Original Article

Body composition and physical fitness of different blood groups in Olympic athletes

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ABSTRACT

Background and Aim: A comprehensive understanding of an athlete's physical fitness and overall condition is paramount in professional sports, especially wrestling. Such insights are instrumental in talent identification, sculpting training regimens, and, ultimately, ensuring success on the field. Given this backdrop, this study embarked on a mission to meticulously investigate the variances in body composition and diverse elements of physical fitness among the elite Olympic athletes of Iraq. The emphasis was on delineating correlations or disparities based on their blood groups. Methods: Adopting a robust semi-experimental approach, this research incorporated 40 young, spirited wrestlers from Baghdad. These athletes represented a spectrum of blood groups: A, B, AB, and O, all unified by a positive RH factor. Spanning from January 2021 to May 2023, post the acquisition of informed consent; these participants underwent rigorous laboratory evaluations. These assessments delved into determining their blood group, deciphering body fat percentages, BMI metrics, and gauging attributes like endurance, muscle tenacity, speed, agility, anaerobic prowess, and peak oxygen consumption. To ensure data integrity, analyses were diligently performed using the renowned SPSS22 software, with a stringent significance benchmark of .05. Results: The findings were revelatory. Clear-cut distinctions were evident across the four blood group categories ($p < .05$). Athletes with the O blood group consistently eclipsed their counterparts, while the AB group presented a contrasting picture, trailing in most metrics. Conclusion: The research underscores that an athlete's blood group might significantly determine their physical composition and performance capabilities, especially in Olympic sports.

Keywords: Sport medicine, Health, Olympic athletes, Physical fitness, Blood groups, Body composition.

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INTRODUCTION

Sport is considered a heavy and intense activity due to its special physical requirements, such as power, strength, speed, lactic acid tolerance, and endurance in aerobic and anaerobic exercises (Malm, Jakobsson, & Isaksson, 2019). An *athlete* is a *sportsperson* trained to compete in one or more sports that involve physical strength, speed, or endurance (Campa & Coratella, 2021). Physical readiness can also be considered a uniform measure for most bodily functions, such as skeletal, muscular, cardiovascular, respiratory, circulatory, psychological, endocrine, and metabolism, involved in daily physical or sports activities (Di Liegro, Schiera, Proia, & Di Liegro, 2019). Therefore, knowledge of the physical readiness and condition of Olympic athletes is an important and fundamental principle in planning optimal training for them (Haugen, Seiler, Sandbakk, & Tønnessen, 2019). Accordingly, considering the high importance of physical readiness and the condition of Olympic athletes, it is a fundamental principle in planning optimal training.

Physical conditions and fitness are critical factors in wrestling due to the sport's unique physical demands, such as the characteristics of both aerobic and anaerobic exercises, power, strength, speed, lactate tolerance, and endurance (H. Chaabene et al., 2017). Fitness also serves as a comprehensive measurement of most of the body's functions, such as skeletal muscle, cardiovascular, respiratory, blood circulation, psychological, endocrine, and metabolism, which are involved in daily physical activities or sports performance (Ruegsegger & Booth, 2018). Therefore, knowledge of Olympic athletes' fitness level and physical condition is fundamental and essential in optimizing their training programs. Consequently, by evaluating Olympic athletes' current physiological abilities and using physical fitness tests, appropriate information can be provided to them and their coaches regarding their physiological capabilities and capacities (Helmi Chaabene et al., 2018). Additionally, it provides an opportunity to compare Olympic athletes' physical capacities with the available information of similar groups, such as national norms. Ultimately, when physical fitness is assessed, the performance status of all these systems is evaluated. It is because physical fitness has become one of the most important factors in sports performance today. That is why, today, physical fitness is one of the most important indicators of health, just like a prediction of illness and death for cardiovascular patients and for all causes (Ekelund et al., 1988).

