

Assessing positional variations in key physical fitness components of elite field hockey players

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ABSTRACT

Field hockey is an intense team sport that requires different physical demands depending on playing positions. Each position-defender, midfielder, forward-requires different aspects of physiology in terms of strength, speed, endurance, agility and flexibility for optimal performance. The aim of this study was to evaluate positional differences in key components of physical fitness among male elite field hockey players. Thirty male players (aged 18-22 years old) were divided into positional groups: defenders, midfielders, and forwards (n = 10 each). Five components of physical fitness were assessed: explosive power (standing broad jump), flexibility (sit-and-reach), agility (agility run test), sprint speed (40-yard sprint), and aerobic endurance (Cooper 12-minute run). The data were analyzed with a one-way Anova with post hoc LSD tests for differences by position. Positional differences in sprint speed and aerobic endurance were significant ($p < .05$). Midfielders achieved higher sprint performance than defenders and forwards, which points to quick transitions. Defenders achieved higher aerobic endurance than midfielders and forwards, which is in agreement with the sustained nature of their role in defense. In explosive power, flexibility, and agility, no significant positional differences were found. The present study has established that there exist different physical fitness profiles based on playing position in field hockey with the underlying requirement for speed in midfielders and endurance in defenders. In order to achieve improvement in performance, but also reduce the risk of injuries and fulfill tactical needs, position-specific training programs are necessary. Such specific conditioning will help optimize effectiveness during a field hockey match.

Keywords: Field hockey, Playing position, Physical fitness, Performance assessment, Positional differences.

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INTRODUCTION

In field hockey, physical fitness is important because of the high-intensity nature of the game and various performance qualities required (Bashir et al., 2024). The best performance observed comes from a combination of body composition, muscular strength, and endurance. Major components include BMI, predicted VO_{2max} , core strength assessed by sit-ups, and speed via a 20 m sprint; all these are important in high-intensity actions and maintaining performance during a match (Razali et al., 2017). Time-motion analysis of elite players demonstrates that although a substantial amount of the game is covered at low intensities, repeated-sprint ability is important for quick responses and maintenance of performance during periods of intense exercise (Spencer et al., 2004; Islam et al., 2024). Elite players travel a considerable distance at high intensity, so individual conditioning programs should reflect specific positional demands (Lythe & Kilding, 2011; Singh et al., 2024). Proper conditioning ensures that the players' fitness profiles match the physical and tactical role or roles within their respective positions for the good of the entire team. Other team sports, such as basketball, have supported this, with centres and forwards showing varied physical and tactical profiles that influence their performances throughout the season (Ibáñez et al., 2023). Coaches are better able to create training plans that emphasize strengths and weaknesses as a result of these positional differences. For example, it has been demonstrated that high-intensity interval training can improve team-sport athletes' overall performance and oxygen consumption (Atakan et al., 2021). Therefore, improving fitness for the best field hockey performance requires position-specific, scientifically organized training. In the fast-paced team sport of field hockey, players must execute intricate skills under a range of physical demands in relation to various playing positions. Due to the various tactical and physiological demands of competitive play, each of the corresponding positional roles—forwards, midfielders, and defenders—has particular physical fitness requirements (Slimani & Nikolaidis, 2019; Reilly & Borrie, 1992).

The greater the understanding of positional differences in physical fitness components, the better the chances of assuring optimized performance with minimal injury risk through appropriate, specific conditioning (Thelen & Koppenhaver, 2015). While defenders mainly focus on strength and stability to hold defence positions and intercept the opponent team, midfielders and forwards require higher aerobic endurance and anaerobic power to maintain continuous movements, fast sprints, and offensive skill performances throughout a match (Powell et al., 2023). This divergence shows the heterogeneity of physical demands due to tactical roles and contexts of matches (Gabbett & Mulvey, 2008; Reza et al., 2024). Aerobic capacity is one of the basic components for both male and female field hockey players to sustain their performances throughout a prolonged period of a match (Peterson et al., 2015). Midfielders usually cover the longest distances during the game, so they have increased demands for aerobic endurance (Modric et al., 2020). The Cooper test and Yo-Yo intermittent recovery tests are popular field tests for aerobic fitness in this population (Schmitz et al., 2018; Krstrup et al., 2003). Improved aerobic fitness enables quicker recoveries between repeated high-intensity efforts while increasing overall work rate (Tomlin & Wenger, 2001). Speed and sprint performance become key success factors for duels and scoring opportunities (Vescovi, 2014). The 40-meter sprint is one test that is commonly used to assess hockey players' maximum velocity and acceleration (Tønnessen et al., 2011).

