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FITNESS DEMANDS ON POSITIONAL DIFFERENCES IN HOCKEY: AN ANALYTICAL STUDY

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Abstract: The primary aim of the study was to examine the motor fitness as well as physiological characteristics of professional hockey players classified by their playing position. A total of Sixty (N=60) male hockey players who volunteered for the present study had participated in the 8th Senior National Hockey Championship 2018, Imphal with age 22.5 ± 4.5 years were categorized as goalkeepers, fullbacks, halfback and forwards. The following motor and physiological variables were measured in all groups: speed, abdominal muscular strength, agility, vital capacity, resting heart rate and VO_2 max through the administration of 50 meter dash, bent knee sit-up, illinois agility test, Spirometer digital heart monitor and queen college step test to assess motor and physiological variables among different positional field Hockey Players. The one way ANOVA was used in 0.05 levels of significance. For analysis of data, SPSS (version 23) software was used. The results revealed significant difference were found in Speed (F= 11.97, P=.000), Agility (F= 6.50, P=.001), Vital Capacity (F= 17.80, P=.000) and VO_2 max (F= 6.41, P=.001) of motor and physiological variables among different positional field hockey Player whereas insignificant difference in Abdominal Muscular Strength and Resting Heart Rate among hockey players.

Key Words: **Motor fitness, Speed, Agility, Vital Capacity, VO_2 max, Resting Heart Rate.**

1. INTRODUCTION

Hockey is a popular sport played in more than 132 countries. Hockey is played with 11 player's a-side (with a maximum of 5 extra players who can be substituted) on a rectangular, 91.40 meters long side-lines and 55 meters wide back-line. The rules of the game allow unlimited substitutions. Unique to field hockey is the semi-crouched position in which players move a large percentage of the match or training session. Today hockey is essentially a team game and has developed into a fast and highly skilful one. The game includes short bursts of speed with rest pauses or slow movements in between for a period of four quarters of 15 minutes with an interval of 2 minutes between quarter 1 and 2 and between quarter 3 and 4 and a half-time interval of 5 minutes between quarter 2 and 3.

In the game of Hockey, the players have to be very alert and active during the play. The player has to perform number of zigzag movements and straight runs with high speed, in accordance with the requirements of the game. The characteristics of modern hockey have been described as short duration attacks with fast crossing in the middle field, continuous free running of those players who are not in possession of the ball; constant changing of positions during attacks and very good physical fitness in speed, endurance, stamina and agility – the basis of modern hockey. High level of performance in sports and games might be dependent upon the physiological make up and it was recognized that physiological proficiency was needed for the high level performance. Physiological variables may be defined as those variables which are directly linked with various physiological systems such as heart rate, blood pressure, vital capacity, fat percentage, respiratory rate and haemoglobin.

Hockey is a team sport in which positional play has a considerable importance. Field positions in any game are related to the structure and pattern of the game. The rules and regulations which govern the game also influence the field positions. A player may specialize to play in a particular position. It is better if he develops skills necessary for other positions. All players should be aware of both the attacking and defensive principles of game and a player must learn from his own observations and mistakes.

2. METHODOLOGY

Subjects**:** For the purpose of the study four positional groups have been taken for the present study. A total of sixty (n=60) i.e. Goalkeepers (10), Fullbacks (15), Halfbacks (15) and Forwards (20) hockey players who have participated in 8th Senior National Hockey Championship 2018 at Imphal, with age ranging between 18 - 27 years were selected as subjects for the study. These subjects were belonging to different affiliated state unit of Hockey India.

