

Correlations of Back Strength with Selected Anthropometric Variables and Performance Tests in Indian Inter-University Male Field Hockey Players

S. Koley¹ and A. Kar²

Citation: Koley S and Kar A. 2017. Correlations of Back Strength with Selected Anthropometric Variables and Performance Tests in Indian Inter-University Male Field Hockey Players. Human Biology Review, 6 (1) 53-62.

¹Shyamal Koley, Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar -143005, Punjab, India. Email: drkoley@yahoo.co.uk

²Abhijit Kar, Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar -143005, Punjab, India. Email: abhijit331989@gmail.com
Corresponding author - Prof. (Dr.) Shyamal Koley, Ph.D., Professor, Dean and Head, Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar - 143005, Punjab, India, E mail- drkoley@yahoo.co.uk

ABSTRACT: *The purpose of this study was of two-fold: first, to estimate the back strength of Indian inter-university male field hockey players and, second, to search the correlations of it with selected anthropometric variables and performance tests. To serve this purpose, a total of nine anthropometric variables, such as height, weight, body mass index, percent body fat, knee height, length of femur, femur biepicondylar diameter, skeletal mass and back strength, and two performance tests, such as sit and reach test and Slalom sprint and dribble test were measured on purposely selected 120 Indian inter-university male hockey players aged 18–25 years collected from the inter-university competition held in Guru Nanak Dev University, Amritsar, India during March, 2014. An adequate number of controls (n=119) were also taken from the same place for comparison. The results showed that the hockey players had the higher mean values in all the variables, except percent body fat and slalom sprint and dribble test than their control counterparts, showing statistically significant differences ($p \leq 0.003 - 0.001$) between them. No significant correlations of back strength were found with any of the variables in Indian inter-university male field hockey players. In conclusion, it may be stated that back strength may not be used as one of the indicating factors for the performance of the field hockey players.*

Keywords: Back strength. Anthropometric variables. Performance tests. Indian inter-university male hockey players.

INTRODUCTION

Field hockey is an intermittent endurance sport involving short sprinting as well as movement with and without ball (Manna et al. 2009). Successful performance in field hockey is influenced by morphological and anthropometric characteristics such as body size and composition, functional parameters (physical capacity) (Bale and McNaught-Davis 1983, Fedotova et al. 1990, Mokha and Sidhu 1987, Seluyanov and Sarsaniya 1991, Withers and Roberts 1991, Scott 1991, Singh et al. 2010) and fitness (explosive strength, maximum speed, anaerobic and aerobic capacity) and agility (Bril 1980, Ayrapetyanz and Godik 1991, Nikitushkin and Guba 1998, Volkov and Filin 1983). Musculoskeletal injuries are more common in athletes. Of those, the most disabling injuries are included lumbar spine and lower extremities in them (Biering-Sorensen 1984, Beckman and Buchanan 1995). Some predisposing factors for those complications are muscular weakness and poor strength. Lack of back and hip strength often result low back pain and lower extremity injury (Biering-Sorensen 1984). Studies relating to back strength of field hockey players are less reported. As in field hockey, players are to bend forward to the ground for the maximum groundwork and to cover a wider range all around during the game (Sodhi 1991) and maximum strain comes over the back muscles as well as abdominal muscles during the entire duration of the game. These back/trunk extensors get fatigued and sore as the game goes on. Although some players may have weakness in their back/trunk extensors, more often this discomfort is related to muscle imbalance. Muscle imbalance in field hockey players may also result in sore or tight hips. The most common muscle imbalance in hockey players is tightness of the hip flexors. Thus, evaluation of back strength is essential to the hockey players not only for their maximal performance but to avoid the sports specific injuries too.

Little literature related to the back strength and its association with anthropometric variables is available in various populations (Roy and Pal 2001, Koley and Inder 2014, Koley and Vashishth 2014, Koley and Jain 2013, Koley and Bijwe 2013, Sharma et al. 2012, Koley et al. 2012a and b). More are required for the development of the game. So the present study was planned.