Overall, the continuous progress of sports science and the new findings of research conducted in the field of sports has led to astonishing leaps in records and results obtained from sports activities; because knowledge of the structure and function of the body, both for maintaining health and improving sports performance, including important and attention-grabbing areas of study in physical education and sports science (Cid-Calfucura et al., 2023). Given the new conditions, to achieve excellence in any sport, we must first have comprehensive information about the physical conditions and body composition of athletes so that we can provide appropriate training programs for athletes to progress and advance to the desired levels by comparing this information with the status of elite athletes in that field. However, in addition to body composition and physical fitness, Lippi *et al*. (Lippi et al., 2017), in a study on the effect of blood group, ABO, on sports performance, in conjunction with other variables such as age and weekly exercise, found that blood groups are significantly related to better performance of athletes. Finally, the term blood group can be defined as a practical term for inheriting discovered antigens on the surface of red blood cells by specific antibodies. The characteristics of a definite blood group have been created for each person and cannot be changed by disease involvement over time (Ramnarayan, Manjunath, & Joshi, 2013). Based on the new findings of sports science, in most sports, the structure and physical abilities of athletes and the identification and development of specific physical abilities for each sport, to some extent, determine the type of sports activity and ensure the success of training programs and the selection of suitable individuals. Therefore, considering the necessity of the research, this study aims to investigate the physique and fitness of Olympic competitors from various blood types in Baghdad, Iraq.

MATERIALS AND METHODS

Study design and population

The present research is semi-experimental and descriptive with comparative aspects. The study population of the present research, after coordination with the wrestling board of Ardabil province and informing the coaches of city-level clubs, consisted of Olympic athletes who had three regular training sessions per week for one year, did not consume supplements and drugs during the past six months, were not affected by any particular disease, and were young. Out of these individuals, 67 were selected. After matching their identification information and obtaining consent forms from their parents, the researcher monitored them for blood donation and determined their blood type in the laboratory. After one day, the test results were received, and 40 individuals were categorized into four blood groups with positive RH (A, B, AB, O).

Measures

Speed, strength, agility, endurance, and aerobic capacity tests were used based on standard tests and BMI%, BF, and VO_{2max} to measure physical fitness and body composition.

Measurement methods

A digital scale with an accuracy of 0.01 was used to measure weight and height. A calliper (fat meter) model Amron made in Finland was used to measure body fat thickness. A one-mile (1600 meters) running test was used to estimate VO_{2max} using the following formula:

VO_{2max} (ml/kg/min) = 108 .94 – 8.41 (BMI 0.84 – age * gender (0.21) + time in minutes (0.24) + time in minutes).

The Sargent test was used to determine aerobic power. The 60-meter dash test was used to measure speed. The 9*4 shuttle run test was used to measure agility. The wall-sit test was used to measure muscle strength. The one-minute sit-up test was used to measure local muscular endurance. A digital chronometer was used to measure the record times of the running tests.

Ethical consideration

This study approved by Al-Turath university ethical committee, and all participants signed the informed consent before study inclusion.

Statistical analysis

In this study, descriptive statistics, mean, and standard deviation were used to describe the data, and a one-way ANOVA test was used for statistical analysis, assuming a normal distribution of scores of sample groups in the population. The Shapiro-Wilk test, the Kolmogorov-Smirnov test, and Levene's test were used to test the assumption of equal variances between the groups in the population. The Bonferroni post hoc test was used to determine the significant differences between the means. Moreover, the test results were analysed at the significant threshold of significance of .05 with SPSS 22.

RESULTS

According to the results in Table 1, in terms of body composition, VO_{2max}, height, BMI, age, blood groups O, AB, AB, AB, and B have the highest means. Results show that blood group O has the highest mean in muscular endurance, power, and speed variables among the four blood groups, and blood group AB has the lowest mean (Table 1). Regarding the agility variable, blood group O has the highest mean, and blood group B has the lowest. In the anaerobic power variable, blood group O has the highest mean and blood group AB has the lowest mean. Regarding aerobic power, blood group O has the highest mean and blood group AB has the lowest. As the one-way ANOVA was used as one of the parametric tests for data analysis in this study, necessary assumptions for applying these tests were examined. Based on the results of the Shapiro-Wilk and Smirnov-Kolmogorov tests, the normality assumption of the score distribution in the four blood groups was confirmed ($p > .05$) (Table 2). According to the calculated F coefficient, there was a significant difference between the adjusted means of aerobic power, anaerobic power, muscular endurance, agility, power, and speed variables in the four blood groups ($p < .05$) (Table 3).

