- Vertical jump test to measure explosive power: A stepped wall was used, so that the athlete stands next to the wall, extends his hands to the highest point and places a sign with the middle finger, then swings in place, jumps to the highest point and places a mark on the wall, and then the distance between the two marks is calculated and recorded in (cm). Each player was given (3) attempts, and the best one was recorded.
- Cooper running test (12 minutes) to measure maximum oxygen consumption: Each player ran on a football track for (12) minutes, and the distance he covered was recorded in (km), and then the equation of (Koç et al., 2020) was applied to calculate the maximum oxygen consumption: Maximum oxygen consumption (ml/kg). /minute) = (22.351 x distance traveled (km)) - 11.288.
- Blood groups: The blood sample was taken by a specialist doctor, and it was analyzed in the laboratory in order to determine the blood groups among the study sample members.
- Blood group testing procedure (Brief Overview): Blood group is determined in the laboratory using the agglutination method, where a blood sample is mixed with specific antisera (Anti-A, Anti-B, and Anti-D) to detect the presence of corresponding antigens on red blood cells . The procedure began by collecting a small blood sample from the participant. Drops of the

blood were then placed on a test card or gel card. Anti-A, Anti-B, and Anti-D reagents were added to separate areas of the card. The presence or absence of agglutination (clumping) was then observed to determine the blood type. If agglutination occurred with the Anti-A reagent, the blood was classified as type A. If agglutination occurred with the Anti-B reagent, the blood was classified as type B. If agglutination occurred with both Anti-A and Anti-B reagents, the blood was classified as type AB. If no agglutination occurred with either reagent, the blood was classified as type O. Finally, agglutination with the Anti-D reagent indicated that the blood was Rh positive, while no agglutination indicated Rh negative.

All players in sample study were subject to the same training and nutrition programs approximately**.**

2.3. Statistical Analyses

IBM SPSS version 26 was utilized for data analysis. Descriptive statistics, such as arithmetic mean and standard deviation, were computed for the maximum oxygen consumption (VO2max) and explosive power based on blood group types. In order to establish if differences existed between blood group types, a one-way analysis of variance was carried out, denoted by the term "One-Way ANOVA." In cases where the one-way analysis of variance indicated the existence of differences, the Sidak test was carried out for the purposes of establishing which blood group types differed significantly from one another. The level of significance for the entire analysis was set at $\alpha \leq 0.05$.

3. RESULTS

Table 1 shows the arithmetic means and standard deviations of VO2max and explosive power by blood group (N = 44).

Table 1. Descriptive statistics results of VO2max and explosive power by blood group (N = 44)

Variables	Blood group	N	Mean	SD
VO2Max **(mL/km/min) ***	A	16	40.88	2.81
	B	8	41.37	2.82
	AB	7	41.07	2.61
	O	13	44.41	1.50
Total		**44**	**42.04**	**2.84**
Explosive power (cm)**	A	16	46.62	2.55
	B	8	51.50	2.44
	AB	7	45.00	1.52
	O	13	46.69	4.92
Total		**44**	**47.27**	**3.84**

Players who had blood type O had the highest VO2max (44.41 ± 1.50 mL/kg/min), and blood type B had the highest explosive power (51.50 ± 2.44 cm). Blood types A and AB had lower values in both variables. This study implies that blood type O favors aerobic capacity and blood type B favors explosive power. Table 2 shows the results of the one-way ANOVA used to examine differences in VO2max and explosive power according to blood group (N = 44).

Table 2. Differences in maximum oxygen consumption and explosive power according to the blood type variable

Variables	Source of variance	Sum of Squares	DF	Mean Square	F	p value
VO2Max **(mL/km/min)**	Between Groups	104.741	3	34.914	5.73	0.002*
	Within Groups	243.367	40	6.084		
	Total	348.108	43			
Explosive power (cm)	Between Groups	190.208	3	63.403	5.70	0.002*
	Within Groups	444.519	40	11.113		
	Total	634.727	43			

