International Research Journal of Humanities, Language and Literature
Vol. 3, Issue 6, June 2016 IF- 3.558 ISSN: (2394-1642)
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Website: www.aarf.asia Email : editor@aarf.asia , editoraarf@gmail.com

PHYSICAL AND PHYSIOLOGICAL FACTORS ASSOCIATED WITH PERFORMANCE IN HOCKEY AT SCHOOL LEVEL

Man Mohan Rai Sharma[1], Dr. Nishan Singh Deol[2]

[1]Research Scholar, Department of Physical Education, Punjabi University Patiala, Punjab India

[2]Professor, Department of Physical Education, Punjabi University Patiala, Punjab India

ABSTRACT

Competitive sports make tremendous changes on the physical condition, vitality, endurance and mental powers of the participant. The purpose of this study was to determine the relationship of selected physical and physiological variables such as Grip Strength, Leg Strength, Back Strength, agility, Aerobic capacity, anaerobic capacity and resting pulse rate. Total of three Hundred (N=300) male school hockey players of Uttar Pradesh, Haryana and Delhi who had represented National were selected as subject. The physical variables chosen were Grip Strength, Leg and Back Strength, and agility which were measured by grip Dynamometer (Kg.), leg and back dynamometer (Kg.), standing and shuttle run (sec.) respectively. The Physiological variables were aerobic capacity, anaerobic capacity and resting pulse rate measured by cooper 12 minute run walk test (meter), 50 meter dash (sec.) and counting beats at the radial artery (beats/min) respectively. The performance was measured by the panel of three judges (experts in hockey) were appointed to observe and analyze the hockey playing ability of the subjects. The subjects were assessed by grading out of ten marks by each judge. To found out the relationships between the logically selected factors, scholar used Pearson's Product Moment Correlation. The level of significance was chosen as 0.05. The findings of the study revealed that the performance in hockey were significantly related to right Grip Strength (r=.0.22). Left grip strength (r=.30), leg strength (r=.16), back strength (r=.38), agility (r=-.51), aerobic capacity (r=.63), anaerobic capacity (r=-.74), resting pulse(r=-.77).

KEYWORDS - Aerobic Capacity, Agility, Anaerobic Capacity, Back Strength , Grip Strength, Hockey

1. INTRODUCTION

Physique and body composition have an important role for playing field hockey (Montgomery, 2006; Quinney et al., 2008; Tarter et al., 2009). In field hockey lots of movements and skills are involved so a high level of physical demand is required for match play (Montgomery, 2006; Quinney et al., 2008; Tarter et al., 2009). The game of field hockey involves walking, jogging, sprinting in varied directions with and without ball. As the players have to cover a big area in the ground during attack and defence therefore, the game demands for aerobic as well as anaerobic fitness (Bloomfield et al., 2007; Elferink-Gemser et al., 2006; Hinrichs et al., 2010). A high number of accelerations and decelerations, associated with the large number of changes in direction of play create an additional load to the muscles involved as in field hockey, those players better suited to cope with the demands of the game reach the elite level (Bloomfield et al., 2007; Elferink-Gemser et al., 2006). The intermittent high intensity pattern of activity during the match requires a high function of both the aerobic and anaerobic energy delivery pathways. During aerobic exercise the demand of oxygen increases at the working muscle, so an optimum level of hemoglobin is required to perform at the highest level with high intensity (Nielsen and Weber, 2007; Suhr et al., 2009). During the field hockey training these parameters may be evaluated at regular intervals to assess the training load imposed on the athlete. Lipids have important beneficial biological functions that include the use of triglycerides, for energy production or as stored fat in adipose tissue and use of cholesterol as a component, in conjunction with phospholipids of cellular membranes or in the synthesis of steroid hormones (Kelley and Kelley, 2009). Elevated plasma cholesterol concentrations have been implicated in the development of coronary artery disease (CAD) (Kelley and Kelley, 2009; Altena et al., 2006)

Strength is the ability of the muscles to overcome resistance or to act against resistance. Strength should not be considered a product of only muscular contraction. It is infect, a product of voluntary muscle contraction caused by neuro-muscular system. (**Hardyal Singh, 1991**)

