Volume 4 issue 2 2024 (58-65)
Contents lists available at APSS
Journal of Advances in Para Sport Science (APSS)
Journal homepage: http://apssjournal.com/

Doi: 10.32604/mcb.2024.0xxxxx

ARTICLE

A Comparative Study of Physical Fitness Characteristics Between Male and Female Goalball Players

Fariba Mohammadi[1]*, Somayeh Mozafari[2]

[1] Department of Sport Medicine, Sport Sciences Research Institute, Tehran, Iran
[2] Department of Corrective Exercise & Sport Injury, Faculty of Physical Education and Sport Sciences, Allameh Tabataba'i University, Tehran, Iran

*Corresponding Author: Fariba Mohammadi. Email: mohammadi.ssrc@gmail.com
Received: 02-12-2024 ; Accepted: 15-01-2025 ; Published: 25-01-2025

ABSTRACT: Visual impairment significantly impacts physical activity participation, often leading to reduced fitness levels among affected individuals. This study aims to compare the physical fitness characteristics of male and female goalball athletes aged 14-20 years, a critical developmental period for performance enhancement. A total of 100 athletes (50 male, 50 female) were assessed for strength, endurance, power, flexibility, and balance through various standardized tests. Results indicated significant differences in hand grip strength, medicine ball throw distance, vertical jump, and balance, with males outperforming females ($p < 0.05$). No significant differences were found in push-up and sit-up performance, suggesting comparable endurance capabilities across genders. These findings underscore the necessity for gender-specific training regimens to address identified disparities, particularly in strength and power. The study contributes to a limited body of literature on the physical fitness of goalball players and highlights implications for inclusive training strategies that enhance athletic performance regardless of gender. Future research should explore the correlation between physical fitness attributes and on-court performance metrics to further inform coaching practices.

KEYWORDS: Talent Identification, Blind, Visually Impaired, Anthropometry.

1 Introduction

Visual impairment, commonly known as blindness and low vision, is one of the most prevalent disabilities and a significant cause of functional disability, notably impacting mobility and daily activities (1, 2). Individuals with sensory impairments, including those who are blind, are often limited in their participation in physical activities, resulting in decreased levels of physical activity, muscular strength, cardiovascular endurance, balance, and athletic performance. However, sports activities can improve the physical and psychological motor abilities of these individuals(3). Goalball is a unique and competitive team sport tailored specifically for athletes with visual impairments. Emerging in the 1940s, it has transformed into a significant event within the Paralympic Games, attracting competitors from diverse backgrounds and varying levels of skill. The athletes participating in goalball are categorized into three groups (B1, B2, and B3)

based on their visual acuity, ensuring a fair competitive environment(4). Goalball places a strong emphasis on teamwork, strategy, and physical fitness. Players must rely on their auditory senses to track and defend against the ball, which is embedded with bells, as they work closely with teammates to execute defensive and offensive strategies. The development of physical fitness characteristics such as strength, endurance, and coordination is crucial for excelling in goalball, as these factors significantly impact performance on the court. Superior physical conditioning enables players to react swiftly, maintain balance, and move efficiently across the playing area, directly influencing game outcomes(5-7). Physical fitness in goalball is composed of several crucial components: strength, endurance, power, flexibility, and body composition. Each component significantly influences overall performance in the sport(8, 9). For example, upper body strength is essential for executing powerful throws and effective blocks, flexibility improves movement efficiency, and maintaining an optimal body composition is important for overall athletic performance and injury prevention(8, 10, 11)

Research highlights that physical fitness is a fundamental determinant of performance in team sports, including goalball (6, 12, 13). However, the physical demands of the sport may vary between male and female athletes due to physiological and anatomical differences. Understanding these distinctions is essential for coaches and trainers to design effective training programs tailored to the specific needs of each gender (14). For further insights into the impact of physical fitness on goalball performance and the differences between genders, you may refer to the studies mentioned.

Despite being played under similar rules by both male and female athletes, differences in biological, psychological, and sociocultural factors likely lead to performance variances. Research on gender differences in sports generally points to physiological and biomechanical variations, which could also manifest in goalball, affecting aspects such as speed, strength, power, and endurance(15-17). Strength and Power Output. In sports that require strength and explosive power, such as goalball, men typically outperform women due to larger muscle mass and greater testosterone levels. Studies on elite male and female goalball players confirm that men tend to have higher throwing velocities. This discrepancy is linked to greater upper-body strength in men, which allows them to deliver faster and more forceful throws. A study by Molik et al. (2015) found that male goalball players exhibited faster ball speeds and a higher frequency of power throws compared to their female counterparts. This suggests that men may have an advantage in the offensive aspects of the game(16).

Despite the growing body of literature on physical fitness in sports, there is limited research specifically addressing the physical fitness characteristics of goalball athletes, particularly concerning gender differences. This study aims to fill this gap by comparing the physical fitness characteristics of female and male goalball athletes aged 14 to 20 years, utilizing a statistical population of 50 male and 50 female athletes. This age group represents a critical developmental period in sports, where tailored training can lead to significant performance improvements and skill development.