Table 1. Basic characteristics and demographic data, mean and standard deviation of BMI, BF, VO_{2max}, and physical fitness index scores among Olympic athletes in different blood groups (N = 40).

Variable	Blood groups			
	A	B	AB	O
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Age	17.98 ± 4.03	19.11 ± 4.95	18.85 ± 3.78	18.04 ± 3.81
Height	1.69 ± 0.67	1.71 ± 0.81	1.70 ± 0.75	1.68 ± 0.82
Weight	68.23 ± 5.06	70.01 ± 5.19	72.39 ± 5.12	67.75 ± 5.09
BMI	23.85 ± 3.21	23.93 ± 3.92	25.05 ± 5.11	24.00 ± 3.06
Body fat %	11.41 ± 1.57	11,86 ± 2.07	12.39 ± 2.09	10.72 ± 2.00
VO_{2max} (ml/kg/min)	20.01 ± 2.90	19.88 ± 2.63	20.10 ± 2.44	22.14 ± 2.05
Physical fitness index scores				
Muscular endurance	7.52 ± 2.09	7.04 ± 2.59	5.29 ± 1.97	9.37 ± 2.41
Power	9.64 ± 2.82	9.35 ± 2.71	9.18 ± 2.21	10.01 ± 3.00
Speed	10.00 ± 2.25	10.17 ± 2.08	8.12 ± 2.13	11.63 ± 3.11
Agility	8.40 ± 2.88	8.19 ± 2.82	8.38 ± 1.78	10.10 ± 3.32
Aerobic fitness	11.85 ± 2.14	11.50 ± 2.01	11.09 ± 2.33	12.05 ± 3.49

*Note. * Muscular endurance; Number of repetitions in a given time, Power; Unlimited time, Speed and agility; Based on time, Anaerobic power; Centimetres.*

Table 2. Shapiro-Wilk and Kolmogorov-Smirnov tests for normality assumption of variable scores.

Variable	Kolmogorov-Smirnov test			Shapiro-Wilk test		
	Statistics	**DF**	***p-values***	**Statistics**	**DF**	***p-values***
Muscular endurance	0.593	40	.412	0.611	40	.302
Power	0.544	40	.510	0.743	40	.440
Speed	0.501	40	.500	0.569	40	.371
Agility	0.605	40	.626	0.644	40	.413
Aerobic fitness	0.642	40	.751	0.630	40	.459

Note. DF, Degree of freedom.

Table 3. One-way ANOVA analysis for body fat percentage and body mass index among maximal oxygen consumption and muscular endurance, strength and speed, agility and anaerobic power in different blood groups.

Variable	*DF*	MS	*F*	*p-value*	Eta squared	Statistical power
Body fat %	1	1002.93	25.32	.05	0.503	1.000
Body mass index (kg/m^2)	1	1985.01	29.80	.05	0.576	1.000
Maximal oxygen consumption and muscular endurance						
Maximum oxygen consumption	1	1997.23	20.05	.05	0.470	1.000
Muscular endurance	1	2871.94	26.02	.05	0.531	1.000
Strength and speed						
Power	1	1802.03	28.27	.05	0.574	1.000
Speed	1	2001.08	25.44	.05	0.499	1.000
Agility and anaerobic power						
Agility	1	2020.18	28.17	.05	0.564	.001
Aerobic fitness	1	2013.13	27.32	.005	0.599	.001

Note. MS, Mean square; DF, Degree of freedom.

There is a significant difference in the percentage of body fat and body mass index among the subjects based on their group membership (different blood groups) ($p > .05$). To further investigate the significance of the difference in the mean scores of body fat percentage and body mass index between groups, the Least Significant Difference (LSD) post hoc test was used, which represents the method of the least significant difference. The results of this analysis are presented in Table 4.