Midfielders and forwards need to have explosive sprinting capacity to perform quick transitions to offense, while defenders rely on short sprints with greater emphasis on agility and positioning for defence (Khatri et al., 2025). Plyometric exercises and standing broad jump tests provide an assessment of the explosive power of the lower body, which is highly important during these rapid movements (Chandra et al., 2023). Agility and flexibility are other relevant physical characteristics for performance and injury prevention on the field. Agility tests of change of direction speed capture important dimensions of hockey-specific movement patterns

(Kozlenia et al., 2020). Flexibility, as normally measured through the sit-and-reach test, underlies the joint range of motion to perform technical skills such as dribbling and shooting (Antara et al., 2023; Rahman & Islam, 2020). However, flexibility demonstrates less positional variation than endurance or sprint capacity (Kelly et al., 2018). Anthropometric differences are influential for positional physical fitness profiles (Villaseca-Vicuña et al., 2021). While midfielders and forwards have leaner bodies to maximize speed and endurance, defenders typically have a more robust somatotype to allow strength and balance (Reilly et al., 2000). Fitness training adaptations and biomechanics are influenced by these morphological traits (Folland & Williams, 2007).

Position-specific conditioning programs focusing on these different fitness components have been shown to improve match performance parameters such as more high-intensity running, a higher frequency of sprinting, and better recovery aerobically (Gupta et al., 2025). Innovations in wearable technology and GPS analyses now provide accurate means to quantify such positional demands to further help in individualizing training protocols (Cummins et al., 2013). Despite growing recognition of positional fitness variation in field hockey, there are still limited comprehensive studies on multicomponent analysis in this respect and linking it to training recommendations (Singh & Mitra, 2020). This would involve aerobic endurance, sprint speed, agility, power, and flexibility assessed together to provide a global perspective on player capabilities by position and support evidence-based conditioning (Senthil Kumar et al., 2023; Mola et al., 2025).

The aim of this study is to compare the selected physical fitness components of defenders, midfielders, and forwards in field hockey players. This investigation aims to find distinct quantitative fitness profiles for each position on tests such as the 40-meter sprint, Cooper test, standing broad jump, sit-and-reach, and agility for data-driven, position-specific training interventions.

METHODOLOGY

Subjects

Thirty male field hockey players (N = 30) between the ages of eighteen and twenty-two made up the group. They were hired from Bangladesh's national sports institute, Bangladesh Krira Shikkha Protishtan. Based on their primary roles, the players were divided into three position groups: forwards (n = 10), midfielders (n = 10), and defenders (n = 10). All participants had at least three years of continuous training and had taken part in institutional and national field hockey tournaments. Before participating, each player had a routine medical check-up by the institute's sports medicine unit to ensure they were healthy and free from injuries.

Table 1. Baseline characteristics of the participants.

Variables	Group	n	Mean	Std. Deviation
Age	Defenders	10	19.10	1.52
	Midfielders	10	18.70	1.25
	Forwards	10	19.40	1.07
Height	Defenders	10	170.69	4.77
	Midfielders	10	173.48	3.80
	Forwards	10	170.43	7.89
Weight	Defenders	10	54.10	2.69
	Midfielders	10	60.00	2.75
	Forwards	10	56.90	8.21
BMI	Defenders	10	18.58	0.75
	Midfielders	10	19.93	0.63
	Forwards	10	19.54	1.86

Variables and test procedures

The current study assessed five critical factors of physical fitness that pertain to field hockey including: sprint speed, agility, flexibility, explosive leg strength, and aerobic endurance. All of the variables were measured through standardized field tests conducted in the morning on the BKSP outdoor hockey turf, while environmental conditions were managed to minimize variability. To minimize the effects of fatigue on the standardized tests, a ten minute standard warm-up preceded all the standardized tests and there were sufficient rest intervals between tests.

