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Cardiovascular Fitness in College Students: Role of Blood Type and Somatotype

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ABSTRACT

This study intends to analyze the differences in cardiovascular endurance based on blood type and somatotype in college students. The study included 213 participants, consisting of 68 college students with blood type A, 68 with blood type B, 68 with blood type O, and 9 with blood type AB from the Faculty of Sport Science at Universitas Negeri Makassar. Cardiovascular endurance was assessed using the Multistage Fitness Test (MFT), blood type identification from the respondent's blood type card, and a somatotype assessment based on an anthropometric assessment. The investigation revealed that blood type O had stronger cardiovascular endurance than others, with a higher proportion of both satisfactory and fair categories. In contrast, blood type AB was associated with less endurance, with a large proportion in poor and destitute categories. Mesomorphs outperformed endomorphs and ectomorphs in terms of cardiovascular performance, which supports the theory that an individual's body type determines aerobic abilities. Furthermore, the chi-square test revealed a significant correlation between blood type and cardiovascular endurance ($p < 0.05$). This study considerably improves our understanding of how blood type and somatotype combinations affect athlete performance across various sports. This study recommends the integration of biometric and anthropometric data in athlete selection and development strategies to achieve optimal results.

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1. INTRODUCTION

The world of modern sports has undergone significant developments, particularly in utilizing biometric and genetic data to improve athlete performance (Gale, 2016; Karkazis & Fishman, 2017). One topic that has attracted attention is the relationship between blood type and somatotype (body type) in athlete performance. Blood type, which is genetically determined by antigens on the surface of red blood cells, is hypothesized to affect oxygen transport capacity, energy metabolism efficiency, and the body's response to certain physical activities (Li et al., 2017). On the other hand,

somatotype, which includes the classification of endomorph, mesomorph, and ectomorph, has long been used to analyze the relationship between body structure and physical performance in various sports (Kamionka et al., 2020; Campa et al., 2020).

In recent decades, research related to blood type and sports performance has shown intriguing results. A study by Masayuki (2021) stated that individuals with blood type O tend to perform better in endurance sports, such as long-distance running. The advantage is thought to be due to the more efficient ability to transport oxygen compared to individuals with other blood types. Similar findings were also supported by Kikuchi et al. (2016), who showed that Japanese athletes with blood type O dominate competitive sports such as soccer and marathons.

Morphological characteristics and anthropometric parameters exert a significant influence on motor performance indicators (Ferreira et al., 2017; Zhao et al., 2019; Çinarli & Kafkas, 2019). Somatotype, as one of the anthropometric indicators, has been shown to be a determining factor in athletic performance, influencing strength, endurance, and sport-specific skills (Jakovljević et al., 2022; Ghosh et al., 2025). Research by Bouchard et al. (2015) highlighted that mesomorphs with dominant muscle proportions outperform in activities requiring strength and endurance, such as soccer, basketball, and weightlifting. In contrast, ectomorphs, who have slim and long bodies, thrive at sports like long-distance running and swimming, which require efficient movement and oxygen consumption (Shephard & Shephard, 2015). Another study by Esteve-Ibáñez et al. (2025) showed that endomorphs frequently have limits in sports that require high endurance due to their larger body fat proportion, which can impair metabolic efficiency.

In the world of competitive sports, this issue becomes very relevant. Athlete selection and development strategies frequently rely on physical and physiological characteristics (Ahsan & Ali, 2023; Sauvé et al., 2024). For example, sports federations in countries such as Japan and South Korea use blood type data to map athletes' potential in certain sports (Masayuki, 2021). In addition, somatotype data is used by coaches to design specific training programs according to the physiological needs of each athlete (De Rose et al., 2014).

However, to date, studies that simultaneously integrate blood type and somatotype analysis in the context of athlete performance are still limited (Garcia & Canillas, 2023). Most earlier studies concentrated on a single issue, leaving considerable study gaps. For example, whereas the association between somatotype and physical performance has been extensively researched (Nikbakht, 2011), the relationship with biological characteristics such as blood type has not been widely explored. This presents both a challenge and an opportunity for further research, especially in understanding how the combination of these two factors affects overall athlete performance.