***Selection of Variables*:**

Table 1: Selected Motor & Physiological Variables and Measuring Tools/Test

S.No.	Motor Ability Variables	Tools/Test	Criterion
1.	Speed	50 m dash	Seconds
2.	Agility	Illinois Agility Test	Seconds
3.	Abdominal Strength	Bent Knee Sit Up	Counts. Min^{-1}
4.	Vital Capacity	Spirometer	Litre
5.	Resting Heart Rate	Digital Heart Rate Monitor	Beat. Min^{-1}
6.	VO_2 max	Queen College Step Test	ml. kg^{-1}. Min^{-1}

3. STATISTICAL ANALYSIS

Descriptive statistics [mean, standard deviation] were ascertained for all motor and physiological variables. One Way Analysis of Variance (ANOVA) has been used to test the significant differences between averages of different playing positions (goalkeepers, fullbacks, halfbacks and forwards). When the differences were found to be significant, Scheffe's Post Hoc test was applied to find out the significant differences between the group means.

4. RESULTS

Table 2: Motor and Physiological Characteristics in Relation to Playing Positions

Playing Position	Speed	Abdominal Strength	Agility	Vital Capacity	Resting Heart Rate	VO_2 Max
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Goalkeeper (10)	**7.06 ± 0.21**	**48.90 ± 5.30**	**14.60 ± 0.93**	**3.63 ± 0.23**	**62.70 ± 4.45**	**57.07 ± 4.55**
Fullback (15)	**6.91 ± 0.36**	**45.20 ± 5.08**	**14.25 ± 0.98**	**3.58 ± 0.23**	**61.87 ± 4.82**	**56.45 ± 5.34**
Halfback (15)	**6.59 ± 0.47**	**45.67 ± 4.43**	**13.39 ± 0.84**	**4.40 ± 0.36**	**58.93 ± 3.33**	**63.95 ± 4.45**
Forward (20)	**6.33 ± 0.35**	**45.20 ± 4.37**	**13.37 ± 0.85**	**4.13 ± 0.46**	**62.00 ± 4.27**	**60.59 ± 5.78**
Total (60)	**6.66 ± 0.46**	**45.93 ± 4.80**	**13.80 ± 1.01**	**3.98 ± 0.48**	**61.32 ± 4.36**	**59.81 ± 5.84**

Table 2 shows the descriptive statistics of motor fitness of Speed (goalkeeper) is 7.06 ± .21; fullback is 6.19 ± .36, halfback 6.59 ± .47, forward 6.33 ± .35 and overall average speed 6.66 ± .46 respectively.

* Whereas descriptive statistics of Abdominal Muscular strength (goalkeeper) is 48.90 ± 5.30; fullback is 45.20 ± 5.08, halfback 45.67 ± 4.43, forward 45.20 ± 4.37 and overall average agility 45.93 ± 4.80.

* Whereas descriptive statistics of Agility (goalkeeper) is 14.60 ± .93; fullback is 14.25 ± .98, halfback 13.39 ± .84, forward 13.37 ± 0.85 and overall average agility 13.80 ± 1.01 respectively.

* Descriptive statistics of Vital Capacity of (goalkeeper) is 3.63 ± 0.23; fullback is 3.58 ± 0.23, halfback 4.40 ± 0.36, forward 4.13 ± 0.46 and overall average agility 3.98 ± 0.48 respectively.

* Whereas descriptive statistics of Resting Heart Rate (goalkeeper) is 62.70 ± 4.45; fullback is 61.87 ± 4.82, halfback 58.93 ± 3.33, forward 62.00 ± 4.27 and overall average agility 61.32 ± 4.36 respectively.

* Descriptive statistics of VO_2 Max of (goalkeeper) is 57.07 ± 4.55; fullback is 56.45 ± 5.34, halfback 63.95 ± 4.45, forward 60.59 ± 5.78 and overall average agility 59.81 ± 5.84 respectively

Table 3: Analysis of Variance of Motor Fitness among Positional Hockey Players

Variable		Sum of Squares	df	Mean Square	F	Sig.
Speed	Between Groups	4.87	3	1.62	11.97	.000*
	Within Groups	7.59	56	0.14		
	Total	12.46	59			
Agility	Between Groups	15.67	3	5.22	6.50	.001*
	Within Groups	44.99	56	0.80		
	Total	60.67	59			
Abdominal Muscular Strength	Between Groups	107.90	3	35.96	1.61	.198
	Within Groups	1253.83	56	22.39		
	Total	1361.73	59			
Vital Capacity	Between Groups	6.720	3	2.24	17.80	.000*
	Within Groups	7.047	56	0.13		
	Total	13.767	59			
Heart Rate (Rest)	Between Groups	118.217	3	39.41	2.20	.099
	Within Groups	1004.767	56	17.94		
	Total	1122.983	59			
VO_2 max	Between Groups	514.275	3	171.43	6.41	.001*
	Within Groups	1498.467	56	26.76		
	Total	2012.742	59			