Devender Singh Jaggia and Pradeep Kumar (2015) conducted study to understand the relationship between the selected physiological variables namely aerobic power, anaerobic power, vital capacity and resting pulse rate to the performance of the hockey players. For the purpose of the study 150 hockey players were randomly selected from the population of

players came to participate in the North Zone Inter University Hockey Tournament 2012-13 at Aligarh Muslim University, Aligarh, Uttar Pradesh. The selected players underwent Astrand Nomogram (lit./m), Sargent Jump- Lewis Nomogram (Kg. m/sec) and Dry Spirometer Test (lit.) for the aerobic power, anaerobic power and vital capacity respectively while the resting pulse rate was measured manually at the radial artery. The hockey performance of the selected players was evaluated by the panel of three experts on the basis of subjective observation of the player's performance during the series of matches during the competition and was recorded in points to a maximum of 50 points. Mean, Standard Deviation and Pearson product moment correlation (r) were employed for analyzing the data. The study revealed that the mean and standard deviation of aerobic power, anaerobic power, vital capacity and resting pulse rate of the hockey players were 3.78± 0.64 lit./min., 130.06± 17.38 kg-m./sec., 3986.67± 385.42 lit. and 56.82± 3.60 beats/ min. respectively and they are significantly correlated with their performance as the coefficient of correlation value's obtained were 0.254, 0.379, 0.523 and -0.442 respectively at $p \leq 0.05$. It was concluded that physiological variables like aerobic power, anaerobic power, vital capacity and resting pulse rate plays an important role in the performance of the hockey players. And hence, it is recommended that the findings of the study must be used to design appropriate training programmes to help athletes acquire suitable strategies so as to improve their aerobic power, anaerobic power, vital capacity and resting pulse rate which will leads to an enhanced level of sports performance.

Marije Elferink-Gemser et.al (2004) conducted study to determine the relationship between multidimensional performance characteristics and level of performance in talented youth field hockey players, elite youth players ($n = 38$, mean age 13.2 years, $s = 1.26$) were compared with sub-elite youth players ($n = 88$, mean age 14.2 years, $s = 1.26$) on anthropometric, physiological, technical, tactical and psychological characteristics. Multivariate analyses with performance level and gender as factors, and age as the covariate, showed that the elite youth players scored better than the sub-elite youth players on technical (dribble performance in a peak and repeated shuttle run), tactical (general tactics; tactics for possession and non-possession of the ball) and psychological variables (motivation) ($P < 0.05$). The most discriminating variables were tactics for possession of the ball, motivation and performance in a slalom dribble. Age discriminated between the two groups, indicating that the elite youth players were younger than the sub-elite players. In the guidance of young talented players to the top as well as in the detection of talented players, more attention has to be paid to tactical qualities, motivation and specific technical skills.

2. STATEMENT OF THE PROBLEM

The purpose of this study was to determine the "Physical and Physiological Factors Associated with Performance in Hockey at School Level".

3. OBJECTIVES OF THE STUDY

The Following Objectives of the Study were:-

1. To find out the significant relationship of grip strength with the performance in hockey at school level.

2. To know the significant relationship of leg strength with the performance in hockey at school level.

3. To examine the significant relationship of back strength with the performance in hockey at school level.

4. To find out the significant relationship of agility with the performance in hockey at school level.

5. To find out the significant relationship of aerobic capacity with the performance in hockey at school level.

6. To find out the significant relationship of anaerobic capacity with the performance in hockey at school level.

7. To find out the significant relationship of resting pulse rate with the performance in hockey at school level.

4. HYPOTHESIS

It was hypothesized that performance in hockey would have positive and significant relationship with Physical, Physiological and Anthropometric variables.

1. There would be positive relationship of grip strength with the performance in hockey at school level.

2. There would be significant relationship of leg strength with the performance in hockey at school level.

3. There would be significant relationship of back strength with the performance in hockey at school level.

4. There would be significant relationship of agility with the performance in hockey at school level.

5. There would be significant relationship of aerobic capacity with the performance in hockey at school level.

6. There would be significant relationship of anaerobic capacity with the performance in hockey at school level.

7. There would be significant relationship of resting pulse rate with the performance in hockey at school level.

5. SELECTION OF SUBJECTS

A total of three Hundred (N=300) male school hockey players,16-19 years of age group from Uttar Pradesh, Haryana and Delhi were selected as subject. The Subjects who had represented National were selected as subject.

6. SELECTION OF VARIABLES

The following variables were selected:

1. Physical Variables:
- **(a)** Grip Strength
- **(b)** Leg Strength
- **(c)** Back Strength
- **(d)** Agility

2. Physiological variables:
- **(a)** Aerobic capacity
- **(b)** Anaerobic capacity
- **(c)** Resting pulse rate

7. CRITERION MEASURES

From the review of literature and with consultation of experts, the following tests were selected as criterion measures:

1. The score made by an individual on grip dynamometer was recorded to the nearest kilogram.
2. The score made by an individual on back and leg dynamometer was recorded to the nearest kilogram.
3. Fifty meter dash was conducted to record the time to the nearest $1/10^{th}$ of a second.
4. Time take to shuttle a distance of 10 meters four times and was recorded by the stop watch nearest to the $1/10^{th}$ of a second.
5. Distance covered in Cooper's 12 Minute Run /Walk Test to the nearest 50 meters was recorded to measure aerobic capacity.