The Standing Broad Jump test was applied to measure explosive power. In preparation for the Standing Broad Jump, participants assumed the position of standing behind a take-off line, feet shoulder-width apart and executed a maximum horizontal jump (horizontal reach) using both legs. The distance in centimetres between the starting line and the nearest point of contact upon landing was measured, and the best effort out of the three was recorded (Krishnan et al., 2016). The Sit-and-Reach Test is utilized to evaluate hamstring and lower back flexibility. All participants sat on the floor with the legs outstretched in front of a sit-and-reach box, as they reached as far forward as they could while keeping their knees straight. Each participant was scored based on how far they could reach to the nearest centimetre, measured from two trials (Wells & Dillon, 2013). Agility was assessed by the Agility Run test, which is an appropriately designed task that evaluates speed over ground and coordination in directional changes. Participants start in a prone position, run 10 meters to tap a line, return to tap the start line again and navigate around and between two sets of cones, weaving to the finish line. Participants had two trials recorded on a stopwatch for their time, and the fastest trial in which the lines were adhered to and no cone was displaced (Raya et al., 2013). Sprint speed was assessed by the 40-Meter Sprint Test, which consisted of two maximal condition sprints, starting from a stationary position over 40 meters and electronically timed to the closest 0.01 second. Only the fastest trial was measured for analysis (Kemp, 2010). Finally, the Cooper 12-Minute Run Test was your method of measuring aerobic endurance on a standard 400-meter track. Participants were instructed to run or jog continuously for as much distance as possible for 12 minutes. The further distance, in meters was recorded as indication of the subjects aerobic capacity (Penry et al., 2011).

Data analysis

Data were analysed using IBM SPSS Statistics software, version 27. Descriptive statistics included mean, standard deviation, standard error, minimum, and maximum values for each positional group (defenders, midfielders, and forwards). A one-way Anova was conducted to compare the selected physical fitness components across the three groups. Where the Anova showed significant differences among the variables, $p < .05$, a post-hoc LSD test was run to indicate specific pairwise group differences. The chosen significance level for this research was set at $p < .05$. Tests included the standing broad jump, sit-and-reach flexibility, agility, 40-meter sprint, and the Cooper test on aerobic endurance.

RESULTS

Table 2 presents the descriptive statistics (mean, standard deviation, minimum, and maximum) of field hockey players for defenders, midfielders, and forwards.

A one-way analysis of variance (Anova) (Table 3) was conducted to compare the performance of defenders, midfielders, and forwards on selected physical fitness variables. There were no significant differences among the groups in standing broad jump, $F(2, 27) = 0.05$, $p = .95$; sit and reach, $F(2, 27) = 2.03$, $p = .15$; and agility, $F(2, 27) = 2.41$, $p = .11$. However, a significant difference was found in the 40 m sprint, $F(2, 27) = 10.18$, $p =$

.001, and in the Cooper test, $F(2, 27) = 7.33$, $p = .003$. These results indicate that sprinting and aerobic endurance performance differed significantly among defenders, midfielders, and forwards.

Table 2. Descriptive statistics.

Variables	Group	n	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Standing broad jump	Defenders	10	221.00	15.87	5.02	205.00	260.00
	Midfielders	10	226.56	79.90	25.27	2.60	267.00
	Forwards	10	227.40	20.71	6.55	200.00	270.00
Sit and reach	Defenders	10	7.70	1.77	0.56	6.00	12.00
	Midfielders	10	6.70	1.16	0.37	5.00	9.00
	Forwards	10	6.70	0.67	0.21	6.00	8.00
Agility	Defenders	10	13.63	0.47	0.15	13.19	14.45
	Midfielders	10	13.06	1.01	0.32	11.50	14.41
	Forwards	10	13.74	0.64	0.20	12.50	14.58
40m Sprint	Defenders	10	5.77	0.24	0.08	5.50	6.30
	Midfielders	10	5.37	0.21	0.07	5.00	5.67
	Forwards	10	5.78	0.25	0.08	5.50	6.25
Cooper test	Defenders	10	3225.00	85.80	27.13	3050.00	3300.00
	Midfielders	10	2935.00	221.17	69.94	2450.00	3300.00
	Forwards	10	3110.00	176.07	55.68	2800.00	3350.00

Table 3. One-way Anova of foundation mental skills of hockey players.