Table 4. Coefficients of LSD post hoc test results for the comparison of mean body fat percentage and body mass index (BMI) among different blood groups.

Variable	Body fat percentage		Body mass index	
Blood group	**Adjusted means**	***p-value***	**Adjusted means**	***p-value***
A	10.17	.002	11.28	.006
B	9.49		12.00	
A	10.17	.003	11.28	.003
AB	10.09		10.76	
A	10.17	.001	11.28	.003
O	9.88		10.11	
AB	10.09	.005	10.76	.001
B	9.49		12.00	
AB	10.09	.002	10.76	.005
O	9.88		10.11	
B	9.49	.005	12.00	.001
O	9.88		10.11	

Based on the calculated F coefficient, there is a significant difference between the adjusted means of the oxygen consumption rate and muscular endurance in the subjects based on their group membership (Table 3). There is a significant difference based on group membership (different blood groups) ($p < .05$). To further investigate the significance of the difference in the mean scores of maximum oxygen consumption and muscular endurance among the groups, the least significant difference (LSD) test, which is the method of the least significant difference, was used (Table 5). The results presented in Table 7 show a difference between the adjusted mean scores of maximum oxygen consumption and muscular endurance among the four blood groups ($p < .001$). There is a major distinction between the adjusted means of strength and speed variables in the participants based on their group membership (different blood groups) ($p < .05$) (Table 3). To further investigate the significance of the differences in the means of strength and speed scores between groups, the LSD post hoc test was used to determine the minimum significant difference. The results indicate that there is a significant difference between the adjusted means of strength and speed variables among the four blood groups ($p < .05$) (Table 3). There was a significant difference between the adjusted means of maximum oxygen uptake and muscle endurance scores among the groups ($p < .05$) (Table 6). The result indicates that there is a significant difference between the adjusted means of maximum oxygen uptake and muscle endurance scores among the four blood groups ($p < .001$) (Table 3).

Table 5. Coefficients of LSD post hoc test for comparing the means of VO_{2max} and muscular endurance between groups.

Variable	Maximum oxygen consumption		Muscular endurance	
Blood group	**Adjusted means**	***p-value***	**Adjusted means**	***p-value***
A	11.37	.002	12.16	.014
B	11.03		12.72	
A	11.37	.009	12.16	.004
AB	10.89		11.77	
A	11.37	.003	12.16	.001
O	10.90		13.07	
AB	10.89	.011	11.77	.006
B	11.03		12.72	
AB	10.89	.006	11.77	.009
O	10.90		13.07	
B	11.03	.001	12.72	.001
O	10.90		13.07	

Table 6. Coefficients of results for comparing mean values of strength and speed with LSD follow-up test among groups.

Variable	Power		Speed	
Blood group	**Adjusted means**	***p-value***	**Adjusted means**	***p-value***
A	10.52	.004	10.11	.003
B	10.00		9.71	
A	10.52	.001	10.11	.002
AB	11.06		10.90	
A	10.52	.010	10.11	.003
O	11.45		11.08	
AB	11.06	.002	10.90	.009
B	10.00		9.71	
AB	11.06	.007	10.90	.001
O	11.45		11.08	
B	10.00	.006	9.71	.001
O	11.45		11.08	

There was a significant difference in the mean scores of agilities and aerobic power variables among participants based on their blood group membership ($p < .05$). The LSD follow-up test indicates that there is a significant difference between the adjusted mean scores of agilities and aerobic power variables among the four blood groups ($p < .001$) (Table 7).

Table 7. Coefficients of the comparison test results of mean values of agility and anaerobic power using the LSD follow-up test among groups.

