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Relationship And Prediction Of Speed In Hockey Players Based On Selected Haematological Characteristics, Body Metabolites, Electrolytes And Enzymes

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ABSTRACT

This research explored the relationship and predictive values of haematological characteristics, body metabolites, electrolytes and enzymes in determining the physical fitness variable speed among twenty sub-junior male hockey players (aged 14-16 years) from Himachal Pradesh, selected from national-level championships (2022-2024). Physical fitness characteristic, speed was examined against 25 physiological indicators through SAI Physical Fitness Test and blood analysis. Correlation and regression analyses were employed to assess the predictive capability of these physiological and biochemical variables. Among haematological traits, only RBC count showed a significant negative correlation with speed ($r = -.565, p < .01$). Body metabolites did not significantly relate to speed. Electrolytes such as potassium ($r = .735, p < .01$) and phosphorus ($r = .579, p < .01$) exhibited strong positive associations, and regression analysis revealed a significant model ($R^2 = .776, p < .001$), indicating their predictive strength. Enzymes showed limited influence, with only CPK-Total significantly associated with speed ($r = .505, p < .05$). The findings suggest that among the physiological parameters studied, electrolytes especially potassium and phosphorus are the most robust predictors of speed in young hockey players. These insights may inform performance monitoring and individualized training strategies in sports science.

Keywords: Haematological Characteristics, Body Metabolites, Electrolytes, Enzymes, Speed and Hockey Players.

INTRODUCTION

The roots of sport can be traced back to early human civilization, where physical activity played a vital role in survival, social interaction, and cultural development. Over centuries, sports have evolved into highly organized and competitive pursuits that transcend entertainment and reflect human potential, discipline, and endurance. They have become an essential part of modern society, offering individuals a platform for competition and a way to understand and master their physical and mental capacities.

Among the many sports played globally, hockey holds a unique and deeply embedded cultural significance in India. Often referred to as the soul of Indian sport, hockey has played a pivotal role in shaping the country's sporting identity. India's illustrious history in hockey, with 8 Olympic gold medals, is testimony to the nation's historical dominance in the game. As a high-paced team sport involving continuous movement, tactical execution, and physical contact, hockey requires players to maintain exceptional physical and physiological fitness levels.

Field hockey today is played in over 118 countries, governed by rules that demand speed, agility, endurance, technical skill, and decision-making ability. The game has undergone numerous transformations, especially with synthetic turf, unlimited substitutions, and removing the offside rule all contributing to a faster and more physically demanding sport. Studies (e.g., Boyle et al., 1994; Konarski et al., 2006) reveal that hockey players frequently operate near their physiological limits, covering 8,000-10,000 meters per match, often at high intensities, and executing complex motor and cognitive tasks.

With the increasing competitiveness of sports, athletic performance today is no longer considered solely a function of talent. Instead, now it is recognized as a multidimensional construct influenced by various factors, including heredity, physiological profile, nutrition, mental toughness, training environment, and scientific conditioning. Champions, as is now widely acknowledged, are both born and made. As scientific research in sports progresses, the focus has shifted to identifying measurable predictors of performance. Body metabolites (like glucose and cholesterol), and enzymes (such as SGOT and CPK) play crucial roles in regulating energy systems and overall fitness.

Despite India's strong historical connection to hockey, there is a distinct lack of scientific data on the physical and physiological profiling of Indian hockey players; particularly among sub-junior male athletes. Most of the existing literature is concentrated in developed countries and at elite senior levels, leaving a noticeable research gap in assessing performance predictors at the grassroots level in India.

OBJECTIVE OF THE STUDY

To investigate the role of haematological characteristics, body metabolites, electrolytes and enzymes in predicting the physical fitness variable speed among sub-junior male hockey players. It was hypothesised that the selected haematological characteristics, body metabolites, electrolytes and enzymes would have a significant relationship with the physical fitness variable speed among the sub-junior male hockey players. Moreover, it was also hypothesised that the physical fitness variable speed of the hockey players could be significantly predicted on the basis of selected haematological characteristics, body metabolites, electrolytes and enzymes.