Variables	Groups	Sum of Squares	df	Mean Square	F-ratio	p-value
Standing broad jump	Between Groups	241.931	2	120.965	0.051	.950
	Within Groups	63585.824	27	2355.031		
Sit and reach	Between Groups	6.667	2	3.333	2.032	.151
	Within Groups	44.300	27	1.641		
Agility	Between Groups	2.667	2	1.333	2.413	.109
	Within Groups	14.920	27	0.553		
40m Sprint	Between Groups	1.086	2	0.543	10.182	.001
	Within Groups	1.439	27	0.053		
Cooper test	Between Groups	426500	2	213250	7.330	.003
	Within Groups	785500	27	29092.593		

Note. *. Significant at .05 level.

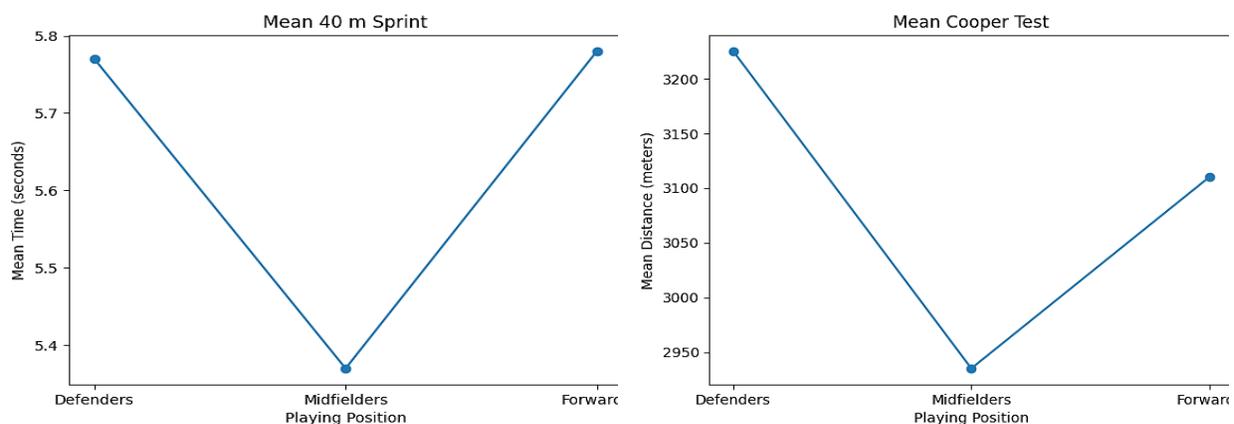


Figure 1. Mean plots of significant variables.

Table 4. Post-hoc (LSD) test.

Variable	Group	Group	Mean Difference	Std. Error	Sig.
40m Sprint	Defenders	Midfielders	.40100*	0.10325	.001
		Forwards	-0.00500	0.10325	.962
	Midfielders	Defenders	-.40100*	0.10325	.001
		Forwards	-.40600*	0.10325	.001
	Forwards	Defenders	0.00500	0.10325	.962
		Midfielders	.40600*	0.10325	.001
Cooper test	Defenders	Midfielders	290.00000*	76.27921	.001
		Forwards	115.00000	76.27921	.143
	Midfielders	Defenders	-290.00000*	76.27921	.001
		Forwards	-175.00000*	76.27921	.030
	Forwards	Defenders	-115.00	76.27921	.143
		Midfielders	175.00000*	76.27921	.030

Table 4 shows the specific group differences identified through a post hoc least significant difference (LSD) test conducted for the variables that showed significant effects in the Anova (40 m sprint and Cooper test). For the 40 m sprint, significant differences were found between defenders and midfielders ($p = .001$) and between midfielders and forwards ($p = .001$). Midfielders ($M = 5.37$ s) demonstrated significantly faster sprint times than both defenders ($M = 5.77$ s) and forwards ($M = 5.78$ s). For the Cooper test, defenders ($M = 3225.00$ m) performed significantly better than midfielders ($M = 2935.00$ m), $p = .001$. Additionally, forwards ($M = 3110.00$ m) covered a significantly greater distance than midfielders ($p = .030$), though the difference between defenders and forwards was not significant ($p = .143$). These findings indicate that midfielders showed lower aerobic endurance compared to defenders and forwards.