Note. *Significance level (α ≤ 0.05)*

It is clear from the results of Table 2 that there are statistically significant differences (p = 0.002) in the maximum oxygen consumption and explosive power among players at the highest levels of basketball in Palestine according to the blood group variable. To determine the sources of differences, the Sidak test was used for post-hoc comparisons between arithmetic means (Table 3):

Table 3. Post-hoc comparisons of maximum oxygen consumption and explosive power according to blood group using the sidak test (n = 44)

Variables	Blood group	Mean	A	B	AB	O
VO2Max **(mL/km/min)**	A	40.88		0.48-	0.18-	*3.52-
	B	41.37			0.29	*3.04-
	AB	41.07				*3.34-
	O	44.41				
Explosive power (cm)	A	46.62		*4.87-	1.62	0.06-
	B	51.50			*6.50	*4.80
	AB	45.00				1.69-
	O	46.69				

Note. **Significance level (α ≤ 0.05)*

The results of Table 3 indicate that there are statistically significant differences between the maximum oxygen consumption and the explosive power of the high-level basketball players in Palestine, according to the variable of blood groups (p < 0.05). The differences were statistically significant in the maximum oxygen consumption only between the blood type (O) and other groups, it was in favor of blood type (O). This result is shown in Figure 1. For the explosive power, the differences were statistically significant between blood type (B) and other types. It was in favor of blood type (B) (this result is shown in Figure 2).

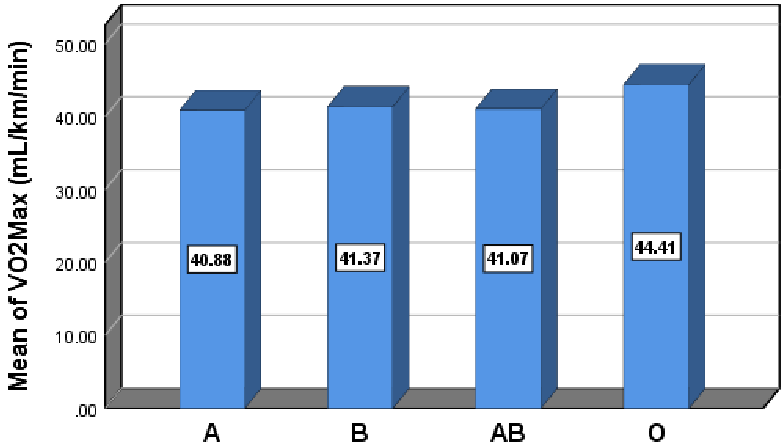

Figure 1. Mean vo2max of high-level basketball players by blood group

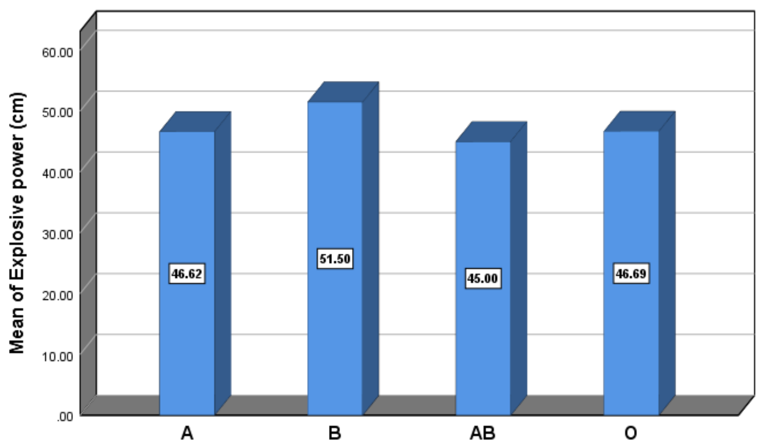

Figure 2. Mean explosive power of high-level basketball players by blood group

4. DISCUSSION

The results showed that the mean values for the study sample were 42.04 mL/kg/min for maximum oxygen consumption and 47.27 cm for explosive power. With regard to the mean of maximum oxygen consumption in the current study, it was within the range of previous studies for basketball players between (40-75) ml/kg/min (Matković, et al., 2005). When comparing the mean maximum oxygen consumption to previous studies in basketball, it was lower than that reported by

Crisp et al. (2013) in a sample of 26 Brazilian basketball players, which reached 50 mL/kg/min. However, the mean in the current study (42.04 mL/kg/min) was higher than that of students at the Faculty of Medical Sciences, Moliga University in Turkey, which was 31.17 mL/kg/min, using the same measurement equation.