Therefore, this study aims to investigate the association between blood type, somatotype, and athlete performance. The results of this study are likely to make major contributions to the advancement of sports science, particularly in the strategy of selecting and coaching players based on biometric data.

2. METHOD

This study used a comparative independent method, which aims to compare cardiovascular endurance based on differences in blood type and somatotype. This method combines quantitative measurement with statistical testing to uncover significant correlations between variables (Sugiyono, 2015). The study population consisted of all active students at the Faculty of Sport Science, Universitas Negeri Makassar, who are members of the BKMF (Faculty Student Activity Body) sports community.

A purposive selection strategy was used to choose the sample, which involved 213 subjects of students of the Faculty of Sport Science, Universitas Negeri Makassar. The subjects were divided into four groups based on blood type: A (68 people), B (68 people), O (68 people), and AB (9 people). The study used the anthropometric evaluation method to determine somatotype, which refers to the three basic dimensions of body type: endomorph, mesomorph, and ectomorph. Blood type mapping is performed without interference, utilizing just the blood type cards owned by each respondent. The endurance test was conducted using a multi-stage fitness test instrument (Widodo & Hanani, 2021). The Multistage Fitness Test (MFT) is performed on a 20-meter track with a speed rhythm that matches the audio rhythm.

3. RESULTS AND DISCUSSION

Results

This study involved 213 students consisting of students that consisted of 68 individuals with blood type A, 68 with blood type B, 68 with blood type O, and 9 with blood type AB. The average age of the subjects was 24.16 years (SD = 3.78). Anthropometric data showed an average height of 167.93 cm (SD = 5.21) and weight of 64.03 kg (SD = 10.12). We divided the proportion of subject somatotypes into endomorph (34%), mesomorph (46%), and ectomorph (20%).

Cardiovascular Endurance Performance Based on Blood Type

Table 1. VO2 Max Performance Classification Based on Blood Type

Category	Blood Type A (%)	Blood Type B (%)	Blood Type O (%)	Blood Type AB (%)
Good	2,94	1,47	10,29	0,00
Fair	22,06	17,65	23,53	33,33
Poor	52,94	54,41	51,47	33,33
Very poor	22,06	26,47	14,71	33,33

Table 1 represents VO2 max performance classification based on blood type. The results of VO2Max measurements using the Multistage Fitness Test (MFT) showed variations in cardiovascular endurance between blood types (Table 1). Subjects with blood type O showed the best performance in the "good" category (10.29%) compared to other blood types. Subjects with blood type AB had a unique performance

distribution, with a high proportion in the "poor" category (33.33%) but also in the "destitute" category (33.33%).

Cardiovascular Endurance Performance Based on Somatotype

Table 2. Performance Distribution Based on Somatotype

Category	Endomorphs (%)	Mesomorphs (%)	Ectomorph (%)
Good	2,8	14,9	6,7
Fair	8,2	51,3	40,2
Poor	57,6	26,5	43,1
Very poor	31,4	7,3	10,0

Table 2 represents performance distribution based on somatotype. Somatotype showed a significant relationship with cardiovascular endurance. Mesomorphs had the highest proportion in the "good" (14.9%) and "fair" (51.3%) categories, while endomorphs dominated the "poor" (57.6%) and "destitute" (31.4%) categories (Table 2). Subjects with an ectomorph somatotype showed a more even distribution of performance between the "fair" and "poor" categories.

The chi-square test showed a significant relationship between blood type and cardiovascular endurance with a p-value = 0.03. In addition, an ANOVA test showed a significant difference between somatotype and cardiovascular endurance performance ($F = 6.82$, $p < 0.01$). Blood type influences cardiovascular endurance, as shown by the fact that subjects with blood type O tend to have better cardiovascular endurance, possibly related to the efficiency of oxygen transport and energy metabolism.