MATERIALS AND METHODS

Participants

The present cross-sectional study was based on purposely selected 120 Indian inter-university male field hockey players aged 18–25 years (mean age 19.67 years, \pm 1.28) from the inter-university competition held in Guru Nanak Dev University, Amritsar, India during March, 2014. An adequate number of controls (n=119) were also taken from the same place for comparison. The age of the subjects were recorded from the date of birth registered in their respective records submitted to the authorities. A written consent was obtained from the subjects. The data were collected under natural environmental conditions in morning (between 8 AM. to 12 noon). The study was approved by the institutional ethical committee.

Anthropometric Measurements

Nine anthropometric variables, such as height (HT), weight (WT), body mass index (BMI), percent body fat (%BF), knee height (KH), length of femur (LOF), femur biepicondylar diameter (FBD), skeletal mass (SM) and back strength (BS) and two performance tests, such as sit and reach test (SRT) and Slalom sprint and dribble test (SSDT) were measured on each subject using standard techniques (Lohmann et al. 1988) and were measured in triplicate with the median value used as the criterion.

The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm. Weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula $\text{weight (kg)}/\text{height}^2 \text{ (m)}^2$. Percent body fat was assessed with standard formula (Womersely and Durning 1977) using the four skinfold measurements (biceps, triceps, subscapular and suprailiac). Knee height and length of femur was measured by the first segment of anthropometre in cm. Femur biepicondylar diameter was measured by sliding caliper in cm. The instruments were calibrated prior to use and all measurements were taken on the subject's right side. The estimation of skeletal mass was done after Matiegka (1921), following the formula:

$$\text{SM (kg)} = \{(\text{HB} + \text{WB} + \text{FB} + \text{AB})/4\}^2 \times \text{ht} \times 1.2\text{kg} \times 0.001$$

Where SM is skeletal mass, HB is biepicondylar humerus, WB is bistyloideus, FB is biepicondylar femur, AB is bimalleolar, ht is height in cm.

Back Strength Measurement

The back strength was measured using back-leg-chest dynamometer. The subject was positioned with body erect and knees bent so that grasped-hand rests at proper height. Then straightening the knees and lifting the chain of the dynamometer, pulling force was applied on the handle. The body was inclined forward at an angle of 60 degrees. The strength of the back muscles was recorded on the dial of the dynamometer as the best of three trials in kg. All subjects were tested after 3 minutes of independent warm-up. Thirty seconds time interval was maintained between each back strength testing.

Sit and Reach Test

Sit and reach test was used to estimate back and hamstring flexibility. The player performed warm up for 10 minutes and then removed their shoes for test. The researcher secured the ruler to the box top with the tape so that the front edge of the box lined up with the zero-mark on the ruler and the zero-end of the ruler pointed towards the player. The player was asked to sit on the floor with his legs fully extended with the bottom of his bare feet against the box. The player placed one hand on top of the other, slowly bent forward and reached along the top of the ruler as far as possible holding the stretch for two seconds. The researcher recorded the distance reached by the player's finger tips in cm. The player performed the test thrice. The researcher then calculated and recorded the average of the three distances and assessed the player's performance.

Slalom Sprint and Dribble Test

Based on tests for agility and dribbling skills, the field hockey specific slalom sprint and dribble test (Slalom SSDT) was developed to measure field hockey specific slalom sprint and dribble performance (Lemmink et al. 2004). The protocol consisted of a maximal slalom sprint of 30 m while carrying a hockey stick and a maximal slalom dribble of 30 m while dribbling a hockey ball. Twelve cones were placed in a zigzag pattern. Start and finish lines were marked by two cones. The subject was asked to begin the test with both feet behind the starting line, then, upon an auditory signal after a 5 second countdown, the subject ran with a hockey stick around the 12

cones reaching over the finishing line. The protocol of the dribbling portion was identical to the sprinting portion, except that the subject was dribbling a hockey ball. If the subject lost control of the ball—that is, if the subject was more than approximately 2 m away from the cones, the test was repeated. Time was recorded using a stopwatch. Slalom sprint time and slalom dribble time were noted and recorded accurately to within 0.01 seconds.