DISCUSSION

The present study results showed that no positional differences existed in the variables of standing broad jump, flexibility, and agility, which reflect equal explosive strength and sprint compared to defenders and forwards since their role requires them to engage in quick transition. The defenders have a relatively high level of aerobic fitness which could be measured through the Cooper test due to their sustained and repetitive involvement. Thus, a position-specific conditioning program – sprints for midfielders and enhancing defenders' agility level – is of utmost importance. The above study further revealed that there are obvious physiological and morphological differences among the positions. The midfielders possessed a higher degree of anaerobic and peak power, representing the intense and intermittent actions required of the position (Bujnovsky et al., 2015). The goalkeepers have been shown to possess a high level of body fat while the forwards possess a high level of lean mass to enable agility and speed performance; this represents the importance of position-orientated conditioning training (Slimini et al., 2017). Likewise, in GPS data analysis, midfielders completed high-intensity runs, while defenders completed lower intensity runs over longer distances (Strauss et al., 2019). Finally, the longitudinal findings presented that midfielders possess a high degree of aerobic and anaerobic capacity, representing the intensity required of the position in withstanding opponent transitions (Modrić et al., 2020). This further reinforces that the sole training of defenders must be aerobic capacity, midfielders should train for anaerobic power, and forwards require a combination of training. The enhanced sprint capacity of midfielders aligns with other studies that demonstrate the importance of speed and the frequent occurrence of sprints for quick transitions (Gupta et al., 2025). Other studies also indicate that sprint intensity and occurrences are elevated in midfielders, thereby expanding the knowledge of anaerobic and sprint training that better equips such players for the dynamic task required of them (Shalfawi, 2015). The enhanced aerobic endurance of the defenders found within the existing study aligns

with other studies that indicate a high cardiovascular stress level and longer times engaged within the defending actions of a match, regardless of whether the match is (Egger et al., 2025; Hoff et al., 2002). Based on the gradually longer duration of the match and the level of the heart rate response, performance and recovery mechanisms could have been sustained through continued and interval training (Cao et al., 2025; Hottenrott et al., 2012). The flexibility level is the same for all positions and was mentioned in previous works as a common characteristic for all field sports in order to avoid injuries and for good movement performance (Gleim & McHugh, 1997; Koźlenia & Domaradzki, 2021). Anthropometric research also confirms midfielders have more body mass and height that are useful for versatility, while defenders and goalkeepers possess features that are useful for stability with the maintenance of defensive coverage (Kubayi et al., 2017; Leão et al., 2019; Joksimović et al., 2020). Overall, the findings demonstrate that while sprint speed is crucial for midfield players and aerobic endurance is crucial for defenders, strength, agility, and flexibility serve as the foundation for all field hockey players. In order to maximize performance, reduce the risk of injury, and meet the demanding tactical demands of contemporary field hockey, position-specific conditioning programs have thus become an individualized requirement of the sport.

CONCLUSION

According to the current study, field hockey players have different physical fitness profiles based on where they play, with midfielders requiring more speed and defenders requiring more endurance. As a result, position-specific training plans are essential for enhancing performance, reducing the chance of injury, and meeting tactical needs. Field hockey performance can be significantly improved with this type of targeted training.

AUTHOR CONTRIBUTIONS

Md. Azadul Islam led the overall conception, design, and planning of the study. He established the research objectives, provided continuous academic supervision throughout the investigation, and finalized the manuscript for publication. Md. Ashikuzzaman contributed to the conception and design of the study and was primarily responsible for data collection. He also prepared the tables and figures, drafted the initial manuscript, and participated in revising and finalizing the paper. Md. Rayhan Rakib contributed to the conception and design of the study and conducted the data analysis. He assisted in preparing the tables and figures, drafting the manuscript, and revising and finalizing it for publication. Leo Louma contributed to the conception and design and was involved in data analysis. He also supported the preparation of tables and figures and participated in drafting, revising, and finalizing the manuscript. Md. Arman Gazi contributed to the conception and design of the study and performed data analysis. He assisted in preparing the tables and figures and contributed to drafting, revising, and finalizing the manuscript. Suvo Roy contributed to the conception and design and participated in data analysis. He prepared tables and figures, contributed to drafting and revising the manuscript, finalized it for publication, and served as the corresponding author. All authors made substantial intellectual contributions to this research and approved the final version of the manuscript for publication.

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