The mesomorph somatotype showed better performance compared to the endomorph and ectomorph, supported by a more dominant proportion of muscle mass. These findings indicate the potential for integrating blood type and somatotype data to improve athlete selection strategies in endurance sports. These results offer substantial benefits to the development of athlete selection and training methods based on biometric and anthropometric data.

Discussion

This study showed a significant relationship between blood type and somatotype in cardiovascular endurance. Subjects with blood type O showed better cardiovascular performance compared to other blood types, as shown by a higher proportion of the "good" category (10.29%). This finding supports previous studies that stated that blood type O has advantages in oxygen transport, hemoglobin, and aerobic capacity (Li et al., 2017). This ability provides advantages in physical activities that require high endurance, such as endurance-based sports. Research conducted by Mangwayana et al. (2021) found that individuals with blood type O tend to have dominant type I muscle fibers. Type I muscle fibers have more mitochondria and longer connections to blood vessels than type II fibers. In addition, mitochondrial volume density showed a forceful correlation with the oxygen diffusion coefficient in three different muscle groups,

namely the retractors, sartorius, and soleus, indicating superior aerobic capacity (Pilotto et al., 2022; Peden et al., 2024).

Somatotypes also influence cardiovascular endurance, where mesomorphs perform better than endomorphs and ectomorphs. In addition, these results also support a study by Kamionka et al. (2020) that mesomorphs have better physical adaptation abilities than other body types. Individuals with a mesomorphic body type tend to have superior muscular strength and endurance and aerobic capacity (Ryan-Stewart et al., 2018). Mesomorphs, with a greater muscle mass, have a higher metabolic efficiency and adaptability to intense physical activity (Bouchard et al., 2015). Furthermore, mesomorphs also can produce greater muscle torque, thus better supporting physical performance (Kathirgamam et al., 2020). In contrast, endomorphs, who have more body fat, showed difficulties in using oxygen and being energy efficient during physical activity, as indicated by many of them falling into the "fair" and "poor" performance categories. The endomorph body type has lower speed, muscular explosive power, agility, flexibility, strength, and physical fitness compared to the ectomorph and mesomorph types (Anggitasari et al., 2019). The different body types were closely linked to how well people performed in the physical fitness tests, which is mostly affected by their genetics.

These findings can be used to design more specific training programs based on blood type and somatotype (Gutnik et al., 2015; Ahmed et al., 2024). For example, athletes with a mesomorphic somatotype can be given a high-resistance training program to maximize their physical potential, while endomorphs may require an approach that focuses more on reducing body fat mass. Biometric data such as blood type and somatotype can be additional criteria in the athlete selection process. Blood type O and mesomorphic somatotype can be early indicators of better endurance potential, especially in endurance sports such as long-distance running, soccer, and triathlons. The combination of blood type and somatotype analysis in the context of cardiovascular endurance is a new field that needs to be further developed. Studies with larger samples and more diverse populations can strengthen these results and provide a more profound understanding.

This approach can be the basis for further, more in-depth research, especially in understanding how biological and anthropometric factors work synergistically in influencing physical performance. By leveraging blood type and somatotype information, coaches and sports organizations can design more personalized and effective approaches, thereby supporting the improvement of overall athlete performance.

4. CONCLUSION

This study revealed that there was a significant relationship between blood type, somatotype, and cardiovascular endurance. Individuals with blood type O showed better endurance performance than other blood types, especially in the "good" and "fair" categories. The result suggests that blood type O may have higher oxygen transport efficiency and energy metabolism, providing advantages in endurance-based physical activities. In terms

of somatotype, mesomorphs had superior cardiovascular endurance performance compared to endomorphs and ectomorphs. This advantage is due to the more dominant proportion of muscle mass in mesomorphs, which supports metabolic efficiency and adaptation to intense physical activities. In contrast, endomorphs showed greater endurance limitations, mainly due to the higher proportion of body fat.

This technique may serve as a foundation for additional, more comprehensive study, particularly in elucidating the synergistic effects of biological and anthropometric parameters on physical performance. By utilizing blood type and somatotype data, coaches and sports organizations can formulate more tailored and effective strategies, therefore enhancing overall athlete performance.

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