Variable	Agility		Aerobic fitness	
Blood group	**Adjusted means**	***p-value***	**Adjusted means**	***p-value***
A	9.55	.001	13.01	.002
B	9.07		12.04	
A	9.55	.003	13.01	.005
AB	10.12		12.79	
A	9.55	.002	13.01	.003
O	10.63		13.21	
AB	10.12	.005	12.79	.001
B	9.07		12.04	
AB	10.12	.007	12.79	.006
O	10.63		13.21	
B	9.07	.001	12.04	.001
O	10.63		13.21	

DISCUSSION

Finding the specific physical and physiological elements that influence performance has been a major focus for coaches and sports scientists in recent years. Based on previous research, a study by Lippi *et al*. (Lippi et al., 2017) on blood groups and their impact on endurance sports performance has been conducted, as well as numerous studies in medical fields such as the ABO blood group system and diseases such as cardiovascular disease, coronary artery disease, cancer, diabetes, osteoporosis, and in the field of humanities such as psychology and personality, criminology, and more.

This analysis of Olympic competitors across blood types of analyses body composition and certain measures of physical fitness. Results demonstrated that BMI and body fat percentage, as well as maximal the absorption of oxygen, powerful endurance of muscle, agility, quickness, and aerobic power, varied significantly between blood types. Findings by Leo et al., who examined the correlation between body fat percentage and fitness levels across age groups and roles in young male football players, were consistent with these observations.

Consistent with the findings of Smith et al. and Flor et al., the current investigation demonstrates a statistically significant variation in BMI between blood types. Although in this study, the highest BMI was related to blood group A and groups B and O, respectively, in the current study, the highest BMI value belongs to blood group B, and on the other hand, it was not consistent with the results of Alwasaidi *et al*. (Alwasaidi et al., 2017) regarding blood groups and the distribution of obesity and BMI.

However, regarding body fat percentage in different blood groups, the results of the study show that there is a significant difference. Consistent with the findings of Tsirigkakis et al. and Heydari et al. is what we saw in the current investigation regarding aerobic capacity and body fat percentage. The blood group O, which has the lowest body fat percentage, they have the highest aerobic capacity. Regarding maximum oxygen consumption, blood group AB has the lowest Max VO_2 level, this agrees with the findings of Pérez-Gómez et al. and Zhou et al. In general, the results of this study can be used by coaches and sports specialists to design training programs tailored to the physical characteristics of individuals based on their blood group. Individuals with blood type O have a lower percentage of body fat in all these variables. They are in a desirable condition for aerobic and anaerobic exercise, and those with suitable explosive power and agility were also preferable regarding speed variables. Moreover, in line with Lohma *et al*. (Lohman et al., 2008), those with a suitable physical combination had superior physical readiness. Considering the findings of this study and previous internal and external research results in various fields, body composition, physical readiness factors, medical issues, blood groups, and the effect of blood groups on endurance sports, it is clear that body composition and physical readiness factors and cardiovascular and respiratory readiness at a high level are determined by individuals' genetics. Since blood groups are among immunological and genetic issues, the potential of athletes can be, to some extent, predicted based on their blood type, as the superiority of individuals can be distinguished to some extent based on their blood type. Consequently, this study shows that individuals with blood type O are the most capable athletes regarding body composition and some physical readiness factors. Therefore, considering this studies and other research results, it can provide a wide research field for sports science experts and related fields (Leão et al., 2022; Wang, Zhou, Zhao, & He, 2022).

CONCLUSION

In the course of our investigation of Olympic competitors, we conducted an analysis of disparities in the shape of the body and other physical fitness components across different blood types. The results of our study emphasize the variations observed in body composition metrics, such as their body mass index and percentage of body fat, as well as important physical fitness components including maximal absorption of oxygen, muscle strength, skeletal muscle endurance, agility, quickness, and anaerobic power, among individuals belonging to different blood groups.

AUTHOR CONTRIBUTIONS

Conceptualization – O.S.A., and S.S.A.; Methodology – O.S.A., and S.S.A.; Formal analysis – O.S.A., R.T.D., and S.S.A.; Data curation – S.S.A., and R.T.D.; Writing–original draft preparation – O.S.A., R.T.D., and S.S.A.; Writing – review and editing – O.S.A., and S.S.A.

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No potential conflict of interest was reported by the authors.

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