0.05 level of significance **(3, 56 = 2.76)**

Table-3 showed that significant differences were found in motor fitness of Speed (F= 11.97, P=.000) & Agility (F= 6.50, P=.001) and also in physiological variables of Vital Capacity (F= 17.80, P=.000) & VO_2 max (F= 6.41, P=.001) among Hockey Player of different playing position as calculated values were found greater than the tabulated F value (F = 2.76) at .05 level of significance. Whereas insignificant difference was found in the Abdominal Muscular Strength and Resting Heart Rate among positional of hockey players as calculated F value was found lower than the tabulated F value at .05 level of significance.

Since the significant difference was found in three variables namely Speed, Agility, Vital Capacity and VO_2 max; further Scheffe's Post Hoc test was applied and shown in table 4, 5, 6 & 7.

Table 4: Post Hoc Test for Speed among Positional Hockey Players

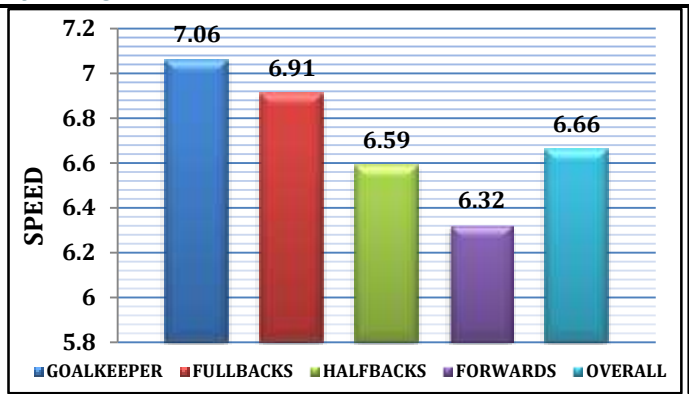
Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Speed	Goalkeeper	Fullback	0.14	0.15	.819
		Halfback	0.47*	0.15	.030
		Forward	0.73*	0.14	.000
	Fullback	Halfback	0.32	0.13	.138
		Forward	0.59*	0.13	.000
	Halfback	Forward	0.27	0.13	.224

Table 4 shows that significant different were found in speed with goalkeepers & halfbacks, goalkeepers & forwards, halfback & forward hockey players at 0.05 level of significance; whereas no significant difference was found between goalkeepers & fullback hockey players, fullback & halfback hockey players, and halfback & forward hockey players. A means comparison of speed of goalkeepers, fullbacks, halfbacks and forwards of men hockey is presented graphically in Figure I.

Table 5: Post Hoc Test for Agility among Positional Hockey Players

Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Agility	Goalkeeper	Fullback	0.35	0.37	.825
		Halfback	1.21*	0.37	.019
		Forward	1.23*	0.35	.009
	Fullback	Halfback	0.86	0.33	.088
		Forward	0.89*	0.31	.049
	Halfback	Forward	0.27	0.31	1.00

Table 5 shows that goalkeepers has significant different in agility with halfbacks & forwards hockey players and also found significant different between fullback & forward hockey players at 0.05 level of significance; whereas no significant difference was found between goalkeepers & fullback, fullback & halfback and halfbacks & forwards hockey players. A means comparison of agility of goalkeepers, fullbacks, halfbacks and forwards of men hockey is presented graphically in figure II.