Statistical Analysis

Standard descriptive statistics (mean \pm standard deviation) were determined for directly measured and derived variables. Student's t-test was applied for the comparisons of data between Indian inter-university male field hockey players and controls. Pearson's correlation coefficients were applied to establish the relationships among the variables measured. Data were analyzed using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Descriptive statistics of selected anthropometric characteristics and performance tests in Indian inter-university male field hockey players are shown in table 1. The results showed that the hockey players had the higher mean values in all the variables, except percent body fat and slalom sprint and dribble test than their control counterparts, showing statistically significant differences ($p < 0.003-0.001$) were found between Indian inter-university male field hockey players and controls in all the variables studied.

Table 2 showed the correlation matrix of back strength, selected anthropometric variables and performance tests of Indian inter-university male field hockey players. Statistically no significant correlations were found in any case in inter-university male field hockey players but in controls significant positive correlations ($p < 0.05-0.01$) of back strength were observed with height, weight, knee height, femur biepicondylar diameter, skeletal mass, and significant negative correlations ($p < 0.05$) with sit and reach test. So far anthropometric variables were concerned, significant positive correlations were found in most of the cases both in inter-university male field hockey players and controls.

Table 1. Descriptive statistics of back strength, selected anthropometric variables and performance tests in Indian inter-university male field hockey players and controls

Variables	Hockey players		Controls		t-value	p-value
	Mean	SD	Mean	SD		
Height(cm)	170.13	5.71	166.87	8.54	3.460	<0.001
Weight(Kg)	63.24	6.95	52.91	9.52	9.580	<0.001
BMI(Kg/m ²)	21.83	1.92	19.22	3.13	7.779	<0.001
% body fat(%)	16.78	2.58	23.41	3.68	16.153	<0.001
Knee height(cm)	50.43	1.80	43.43	3.78	18.254	<0.001
Length femur (cm)	60.16	2.15	51.92	4.39	26.319	<0.001
FB Diameter(cm)	11.19	7.77	9.05	0.73	2.977	<0.003
Skeletal mass(Kg)	11.76	3.00	7.27	1.47	3.665	<0.001
Sit & reach(cm)	6.63	6.22	1.81	8.53	4.992	<0.001
Slalom sprint & dribble test(sec)	10.41	1.44	26.13	5.15	32.195	<0.001
Back strength (Kg)	114.56	12.77	102.47	29.79	4.080	<0.001

DISCUSSION

Hockey is a short-distance sport where running means mostly sprinting, and the sprinting-distances vary from only a few meters to not more than 50 or 60 meters. Therefore, quickness, explosive strength and agility are the characteristics that significantly influence performance in the field hockey. Athletes with poor back muscle strength are prone to sports specific injuries (Latiner et al. 1999). It was also reported that reduced back extensor muscle strength might be a major risk factor for non-specific low back pain (Biering-Sorensen 1984, Beckman and Buchanan 1995). Thus, assessment of back strength is one of the important preventive measures for sports persons. It was reported that a battery of anthropometric and morphological tests could distinguish between players of different ability in the same sport (Keogh 1999). The same is true

for the field hockey too (Manna et al 2009, Scott 1991, Singh et al. 2010, Reilly and Borrie 1992).

Table 2. Correlation matrix of back strength, selected anthropometric variables and performance tests in inter-university male hockey players