RESEARCH DESIGN AND METHODOLOGY

The present investigation employed a non-experimental quantitative research design with a complex correlational approach. This design was appropriate for assessing the relationship between selected haematological characteristics, body metabolites, electrolytes and enzymes (independent variables), and physical fitness component speed (dependent variable) in sub-junior national-level male hockey players. Additionally, the study aimed to identify predictors among the physiological variables that significantly influence physical fitness attribute speed. The study was conducted in two Government Sports Hostels located in Sundernagar and Una, Himachal Pradesh, India. Population of study comprised of male hockey players from Himachal Pradesh who participated in Sub-Junior National Level Championships. A purposive sample of 20 male players, aged 14 to 16 years, was selected from the hostels. All selected participants were active athletes who had competed at the national level during the academic sessions 2022-23 and 2023-24. A purposive sampling procedure was employed, with subject recommendations taken from team coaches. Physical fitness component speed was assessed using the Sports Authority of India (SAI) Physical Fitness Test Battery. Blood samples were drawn and analysed to assess the independent variables using Haematology and Biochemistry

Analyser. All blood investigations were conducted by SRL Diagnostic, Civil Hospital, Sundernagar, Zonal Hospital, Mandi, Zonal Hospital, Una (Himachal Pradesh).

The collected data were statistically analysed using IBM SPSS Version 26.0. Descriptive statistics (mean, standard deviation) were used to summarize the data. Pearson's Product-Moment Correlation Coefficient was applied to examine the relationship between independent and dependent variables. Multiple Regression Analysis was used to identify predictors of physical fitness attribute speed based on haematological and biochemical variables. The level of statistical significance was set at $p < 0.05$ for hypothesis testing.

RESULTS OF THE STUDY

The coefficient of correlation calculated between selected haematological traits, body metabolites, electrolytes, and enzymes with physical fitness characteristic speed of hockey players and the predictors of physical fitness characteristic speed of hockey players on the basis of selected haematological traits, body metabolites, electrolytes, and enzymes are presented in the tables 1 to 13.

Table-1 Relationship of Haematological Traits with Physical Fitness Characteristic i.e. Speed of Hockey Players (N = 20)

Sr. No.	Traits Correlated with Physical Fitness Characteristic i.e. Speed	Co-efficient of Correlation 'r'
1.	Haemoglobin	-.334
2.	RBCs	-.565**
3.	WBCs	.275
4.	Platelets	.017

*Significant at .05 level (r = .443), **Significant at .01 level (r = .561), df = 18

Table-1 displays that the RBCs of hockey players have a negative but significant relationship (r = -.565, p<.01) with speed, whereas with haemoglobin (r = -.334) it has a negative and non-significant relationship. However, other haematological traits i.e. WBCs (r = .275) and platelets (r = .017), show a positive but non-significant relationship with the speed variable of physical fitness among hockey players.

Table-2 Model Summary of Haematological Traits to Speed of Hockey Players

R	R Square	Adjusted R Square	Std. Error of Estimation
.632	.399	.239	.230

Table-2 illustrates that the correlation coefficient (R) between the traits is .632 (63.2 percent) while the coefficient of determination is .399 (39.9 percent). Thus, the outcomes establish that the haematological characteristics account for 39.9% of the variance in the physical fitness attribute speed among hockey players.

Table-3 Analysis of Variance of Haematological Traits on Speed of Hockey Players

Source of Variance	Sum of Square	Df	Mean Square	F	Sig.
Regression	.529	4	.132	2 .488	.088

Residual	.797	15	.053		
Total	1.326	19			

Table-3 reveals that the p-value for the F-test is .088, which is greater than .05 and hence, not significant. Accordingly, the model does not explain the large variations in the physical fitness attribute speed of sub-junior hockey players by indicating towards the roles played by haematological characteristics i.e. haemoglobin, RBCs, WBCs and platelets. Hence, the model is non-significant.