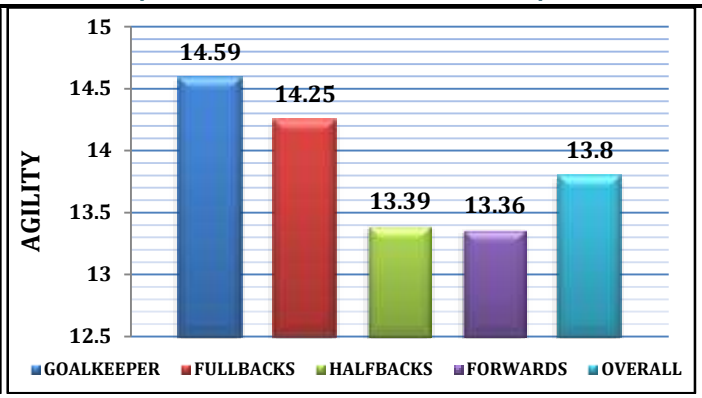


Figure I & II: Mean Comparison of Speed and Agility among Positional Hockey Players

Table 6: Post Hoc Test for Vital Capacity among Positional Hockey Players

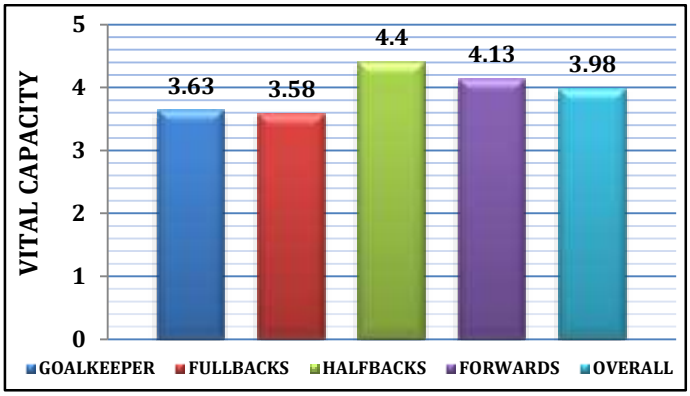
Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Vital Capacity	Goalkeeper	Fullback	0.05	0.15	.989
		Halfback	-0.77*	0.15	.000
		Forward	-0.50*	0.14	.007
	Fullback	Halfback	-0.82*	0.13	.000
		Forward	-0.55*	0.12	.001
	Halfback	Forward	0.27	0.12	.187

Table 6 shows that goalkeepers has significant different in Vital Capacity with halfbacks & forwards hockey players and also significant differences were between fullback & forward, fullback & forward hockey players at 0.05 level of significance, whereas no significant difference was found between goalkeepers & fullback, halfbacks & forwards hockey players. A means comparison of agility of goalkeepers, fullbacks, halfbacks and forwards of men hockey is presented graphically in figure III.

Table 7: Post Hoc Test for VO_2 max among Positional Hockey Players

Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
VO_2 max	Goalkeeper	Fullback	0.62	2.12	.993
		Halfback	-6.89*	2.11	.020
		Forward	-3.53	2.00	.385
	Fullback	Halfback	-7.50*	1.89	.003
		Forward	-4.14	1.77	.152
	Halfback	Forward	3.36	1.77	.317

Table 7 shows that significant differences were found in VO_2 max between goalkeeper & halfbacks and fullback & forwards hockey players at 0.05 level of significance, whereas no significant difference were found between goalkeepers with fullback & halfbacks & forwards; fullbacks & forwards and halfback & forwards hockey players. A means comparison of agility of goalkeepers, fullbacks, halfbacks and forwards of men hockey is presented graphically in figure IV.