6. Number of heart beats per minute during resting condition was recorded.

8. STATISTICAL PROCEDURE

To found out the relationships between the logically selected factors, scholar used Pearson's Product Moment Correlation. Level of significance was set at 0.05 levels.

9. FINDINGS

In order to find out the relationship of selected physical and physiological variables with the performance in hockey, Pearson's product moment correlation was used. Descriptive statistics and Correlation matrix was given in the following tables.

Table 1

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF RIGHT GRIP STRENGTH OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Right Grip Strength	300	42.23	3.87	.22	0.227	000

Significant at 0.05 level of significance

Table 1 reveals that the Mean of **right grip strength** was 42.23 and the standard deviation was 3.87. The Coefficient of correlation (r) of right grip strength with the performance in hockey was 0.227. The value of Coefficient of correlation (r) (0.227) shows significant relationship at 0.05 level of significance. It indicates that right grip strength has positive relationship with the performance of school level hockey players.

Table 2

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF LEFT GRIP STRENGTH OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Left Grip Strength	300	39.22	4.48	.25	0.305	000

Significant at 0.05 level of significance

Table 2 reveals that the Mean of Left Grip Strength was 39.22 and the standard deviation was 4.48. The Coefficient of correlation (r) of right grip strength with the performance in hockey was 0.305. The value of Coefficient of correlation (r) (0.305) shows significant relationship at 0.05 level of significance. It indicates that left grip strength has positive relationship with the performance of school level hockey players.

Table 3

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF LEG STRENGTH OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Leg Strength	300	119.40	3.66	.21	0.162	.005

Significant at 0.05 level of significance

Table 3 reveals that the Mean of Leg strength was 119.40 and the standard deviation was 3.66. The Coefficient of correlation (r) of leg strength with the performance in hockey was 0.162. The value of Coefficient of correlation (r) (0.162) shows significant relationship at 0.05 level of significance. It indicates that leg strength has positive relationship with the performance of school level hockey players.

Table 4

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF BACK STRENGTH OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Back Strength	300	94.61	9.20	.53	0.38	.005

Significant at 0.05 level of significance

Table 4 reveals that the Mean of back Strength was 94.61 and the standard deviation was 9.20. The Coefficient of correlation (r) of back strength with the performance in hockey was 0.38. The value of Coefficient of correlation (r) (0.38) shows significant relationship at 0.05 level of significance. It indicates that back strength has positive relationship with the performance of school level hockey players.

Table 5

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF AGILITY OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Agility	300	10.59	1.27	.07	-0.515	000

Significant at 0.05 level of significance

Table 5 reveals that the Mean of agility was 10.59 and the standard deviation was 1.27. The Coefficient of correlation (r) of agility with the performance in hockey was -0.515. The value of Coefficient of correlation (r) (-0.515) shows significant relationship at 0.05 level of significance. It indicates that agility has negative relationship with the performance of school level hockey players.

Table 6

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF AEROBIC CAPACITY OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Aerobic Capacity	300	3000.10	205.80	11.88222	0.632	000

Significant at 0.05 level of significance

Table 6 reveals that the Mean of Left Grip Strength was 3000.10 and the standard deviation was 205.80. The Coefficient of correlation (r) of **Aerobic Capacity** with the performance in hockey was 0.632. The value of Coefficient of correlation (r) (0.632) shows significant relationship at 0.05 level of significance. It indicates that **Aerobic Capacity** has positive relationship with the performance of school level hockey players.

Table 7

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF ANAEROBIC CAPACITY OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Anaerobic Capacity	300	6.45	.60	.03469	-0.745	000

Significant at 0.05 level of significance

Table 7 reveals that the Mean of **Anaerobic Capacity** was 6.45 and the standard deviation was 0.60. The Coefficient of correlation (r) of **Anaerobic Capacity** with the performance in hockey was -0.745. The value of Coefficient of correlation (r) (-0.745) shows significant relationship at 0.05 level of significance. It indicates that **Anaerobic Capacity** has negative relationship with the performance of school level hockey players.