Regarding explosive power, the mean in the current study was lower than in previous studies, including Koç et al. (2020), where the mean vertical jump was 53.62 cm, and Anne & Cohen (2008), where it reached 54.3 cm. The researchers believe that the main reasons for the discrepancy between the results of the current study and previous studies may be due to the difference in the factors that affect energy production systems in terms of: genetic factors, training and nutrition, which vary from one player to another and from one team to another (McArdle et al., 1986).

With respect to the influence of blood types, the findings presented in Table 3 and Fig. 1, 2 suggest that the attention of physiologists, in general, and sports training physiology, in particular, should be drawn to the issue, bearing in mind the strong association between blood types and genetics, such as the association between muscle fiber types, maximal oxygen consumption, and muscle power. Thus, genetics may be seen as a common link between blood types and types of muscle fibers. In this context of recent studies on the role of blood types in physical and performance abilities in sports, the results of this study raise some interesting issues. For instance, what is the link between blood types and types of muscle fibers, motor units, and heart functions? Can blood types be used in the selection of sports in the future? Is there a variation in blood types among different types of games and roles in a particular game? Does blood type influence the types of nutrition and training for athletes? These are some of the issues to be answered in the future, and this study aims to open the way for further investigations in this field.

The first studies indicated a relationship between endurance and the type of slow muscle fibers, an example of which is the study of Costill et al. (2000), where the percentage of slow twitch fibers (STF) in running players reached (79%). Other studies have indicated a strong relationship between Fast Twitch Fibers (FTF) and anaerobic work (Golnick et al., 1972). Regarding the appearance of differences in Vo2max between blood types and in favor of blood type (O), researchers believe that the main reason for this is the lack of antioxidants in blood type (O) compared to other types, rather than the fact that it is believed to have better aerobic capabilities. This result was confirmed by Lppi et al. (2017) study which concluded that the (O) blood type explained (62.2%) of the performance in running a half marathon, and such a result confirms the importance of the genetic factor. Klissouras (1973) indicated that genetics contributes (73%) of the maximum oxygen consumption, while the remainder is due to other environmental factors, including training and nutrition. In addition, studies in the medical field have shown that individuals with blood type O have stronger immunity. Research by Munoz et al. (2021); El-Shitany et al. (2021) indicated that blood type O provides the best protection and ability to confront COVID-19. These findings also highlight the importance of studying the relationship between blood types, immunity, and the physiological capabilities of athletes. As for the superiority of people with type (B) blood over those with other blood types, this may be due to their possession of better anoxic capabilities in terms of the type of fast muscle fibers, motor units, and anaerobic enzymes such as: phosphofructokinase (PSK) and triadenosine phosphate (ATP) enzymes ATP-ase (Golnick et al., 1972).

5. CONCLUSIONS

While genetic factors, including blood type, may contribute to athletic performance, the findings suggest that other variables such as training, nutrition, and individual physiological characteristics have a more significant and direct impact. The results indicate that the VO_2max and explosive power levels of the study sample fall within the acceptable range for basketball players. Additionally, the highest mean VO_2max was observed among individuals with blood type (O), while those with blood type (B) recorded the highest mean explosive power. However, there is no precise scientific basis to explain these differences according to blood type, particularly due to the scarcity of studies addressing this topic among athletes. To achieve a more accurate scientific explanation of these findings, further research is required to explore the relationship between blood types and other physiological variables, such as muscle fiber composition, cardiac impulse rate, pulmonary ventilation, and specific aerobic and anaerobic enzymes. Such investigations may provide deeper insights into the potential role of blood groups in athletic performance. More extensive studies with larger sample sizes and advanced genetic analyses are needed to explore potential links between blood types and athletic performance. It is also recommend conducting studies to investigate the relationship between blood groups and muscle fiber type in athletes.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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