Table-4 Relationship of Body Metabolites with Physical Fitness Characteristic i.e. Speed of Hockey Players (N = 20)

Sr. No.	Traits Correlated with Physical Fitness Characteristic i.e. Speed	Co-efficient of Correlation 'r'
1.	Blood Glucose	.276
2.	Uric Acid	-.005
3.	Total Protein	.116
4.	Bilirubin	-.001
5.	Albumin	-.048
6.	Serum Creatinine	-.019
7.	Cholesterol	-.122
8.	Triglycerides	-.060
9.	HDL	-.208
10.	LDL	-.034

*Significant at .05 level (r = .443), **Significant at .01 level (r = .561), df = 18

Table-4 shows that the blood glucose (r = .276) and total protein (r = .116) of hockey players have a positive but non-significant relationship with physical fitness variable speed. While, other body metabolites i.e. uric acid (r = -.005), bilirubin (r = -.001), albumin (r = -.048), serum creatinine, (r = -.019), cholesterol (r = -.122), triglycerides, (r = -.060), HDL (r = -.208) and LDL (r = -.034) reveal a negative and non-significant relationship with speed variable of physical fitness among hockey players.

Table-5 Model Summary of Body Metabolites to Speed of Hockey Players

R	R Square	Adjusted R Square	Std. Error of Estimation
.551	.303	-.470	.320

Table-5 exhibits that the correlation coefficient (R) between the traits is .551 (55.1 percent) while the coefficient of determination is .303 (30.3 percent). Thus, the outcomes establish that the body metabolites account for 30.3% of the variance in the physical fitness attribute speed among hockey players.

Table-6 Analysis of Variance of Body Metabolites on Speed of Hockey Players

Source of Variance	Sum of Square	Df	Mean Square	F	Sig.
Regression	.402	10	.040	.392	.920
Residual	.923	9	.103		
Total	1.326	19			

Table-6 unveils that the p-value for the F-test is .920, which is greater than .05 and hence, not significant. Accordingly, the model does not explain the large variations in the physical fitness attribute speed of sub-junior hockey players by indicating towards the roles played by body metabolites i.e. blood glucose, uric acid, total protein, bilirubin, albumin, serum creatinine, cholesterol, triglycerides, HDL and LDL. Hence, the model is non-significant.

Table-7 Relationship of Electrolytes with Physical Fitness Characteristic i.e. Speed of Hockey Players (N = 20)

Sr. No.	Traits Correlated with Physical Fitness Characteristic i.e. Speed	Co-efficient of Correlation 'r'
1.	Sodium (Na^+)	-.107
2.	Potassium (K^+)	.735**
3.	Chloride (Cl^-)	-.007
4.	Calcium (Ca^{2+})	.195
5.	Phosphorus (P)	.579**

*Significant at .05 level (r = .443), **Significant at .01 level (r = .561), df = 18

Table-7 predicts that the potassium (K^+) (r = .735, p<.01) and phosphorus (P) (r = .579, p<.01) of hockey players have a positive and significant relationship with physical fitness variable speed, while with calcium (Ca^{2+}) (r = .195) it has a positive but non-significant relationship. Furthermore, other electrolytes i.e. sodium (Na^+) (r = -.107) and chloride (Cl^-) (r = -.007) show a negative and non-significant relationship with speed variable of physical fitness among hockey players.

Table-8 Model Summary of Electrolytes to Speed of Hockey Players

R	R Square	Adjusted R Square	Std. Error of Estimation
.881	.776	.696	.145

Table-8 explains that the correlation coefficient (R) between the traits is .881 (88.1 percent) while the coefficient of determination is .776 (77.6 percent). Thus, the outcomes establish that the electrolytes account for 77.6% of the variance in The physical fitness attribute speed among hockey players.

Table-9 Analysis of Variance of Electrolytes on Speed of Hockey Players

Source of Variance	Sum of Square	Df	Mean Square	F	Sig.