Table 8

DESCRIPTIVE STATISTICS AND CORRELATION MATRIX OF RESTING PULSE RATE OF SCHOOL LEVEL HOCKEY PLAYERS

Physical Variables	N	Mean	Std. Deviation	Std. Error	Coefficient of correlation (r)	Sig. Two Tailed
Resting Pulse Rate	300	64.4533	4.25380	.24559	-0.775	000

Significant at 0.05 level of significance

Table 8 reveals that the Mean of Resting Pulse Rate was 64.4533 and the standard deviation was4.25. The Coefficient of correlation (r) of Resting Pulse Rate with the performance in hockey was -0.775. The value of Coefficient of correlation (r) (-0.775) shows significant relationship at 0.05 level of significance. It indicates that Resting Pulse Rate has negative relationship with the performance of school level hockey players.

10. DISCUSSION OF FINDINGS

Correlation matrix of selected physical variables associated with performance in hockey on different playing position at school level, as the satisfactory relationship was found among the playing position and right hand grip strength (0.227), and a low level of relationship was found among the left hand grip strength (0.305) with the playing position whereas also a low level of relationship was found among the leg strength (0.162) with the playing position, in case of back strength (0.128) also not much higher relationship was found with the playing position in hockey. A highly correlation was found among the agility (-0.51) with the playing position in hockey.

It may be due to hockey players required to change body position rapidly during game situation at different playing positions. Agility helps and enhances the performance in activities which require rapid change in direction for maintaining balance, speed, strength and control. It is a pioneer aspect in every sport. Good agility can contribute into better

performance and instant response that can help to overcome the gimmick of the opponents. The satisfactory relationship was found in grip strength it may be due to reason that the subjects use to play hockey regularly during which they hold the hockey stick throughout the game and training sessions which may be one of the reason that the subjects were showing significant relationship with the grip strength. At last statistical analysis of leg strength also shows the positive relationship with the performance because during the game subjects remain in such bending position of legs in this position their legs muscles bears their body weight most of the time hence this cause shows the significant relationship with performance in hockey game.

Correlation matrix of selected Physiological variables associated with performance in hockey on different playing position at school level, as the satisfactory relationship was found among the playing position and aerobic capacity (0.632), and a strong level of relationship was found among the anaerobic capacity (-0.745) with the playing position whereas also a high level of relationship was found among the resting pulse rate (-0.775) with the playing position as statistical analysis showing strong relation with the physiological variables i:e aerobic capacity, anaerobic capacity and resting pulse rate because hockey game is driven by high intensity and high volume activity. Hockey player has to do repetitive sporting movement under the condition of fatigue throughout the duration of the game in which working muscles are required maximum amount of oxygen from the blood. Hence the individuals having more aerobic capacity his circulatory system will be able to provide sufficient amount of oxygen to the working muscles and according to the analysis anaerobic capacity is also having strong relationship with the performance in hockey may due to the reason that during game an individual has to run short sprint to take the possession of ball and to defend it from the opponents during counter attack which may be the reason for improving anaerobic capacity of the hockey players. Subjects were having good aerobic and anaerobic capacity which results in turned to provide better resting pulse rate to the individual.

11. DISCUSSION OF HYPOTHESIS

The Hypothesis which was stated-

1. There would be significant relationship of grip strength with the performance in hockey at school level was accepted at 0.05 level of significance.
2. There would be significant relationship of leg strength with the performance in hockey at school level was accepted at 0.05 level of significance.

3. There would be significant relationship of back strength with the performance in hockey at school level was accepted at 0.05 level of significance.
4. There would be significant relationship of agility with the performance in hockey at school level was accepted at 0.05 level of significance.
5. There would be significant relationship of aerobic capacity with the performance in hockey at school level was accepted at 0.05 level of significance.
6. There would be significant relationship of anaerobic capacity with the performance in hockey at school level was accepted at 0.05 level of significance.
7. There would be significant relationship of resting pulse rate with the performance in hockey at school level was accepted at 0.05 level of significance.

12. CONCLUSIONS

Within the limitations of the study the following conclusions were drawn:-

1. There was significant relationship of grip strength with the performance in hockey at school level.

2. There was significant relationship of leg strength with the performance in hockey at school level.

3. There was significant relationship of back strength with the performance in hockey at school level.

4. There was significant relationship of agility with the performance in hockey at school level.

5. There was significant relationship of aerobic capacity with the performance in hockey at school level.

6. There was significant relationship of anaerobic capacity with the performance in hockey at school level.

7. There was significant relationship of resting pulse rate with the performance in hockey at school level.

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