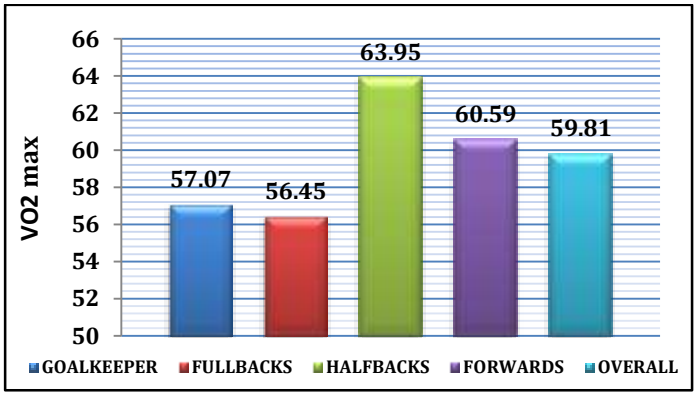


Figure III & IV: Mean Comparison of Vital Capacity and VO_2 max among Positional Hockey Players

5. DISCUSSION OF FINDING

With a comprehensive competition in hockey, the game has today become highly demanding and the role of each player at every position has been well specified. Motor and physiological abilities were studied to examine the distinguishing characteristics of elite hockey players in relation to their playing position. It was concluded that the combination of motor fitness characteristics and the physiological feature observed allow players to best meet the demands imposed on them by their position.

The findings of the present study in comparing the motor fitness demands among field hockey players at different positions shows the following results and are discussed below.

In the above statistical analysis, it was found that the speed of the forward players were better than other positional players namely, goalkeepers, fullbacks and midfielders. Modern Hockey is a game of speed and power. The forwards must be ready to run fast, to stop quickly, to turn around fast, to change the direction quickly, the must be agile and fast. The use of speed is very much needed for the forwards. Most of the time forward players have to run faster during the Match, whereas the fullbacks and midfielders have to serve and pass the ball to the forwards. By running fast to convert the ball into goal, overtaking the defence players of their opponents, they forward players must have good speed. Due to the above said reasons, the speed of the Men Hockey forward players were found better than the other field players of goalkeepers, fullbacks and mid-fielders. However, due to the lack of critical literature related to the study of speed on positional hockey player could not compare with the present study. But in terms of average speed of the present study were well comparable with the values (6.21 sec) of national players of Singh, K & Kumar, R (2018) and Bhalla, Dhruv (2019) of previous reported studies.

The results of the present study suggested that agility of forwards hockey players were found higher than halfbacks, fullback and goalkeepers. It was also seen that halfback hockey player's agility was better than fullbacks and goalkeepers. Changing position and direction of the body quickly at a higher speed is very much useful in Hockey. It may also provide insight into the physical qualities important for success in that position, while also providing a greater understanding of the factors limiting performance for those players. The forward players in field hockey require tremendous speed and agility in order to dodge, penetrate into the shooting circle, dive and deflect or to shoot the ball into the goal with variations in skill. Hence they have shown high degree of agility than other positional players. Forwards have also exhibited more agility than halfbacks, fullbacks and goalkeeper as the basic duties of halfbacks, fullbacks and goalkeeper are more confine in defensive play and more conscious and hold more responsibility in execution of delay strokes. However there is lack of critical literature related to the study of agility on positional hockey player could not compare with the present study. But the result of the studies was consistent with the result of Boone et al. (2012); in which forwards were significantly faster than goalkeepers, fullbacks and halfbacks. In another study, Gil, S.M. et al. (2007) it was found that forwards were the fastest group and goalkeepers are the slowest.

It has been found that goalkeepers possess greatest value for abdominal muscular strength than fullbacks, halfback and forwards hockey players. It is also found that halfback posses' greater abdominal strength than fullbacks and forward player. In between the hockey playing position, forwards was found that least abdominal strength. From the finding, it is evident from the revealed data and result that the explosive leg strength showed insignificant difference between the positional field hockey players. This may be because of the selected players for this study were the national level players and trained for various similar training. Modern field hockey adopted the concept of total hockey due to fulfill the best meet of the demands of the sports. Hence there were no significant differences between the different positional hockey players. However, due to the lack of critical literature related to the study of speed on positional hockey player could not compare with the present study.

In the present study, the vital capacity of halfback players were found to be significantly higher than the other positional players and have significant difference between Goalkeeper and Halfback, Goalkeeper and Forward, Fullback and Halfback and Fullback and Forward player. The halfback is considered to be the engine room of the team. Halfback players come in all shapes and sizes. The halfbacks are the back bone of the team. They are the "play maker" and responsible to rotate and maintained the rhythm of the game as per the team requirements. In field hockey, halfback players always required high demands of fitness in respect to other field position.