Regression	1.029	5	.206		
Residual	.297	14	.021	9.68	.000
Total	1.326	19			

Table-9 elucidates that the p-value for the F-test is .000, which is lesser than .05 and hence, significant. Accordingly, the model explains the large variations in the physical fitness attribute speed of sub-junior hockey players by indicating towards the roles played by electrolytes i.e. sodium (Na^+), potassium (K^+), chloride (Cl^-), calcium (Ca^{2+}) and phosphorus (P). Hence, the model is significant.

Table-10 Regression Coefficients Associated with Speed of Hockey Players

	Unstandardized Coefficient	T-Value	P-Value	Remarks
(Constant)	-.178	-.029	.978	Not Significant
Sodium (Na^+)	-.034	-.556	.587	Not Significant
Potassium (K^+)	.445	4.605	.000	Significant
Chloride (Cl^-)	.073	1.840	.087	Not Significant
Calcium (Ca^{2+})	-.121	-.700	.496	Not Significant
Phosphorus (P)	.197	3.174	.007	Significant

From the table-10 it is clear that, sodium (Na^+) is negatively related to the physical fitness characteristic speed of the hockey players as noticeable from the score of its coefficient (-.034) which implies that if sodium (Na^+) increases by one unit, the speed will decrease by (.034) units, while keeping other predicting characteristics constant. However, it is also apparent from the table that the relationship of sodium (Na^+) with speed is not significant (p-value = .587).

Potassium (K^+) is positively related to the physical fitness characteristic speed of the hockey players as observable from the value of its coefficient (.445) which infers that if potassium (K^+) increases by one unit, speed will increase by (.445) units, while keeping other predicting features constant. However, it is also visible from the table that the association of potassium (K^+) with speed is significant (p-value = .000).

Chloride (Cl^-) is positively related to the physical fitness characteristic speed of the hockey players as apparent from the score of its coefficient (.073) which indicates that if chloride (Cl^-) increases by one unit, speed will increase by (.073) units, while keeping other predicting traits constant. But it is also evident from the table that the relationship of chloride (Cl^-) with speed is not significant (p-value = .087).

Calcium (Ca^{2+}) is negatively related to the physical fitness characteristic speed of the hockey players as noticeable from the value of its coefficient (-.121) which implies that if calcium (Ca^{2+}) increases by one unit, speed will decrease by (.121) units, while keeping other predicting characteristics constant. However, it is also evident from the table that the association of calcium (Ca^{2+}) with speed is not significant (p-value = .496).

Phosphorus (P) is positively related to the physical fitness characteristic speed of the hockey players as evident from the score of its coefficient (.197) which indicates that if phosphorus (P) increases by one unit, speed will increase by (.197) units, while keeping other predicting characteristics constant. Nonetheless, it is also apparent from the table that the relationship of phosphorus (P) with speed is significant (p-value = .007).

Henceforth, it can be resolved that with reference to the physical fitness characteristic speed of the hockey players the most contributing electrolyte is potassium (K^+) which is followed by phosphorus (P) and chloride (Cl^-).

The Regression Equation

On the basis of above table, the Regression Equation is:

Speed of Hockey Players = -.178 - .034Na^+ + .445K^+ + .073Cl^- -.121Ca^{2+} + .197P.

Table-11 Relationship of Enzymes with Physical Fitness Characteristic i.e. Speed of Hockey Players (N = 20)

Sr. No.	Traits Correlated with Physical Fitness Characteristic i.e. Speed	Co-efficient of Correlation 'r'
1.	Alkaline Phosphatase	.016
2.	S.G.O.T. (AST)	-.015
3.	S.G.P.T. (ALT)	-.144
4.	Amylase	.249
5.	CPK-Total	.505*
6.	Lipase	-.182

*Significant at .05 level (r = .443), **Significant at .01 level (r = .561), df = 18

Table-11 demonstrates that the CPK-Total has a positive and significant relationship (r = .505, p<.05) with speed of the hockey players, whereas alkaline phosphatase (r = .016) and amylase (r = .249) have a positive but non-significant relationship. However, other enzymes i.e. S.G.O.T. (AST) (r = -.015), S.G.P.T. (ALT) (r = -.144) and lipase (r = -.182) display a negative and non-significant relationship with speed variable of physical fitness among hockey players.