2 Methods

2.1 Participants

This research is categorized as a cross-sectional and observational study aimed at comparing the physical fitness characteristics of both female and male goalball athletes with visual impairments and blindness. The study included 100 goalball athletes aged 14 to 20 years, evenly divided into 50 female and 50 male participants.

After a thorough assessment of the inclusion criteria (having a minimum of three years of experience in goalball, participation in the national goalball league, and attending three regular training sessions per week) and the exclusion criteria (the presence of cardiovascular and respiratory diseases, the use of specific medications, severe physical injuries, a history of surgeries that resulted in disabilities, and dissatisfaction with continued participation), the consent forms for participation in the research were signed by the athletes and their coaches. Consequently, the selected athletes were included in the study.

2.2 Measurement and Tools

The physical fitness assessments included:

Strength: The hand grip strength test was conducted using a dynamometer tailored to fit the participant's palm (18). Athletes exerted maximum effort to squeeze the dynamometer while standing, first with the right hand and then with the left, following a rest period. Each test was repeated twice, with a one-minute interval between attempts (19).

Endurance: Muscle endurance was evaluated through the push-up and sit-up tests. For the push-up test, after providing the necessary instructions, participants were asked to place their hands on the ground at a distance of 10 to 20 centimeters wider than shoulder width, ensuring that their bodies were in a straight line. They were instructed to lower themselves by bending their elbows until a 90-degree angle was formed, then return to the starting position. The number of correctly executed push-ups within a 60-second timeframe was recorded as their score(20). In the sit-up test, following the necessary instructions, participants lay on the ground with their knees bent and their arms crossed over their chest. Upon receiving the command from the tester, they began performing the sit-up movement. A repetition was counted as valid when the participant lifted their spine off the ground, making contact between their elbows and knees, and then returned fully to the ground. The total number of sit-ups completed within one minute was recorded as the participant's score(20).

Power: To evaluate upper body muscular power, the medicine ball throw test was utilized. This test was conducted twice, allowing for a one-minute rest period between attempts, with the best result recorded for each participant(18). For assessing lower body explosive power, the vertical jump test (Sargent test) was employed. In this test, participants stood on their feet and stretched their bodies to reach as high as possible, marking a spot on the wall with their middle finger. They then assumed a jumping stance and, with optimal balance, jumped upward as high as they could. At the peak of their jump, they touched the wall again, leaving a second mark above the initial one. The distance between these two marks, measured in centimeters, was recorded as the participant's score. This test was also performed twice, with a one-minute rest interval between attempts, and the best result was noted for each individual(21).

Flexibility: The sit and reach test was employed to evaluate flexibility. In this test, the participant lay flat on the ground, extending their arms fully in front of their body, with the palm of one hand resting atop the other. They then leaned forward, aiming to bring their fingertips as close as possible to their toes, bending forward to their maximum extent. The distance from the fingertips to the toes was recorded separately for each foot. This test was performed twice, with a one-minute rest interval between attempts, and the best result for each participant was documented(18).

Balance: The stork balance stand test (standing on one leg) was utilized to measure balance. For this test, the participant stands on one leg, with their eyes closed and hands placed on their hips. The duration of balance, measured in seconds, is recorded using a stopwatch. The test concludes when the participant

either loses their balance on the supporting leg, moves their foot, or raises their arms away from their body in an attempt to maintain stability(22).

2.3 Data analysis

The study data were analyzed using SPSS Version 26. Descriptive statistics were first calculated, followed by the Shapiro–Wilk test to evaluate whether continuous variables adhered to a normal distribution. A significant difference was observed between them. Therefore, the result of the data analysis indicated that the data did not follow a normal distribution. The Mann-Whitney U test was then used for comparisons between groups. A significance level of $p < 0.05$ was established(Table 3).

3 Results

The study aimed to compare the physical fitness characteristics of female and male goalball athletes aged 14-20 years, using a statistical population of 50 male and 50 female athletes. This section presents both descriptive and inferential statistics regarding the various fitness components assessed: strength, endurance, power, flexibility, and balance(Tables 1 and 2).

Table 1. Demographic characteristics of the participants

Variable	Group	Mean (±SD)
Age (years)	male	16.58±2.31
	female	16.54±3.13
Weight (kg)	male	66.37±30.26
	female	53.68±12.61
Standing Height (cm)	male	167.44±15.51
	female	157.38±8.60
Sitting Height (cm)	male	85.16±7.08
	female	80.81±7.88
Body Mass Index (cm2/kg)	male	469.56±118.93
	female	483.53±98.28
Arm Span (cm)	male	172.18±11.09
	female	207.26±14.04
Defensive Height (cm)	male	225.06±24.85
	female	207.26±14.044
Waist-to-Hip (mm)	male	.808±.090
	female	.921±.89