Variables	HT	WT	BMI	%BF	KH	LOF	FBD	SM	S&RT	ST	BS
HT	1	0.61**	-0.005	-0.007	0.70**	0.84**	0.06	0.10	0.17	-0.02	-0.01
WT	0.67**	1	0.79**	-0.79**	0.46**	0.58**	-0.04	-0.02	0.08	-0.01	-0.07
BMI	0.23	0.78**	1	1.00**	0.04	0.08	-0.09	-0.01	-0.02	-0.09	-0.09
%BF	-0.16	0.21*	0.30**	1	0.04	0.08	-0.09	0.09	-0.02	-0.01	-0.09
KH	0.62**	0.55**	0.32**	-0.26**	1	0.61**	0.06	0.09	0.08	0.09	0.13
LOF	0.34**	0.16	0.09	0.30**	-0.11	1	0.06	0.09	0.17	0.06	-0.02
FBD	0.45**	0.50**	0.34**	-0.20*	0.53**	-0.16	1	1.00**	0.13	0.07	-0.01
SM	0.67**	0.67**	0.42**	-0.20*	0.61**	-0.05	0.75**	1	0.08	0.99*	0.19
S&RT	-0.01	0.08	0.14	-0.18*	0.12	-0.30**	0.19	0.20*	1	0.07	0.04
ST	-0.20*	-0.18*	-0.06	0.52**	-0.47**	0.56**	-0.43**	-0.43**	-0.40**	1	-0.21
BS	0.25*	0.32**	0.15	-0.01	0.28**	0.12	0.22*	0.30**	-0.20*	-0.01	1

Upper triangle indicated the hockey players; Lower triangle indicated controls; *Significant at 0.05 level (2 tailed); **Significant at 0.01 level (2 tailed).

In the present study, comparisons of back strength, anthropometric variables and performance tests were made between inter-university male field hockey players and controls. Significant differences ($p \leq 0.003-0.001$) were found in all the variables studied between the male hockey players and their control counterparts. These differences were probably due to effect of regular physical exercise and vigorous training program in hockey players. It was also found that, no significant correlations of back strength were found with any of the variables studied. This particular finding of the present study was in contradiction with the earlier findings (Roy and Pal 2001, Koley and Inder 2014, Koley and Vashishth 2014, Koley and Jain 2013, Koley and Bijwe 2013, Sharma et al. 2012, Koley et al. 2012a and 2012b) where they had stated that several anthropometric variables were strongly correlated with back strength in different populations. In

fact, Koley et al. (2012b) reported strong correlation of back strength with number of anthropometric variables and performance tests in Indian hockey players of national level, showing structural and physiological affinity of back strength towards those variables. Surprisingly, in the present study, no significant correlations of back strength were found with any of the variables studied, may be due to small sample size. Larger sample size covering other states of the country and more anthropometric variables and performance tests would be considered for this purpose in future studies.

CONCLUSION

In conclusion it may be stated that back strength may not be used as one of the indicating factors for the performance of the field hockey players.

REFERENCES

Ayrapetyanz LR, Godik MA 1991. *Sports Games*. IbnSina Press, Tashkent.

Bale P, McNaught-Devis P 1983. The physique, fitness and strength of top class women hockey players. *Journal of Sports Medicine and Physical Fitness* **23**: 80-88.

Beckman SM, Buchanan TS 1995. Ankle inversion injury and hypermobility: Effect on hip and ankle muscle electromyography onset latency. *Archives of Physical Medicine and Rehabilitation* **76**(12): 1138–1143.

Biering-Sorensen FA 1984. Physical measurements as risk indicators for low-back trouble over a one-year period. *Spine* **9**: 106-119.

Bril MS 1980. *Selection in Sport Games*. Physical Culture and Sport, Moscow.

Fedotova EV, Bril MS, Martirosov EG 1990. Element of morpho-function model of elite female field hockey players (review). *Scientific Sport Bulletin* **2**: 29-33.

Keogh J 1999. The use of physical fitness scores and anthropometric data to predict selection in an elite under-18 Australian rules football team. *Journal of Sport Science and Medicine* **2**: 125–133.

Koley S, Bijwe V 2013. Correlations of Back Strength with Selected Anthropometric Traits and Performance Tests in Elite Indian Volleyball Players. *European Journal of Sports and Exercise Science* **2(2)**: 1-5.

Koley S, Inder R 2014. Study of back strength and its correlations among anthropometric variables and performance tests in inter-university basketball players. *European Journal of Sports and Exercise Science* **3(2)**: 1-5.