Table-12 Model Summary of Enzymes to Speed of Hockey Players

R	R Square	Adjusted R Square	Std. Error of Estimation
.545	.297	-.027	.267

Table-12 discloses that the correlation coefficient (R) between the traits is .545 (54.5 percent) while the coefficient of determination is .297 (29.7 percent). Thus, the outcomes establish that the enzymes account for 29.7% of the variance in the physical fitness attribute speed among hockey players.

Table-13 Analysis of Variance of Enzymes on Speed of Hockey Players

Source of Variance	Sum of Square	Df	Mean Square	F	Sig.
Regression	.394	6	.066	.916	.514

Residual	.932	13	.072		
Total	1.326	19			

Table-13 displays that the p-value for the F-test is .514, which is greater than .05 and hence, not significant. Accordingly, the model does not explain the large variations in the physical fitness attribute speed of sub-junior hockey players by indicating towards the roles played by enzymes i.e. alkaline phosphatase, S.G.O.T. (AST), S.G.P.T. (ALT), amylase, CPK-Total, and lipase. Hence, the model is non-significant.

CONCLUSIONS

The outcomes of the research analysis provided significant insights into how different haematological and biochemical features correlate with and predict the speed of sub-junior hockey players, as detailed below:

1. **Haematological Characteristics:**
   - Only RBCs demonstrated a significant inverse correlation with speed ($r = -.565$, $p<.01$), suggesting that higher RBC levels may slightly hinder sprinting ability possibly due to increased blood viscosity.
   - Haemoglobin, WBCs, and platelets did not show significant relationships.
   - The overall regression model was not statistically significant ($F = 2.488$, $p = .088$), indicating weak predictive power.
2. **Body Metabolites:**
   - None of the ten metabolites; including glucose, cholesterol, triglycerides, and creatinine showed a significant correlation with speed.
   - The regression model explained 30.3% of the variance ($R^2 = .303$) but lacked statistical significance ($F = 0.392$, $p = .920$).
3. **Electrolytes:**
   - Potassium ($r = .735$) and phosphorus ($r = .579$) had highly significant positive relationships with speed, marking them as critical contributors to explosive physical performance.
   - The regression model for electrolytes was highly significant ($R^2 = .776$, $F = 9.68$, $p<.001$), indicating strong predictive validity.
   - In the regression equation:
     $\text{Speed} = -0.178 - 0.034(Na^+) + 0.445(K^+) + 0.073(Cl^-) - 0.121(Ca^{2+}) + 0.197(P)$, potassium emerged as the most influential variable, followed by phosphorus.
4. **Enzymes:**
   - Only CPK-Total showed a significant correlation ($r = .505$, $p < .05$), possibly reflecting muscle energy metabolism's role in speed.
   - However, the enzyme model was not statistically significant ($F = 0.916$, $p = .514$), indicating limited predictive capacity overall.

Therefore, the study concludes that among the selected physiological variables, electrolytes; especially potassium and phosphorus are the strongest predictors of speed in sub-junior hockey players. While some individual haematological and enzymatic traits showed moderate correlations, their overall predictive strength was limited. The results reinforce the critical role of electrolyte balance in neuromuscular performance and sprinting efficiency.

FUTURE SCOPE OF RESEARCH

Coaches should monitor and optimize player's electrolyte levels, particularly potassium and phosphorus, through hydration strategies and diet. Nutritional plans should be personalized to support electrolyte homeostasis during intense physical exertion. Longitudinal studies could explore how electrolyte dynamics change over a training season and influence speed.

Incorporating regular biochemical profiling in sports training programs can help identify individual strengths and weaknesses. Future studies should investigate interactions among these variables and their joint effects on multiple physical fitness parameters (e.g., agility, endurance). Given the partial influence of enzymes like CPK-Total, future research might explore their acute versus chronic responses to speed training protocols.

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