Table 2. Fitness component

Fitness component	Group	Mean (±SD)
Hand Grip Strength (kg)	male	33.04±9.49
	female	20.40±5.62
Push-Ups (number)	male	21.18±12.28

	female	21.59±11.31
Sit-Ups (number)	male	29.34±14.19
	female	23.55±10.11
Medicine Ball Throw (m)	male	6.28±5.06
	female	4.10±.97
Vertical Jump (cm)	male	27.58±9.32
	female	19.46±7.46
Flexibility (cm)	male	35.25±8.76
	female	33.79±8.23
Balance (seconds)	male	24.80±22.057
	female	16.57±25.38

Table 3. Independent Mann-Whitney U test

Fitness component	**df**	**p-value**
Hand Grip Strength (kg)	١٠٠	0/001
Push-Ups (number)	١٠٠	0/822
Sit-Ups (number)	١٠٠	0/053
Medicine Ball Throw (m)	١٠٠	0/001
Vertical Jump (cm)	١٠٠	0/001
Flexibility (cm)	١٠٠	0/399
Balance (seconds)	١٠٠	0/008

This study examined the differences between groups across several physical performance indicators. The results of the statistical tests show that there are significant differences between the groups in the variables of balance, vertical jump, medicine ball throw, and hand grip strength ($p < 0.05$). These findings indicate that the groups differ significantly in these indicators. However, in the variables of flexibility, push-ups, and sit-ups, no significant differences were observed ($p > 0.05$). Overall, some physical performance indicators demonstrated notable differences between the groups.

5. Discussion and Conclusion

This study sought to assess the physical fitness attributes of male and female goalball athletes, with a particular emphasis on measures of strength, endurance, power, flexibility, and balance. The results reveal several notable differences in components of physical performance, along with some areas of similarity, providing valuable insights into how gender-specific characteristics may shape physical abilities in young goalball players. This discussion interprets the findings within the framework of previous research on gender differences in athletic performance, highlighting implications for training and development strategies in goalball.

The study found significant differences in hand grip strength and the medicine ball throw test between male and female athletes, with males scoring higher ($p = 0.001$). This aligns with known physiological differences in muscle mass and upper body strength that typically favor males in power-based tests(23-25). Enhanced hand grip strength in males may lead to faster, more powerful throws in goalball, crucial for offensive plays (26-28). Additionally, males demonstrated superior vertical jump performance ($p = 0.001$), reflecting expected gender distinctions in explosive leg power. This disparity may be linked to higher testosterone levels and muscle fiber distribution in males. While jumping isn't directly relevant to gameplay, lower body power aids in agility and stability(29-31). To address these performance gaps, the study suggests that female athletes could benefit from targeted upper-body strength conditioning and lower-body plyometric training.

Balance was another component where male and female athletes showed significant differences, with male athletes demonstrating superior balance scores ($p = 0.008$). The underlying causes of this difference might be linked to physical conditioning, proprioception, and stability training common in male athletic programs. This advantage in balance could provide male athletes with enhanced positional control during rapid movements in goalball, aiding both offensive and defensive tasks(5, 13). For female athletes, the findings suggest that targeted balance training could enhance stability and potentially offset disadvantages in reaction time or defensive response(32).

Surprisingly, no significant differences emerged between male and female athletes in push-ups ($p = 0.822$) and sit-ups ($p = 0.053$), implying similar endurance levels across genders. This may suggest that among young athletes, specific measures of endurance and core strength evolve comparably, likely due to parallel training exposure and the aerobic demands of endurance activities. Flexibility scores also indicated no significant gender differences ($p = 0.399$), which might result from similar training practices promoting flexibility or naturally smaller gender variations in flexibility, especially in lower limb and core flexibility essential to goalball.

The consistency in flexibility and endurance findings implies that both male and female goalball athletes might equally benefit from conditioning exercises focused on core stability, upper body endurance, and general flexibility, irrespective of gender(33). These results support the increasing evidence suggesting that, in sports prioritizing core strength, stability, and endurance, training outcomes might be less affected by gender than previously believed(34). This has substantial implications for creating inclusive training programs that cater to the needs of all athletes, emphasizing individual athletic growth over gender-based adaptations.

In particular, coaches should consider integrating balance exercises for female athletes to improve defensive maneuvers, while introducing explosive power drills for both upper and lower body muscles. By targeting these specific areas, training programs can enhance both male and female athletes' capabilities, leading to more balanced and effective performances in competitive goalball.

In summary, this study identified significant gender differences in physical fitness components among young goalball players, specifically in hand grip strength, medicine ball throw distance, vertical jump, and balance. These differences reflect broader physiological distinctions and emphasize the need for gender-specific training adaptations in goalball. By tailoring conditioning programs to address these differences, coaches can enhance performance and promote equity between male and female athletes in competitive settings.

Limitations and Future Research Directions

This study, while providing critical insights, is limited by its focus on physical fitness without a direct measure of gameplay performance. Future studies could examine how these physical fitness differences translate to in-game metrics, such as successful defensive blocks or throwing accuracy. Moreover, psychological factors such as anxiety, confidence, and team cohesion—already known to vary by gender—could also be included in future analyses to provide a more comprehensive understanding of gender differences in goalball performance.

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