In the contrary with the present study, Neogi, A. et al. (2018) observed that insignificant difference between the hockey players playing in different positions but found similar values of vital capacity. The result of the study has higher mean value of vital capacity of inter-university players study conducted by PS Chahar, (2013).

The significant difference in vital capacity may be attributed to the fact that graded exercise resulted in the higher capacity of lungs. The higher capacity may be due to the increase of the lungs volume and increase in the ventilatory efficiency and higher strength of respiratory muscles after training. It indicated the vitality of the lungs of an individual. Eastwood et al. (2001) also reported that the trained marathon runners had significantly higher lung functions such as total lung capacity. However there is lack of critical literature related to the study of vital capacity on positional hockey player could not compare with the present study.

The finding of the present study revealed that, there were statistically significant differences among different positional players in Maximal oxygen consumption (VO_2 max). In the present study attacking players demonstrated better in VO_2 max, than the defensive players. Among the positional player, halfback possess significantly higher VO_2 max followed by forwards, goalkeeper and fullbacks. In the finding of previous studies, Bandyopadhyay, A, et al. (2019) and Ready and van der Merwe (1986) found that forwards players exhibits higher level of Maximal oxygen consumption (VO_2 max) than other positional players.

Literature addressing aerobic capacity of hockey players according playing position is extremely limited. Although the finding of the present study, average VO2 max value 60.18 ml kg-1 min-1 were lower in compared with West Germany national players and English players (63.5 ml kg-1 min-1 and 62.2 ml kg-1 min-1 respectively; Reilly and Borrie, 1992), however, was higher than that of Spanish national hockey players (59.7 ml kg-1 min-1; Reilly and Borrie, 1992) and Canadian elite field hockey players (59.2 ml kg-1 min-1; Montgomery, 2006).

VO2 max (maximal oxygen uptake) is the highest amount of oxygen that the body can utilize during exhaustive exercise whilst breathing air at sea level. VO2 max is considered the gold standard and is the most important measure of aerobic ability. Smaros described players with higher VO2 max perform the highest number of sprints and are involved more often in decisive plays during a game than those with lower values. So, in effect, players with higher VO2 max can run at a higher intensity and greater distances before depletion of glycogen necessitates a reduction in intensity.

Heart rate is the number of times the heart beats per minute. A slow resting heart rate is characteristic of the trained individual. Fox and Mathew (1982) express the view that training has an impact on heart rate even at rest. The result of the study revealed that, there was statistically insignificant difference among different positional players in resting heart rate. Among the positional player halfback possess slowest resting heart rate with 58.93 bpm and fastest with goalkeeper of 62.00 bpm. The results of the present study showed insignificant similarity in normal resting heart rate suggesting that there may be parallel demands in each playing position standard. The overall average resting heart rate is 60.05 bpm and is ideal resting heart rate for a hockey player. In the new concept of total hockey, all the players were treated and received same protocol of training means and methods which influence the overall developments in physiological efficiency of the hockey players.

6. CONCLUSION

The researcher compared motor fitness and physiological variables among four different positional professional hockey players, within the limitations of the present study and on the basis of the finding results, it is concluded that there is significant differences in motor fitness and Physiological variables between the speed (F= 11.97, P=.000) between goalkeepers & halfbacks, goalkeepers & forwards and halfback & forward; agility (F= 6.50, P=.029) between goalkeeper & halfbacks, goalkeeper & forwards and fullbacks & forwards, vital capacity (F= 17.80, P=.000) between goalkeepers with halfbacks & forwards hockey players and between fullback & forward, fullback & forward and VO_2 max (F= 6.41, P=.001) between goalkeeper & halfbacks and fullback & forwards among the positional hockey players; whereas, insignificant difference was found in abdominal muscular strength and BMI among different position of hockey player.

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