Koley S, Jain VK 2013. Correlations of back strength with selected anthropometric variables and physical performance tests in elite Indian cyclists. *Annals of Biological Research* **4(11)**: 80-84.

Koley S, Jha S, Sandhu JS 2012b. Estimation of Back Strength and Its Association with Selected Anthropometric and Physical Fitness Variables in Indian Inter-university Field Hockey Players. *The Anthropologist* **14(4)**: 359-363.

Koley S, Kalsi R, Sandhu JS 2012a. Estimation of Back Strength and Its Association with Selected Anthropometric Variables in School Going Children of Amritsar, Punjab. *The Anthropologist* **14(4)**: 339-346.

Koley S, Vashishth D 2014. Correlations of Back Endurance with Anthropometric Variables and Performance Tests in Indian Elite Male Hockey Players. *Human Biology Review* **3(2)**: 175-183.

Latiner J, Maher CG, Refshauge K, Colaco I 1999. The Reliability and Validity of the Beiring-Sorensen Test in Asymptomatic Subjects and Subjects Reporting Current or Previous Nonspecific Low Back Pain. *Spine* **24**: 2085-2090.

Lemmink K, Elferink-Gemser MT, Visscher C 2004. Evaluation of the reliability of two field hockey specific sprint and dribble tests in young field hockey players. *British Journal of Sports Medicine* **38**: 138-142.

Lohmann TG, Roche AF, Martorell R 1988. *Anthropometric Standardization Reference Manual*. Champaign, IL: Human Kinetics Books.

Manna I, Khanna GL, Dhara PC 2009. Training induced changes on physiological and biochemical variables of young Indian field hockey players. *Biology of Sport* **26(1)**: 33-43.

Matiegka . 1921. The testing of physical efficiency. *American Journal of Physical Anthropology* **4**: 223-230.

- Mokha R, Sidhu LS 1987. Body fat in various sportive groups. *Journal of Sports Medicine and Physical fitness* **27**: 376-379.
- Nikitushkin VG, Guba VP 1998. *Methods of Selection in Team Sports*. IKAP Press, Moscow.
- Reilly T, Borrie A 1992. Physiology applied to field hockey. *Sports Medicine* **14**: 10-26.
- Reilly T, Secher N, Snell P, Williams C 1990. *Physiology of Sports*. E.&F.N. Spon, London.
- Roy SK, Pal B 2001. Factor influencing Back Strength and the changes due to age of the Oraon Agricultural Labourers of the Jalpaiguri District, West Bengal. *International Journal of Anthropology* **16(4)**: 263-273.
- Scott PA 1991. Morphological characteristics of elite male field hockey players. *Journal of Sports Medicine & Physical Fitness* **31**: 57-61.
- Seluyanov VN, Sarsaniya SK 1991. *Conditioning in Team Sports (Field Hockey, Soccer, Ice Hockey)*. RSAPE Press, Moscow.
- Sharma A, Tripathi V, Koley S 2012. Correlations of Anthropometric Characteristics and Physical Fitness Tests in Indian Elite Field Hockey Players. *Journal of Human Sport and Exercise* **7(3)**: 698-705.
- Singh M, Singh MK, Singh K 2010. Anthropometric measurements, body composition and physical parameters of Indian, Pakistani and Sri Lankan field hockey players. *Serbian Journal of Sports Sciences* **4(2)**: 47-52.
- Sodhi HS 1991. *Sports Anthropometry*. ANOVA Publications, Mohali.
- Volkov VM, Filin VP 1983. *Sport Selection*. Physical Culture and Sport, Moscow.
- Withers RT, Roberts RGD 1981. Physiological profiles of representative women softball, hockey and netball players. *Ergonomics* **24**: 583-591.
- Womersely J, Durnin JUGA 1977. A comparison of the skinfold method with extent of "overweight" and various weight height relationships in the assessment of obesity. *British Journal of Nutrition* **38**: 271-284.