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Shyamal Koley and Rajpreet Uppal

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CORRELATIONS OF STATIC BALANCE WITH HANDGRIP STRENGTH AND ANTHROPOMETRIC VARIABLES IN INDIAN INTER-UNIVERSITY ARCHERY PLAYERS

Shyamal Koley[1*] and Rajpreet Uppal[2]

[1,2] Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar -143005, Punjab, India

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ABSTRACT

The purpose of this study was to evaluate the static balance of Indian inter-university archery players and to search its correlations with handgrip strength and selected anthropometric variables in purposely selected 109 Indian inter-university archery players (57 males and 52 females) aged 18–25 years collected from the competition organized in Guru Nanak Dev University, Amritsar, India. An adequate number of controls (n = 113, 59 males and 54 females) were also taken from the same place for comparison. A total of seven anthropometric variables, viz. height, weight, BMI, percent body fat, percent lean body mass, dominant and non-dominant handgrip strength and two static balance tests, such as standing balance test and stork balance test were measured on each subject. In results, one-way ANOVA showed significant between-group differences ($p \leq 0.006$ - 0.001) in all the variables, except stork balance test among these four sets of population. In Indian inter-university archery players, standing balance test, had statistically significant positive correlations ($p \leq 0.025$ - 0.001) with weight, BMI, percent body fat, right and left handgrip strength, and significant negative correlation ($p \leq 0.025$) with percent lean body mass. However, no significant correlations were found between stork balance test and selected anthropometric variables among them.

INTRODUCTION

Archery is considered as a static sport that requires strength and endurance of the upper body, especially the arms, waist and shoulder. The archer's skill is defined by the ability to shoot an arrow at the target within a certain range of time with maximum precision [1]. Ricotti [2] studied the static and dynamic balance in young athletes and concluded that to create good adult athletes it was of primary importance that the attention was paid for a complete and harmonic development of motor abilities at early ages. It was reported earlier too that postural balance was related to the shooting accuracy both directly and indirectly through stability [3].

Balance is the ability to maintain the body's position over its base of support, whether that base is stationary or moving. Controlling postural sway during stable conditions is called static balance [4]. As a component of motor function, balance is ensured through the connection among sight, deep sensory organs and motor system. It can change according to the musculoskeletal system, age, visual and vestibular stimulation and the unity of these components. Balance is the base for all the movements and effected by various factors, viz. stress and mental setup of the athletes [5], reaction of head coordination and body position [6], visual stimulations [7], muscular tonus and neuromuscular reflection [8], sensory information, joint range of motion, and strength [9-11] repetitive training experiences [12].

Anthropometric dimensions and morphological characteristics play an important role in determining the success of an athlete [13-15]. Quite naturally, the interest in anthropometric characteristics of athletes from different competitive sports has increased tremendously over the last decades. It has been well established that specific physical characteristics or anthropometric profiles indicate whether the player would be suitable for the competition at the highest level in a specific sport [16-20].

Information regarding the association of static balance and anthropometric variables remained largely unreported, especially in Indian context. So the present study was planned with the hypothesis that there would be significant differences in the static balance tests and selected anthropometric characteristics in the inter-university level archers and controls.

*Corresponding author: **Shyamal Koley***
Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar -143005, Punjab, India

There would be significant correlations between the static balance and selected anthropometric variables in the inter-university level archers.

MATERIALS AND METHODS

Subjects

The present cross-sectional study was based on purposely selected 109 Indian inter-university archery players (57 males and 52 females) aged 18–25 years (mean age 20.91 ± 1.84 years) collected from the competition organized in Guru Nanak Dev University, Amritsar, India during September, 2015. An adequate number of controls (n = 113, 59 males and 54 females, mean age 20.94 ± 2.17 years) 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 institutes. The subjects were divided in such a way that age 18 refers to the individuals aged 17 years and 6 months through 18 years and 5 months and 29 days. 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 ethics committee.

Anthropometric Measurements

Seven anthropometric variables, such as height, weight, BMI, percent body fat, percent lean body mass, dominant and non-dominant handgrip strength were taken on each subject using the techniques provided by [21] 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. The subject was asked to stand erect on the stadiometer with bare foot. The horizontal bar of the stadiometer was placed on the vertex of the subject and the readings were recorded. Weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg.The subject was asked to stand erect on the digital weighing machine with minimum cloths and bare foot.

The readings were recorded from the scales of the digital weighing machine in kilograms. BMI was then calculated using the formula weight (kg)/height^2 (m) ^{2}. Percent body fat was assessed using BMI after [22]. Percent lean body mass was calculated subtracting percent body fat from 100.

Handgrip Strength Measurement

The grip strength of both right and left hands was measured using a standard adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., LTD, Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The dynamometer was held freely without support, not touching the subject's trunk.

The position of the hand remained constant without the downward direction. The subjects were asked to put maximum force on the dynamometer thrice from both sides of the hands. The maximum value was recorded in kg. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment.

All subjects were tested after 3 minutes of independent warm-up. Thirty seconds time interval was maintained between each handgrip strength testing.

Static Balance Tests

Two balance tests were considered for the present study, these were standing balance test and stork balance test.

Standing Balance Test

The subject was asked to stand on one leg for as long as possible. The subject was given a minute to practice his balancing before starting the test. The timing stopped when the elevated foot of the subject touched the ground or the subject hopped or otherwise lose his balance position. The best of three attempts was recorded. The test was repeated on the other leg also. The total length of time person could stay in the balance position was recorded.

Stork Balance Test

The stork balance test was done after [23]. The subject was asked to remove the shoes and place the hands on the hips, then to position the non-supporting foot against the inside knee of the supporting leg. The subject was given one minute to practice the balance. Then the subject raised the heel to balance on the ball of the foot. The stopwatch was started as the heel was raised from the floor. The stopwatch was stopped if any of the follow occurred:

The hand(s) came off the hip, the supporting foot swiveled or moved (hopped) in any direction, the non-supporting foot lost contact with the knee, or the heel of the supporting foot touched the floor. The total time in seconds was recorded. The score was the best of three attempts. The rating of the test was done counting the total time stayed in the balanced position by the participants.

Statistical Analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. One way analysis of variance was tested for the comparisons of data among Indian inter-university archery and controls, followed by post-hoc Bonferroni test. 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 static balance tests and anthropometric variables of Indian inter-university archery players and controls were shown in Table 1. One way ANOVA showed significant between group differences ($p \leq 0.006$ - 0.001) in all the variables studied, except stork balance test among these four sets of population.

When sex differences were compared, significant differences ($p \leq 0.006$ - 0.001) were found in all the variables, except stork balance test between Indian inter-university male and female archery players.

Table 1 Descriptive statistics of static balance tests and selected anthropometric variables in archery Players and controls

Variables	Male archers		Control males		Female archers		Control females		F-value	p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Height (cm)	168.62	5.32	169.64	5.67	160.26	5.01	158.38	5.83	54.916	<0.001
Weight (kg)	64.08	8.31	67.06	10.46	53.46	6.44	55.12	8.13	30.997	<0.001
BMI (kg/m^2)	22.56	2.64	23.27	2.95	20.89	2.07	21.99	3.07	6.837	<0.001
Percent body fat	27.44	3.62	28.47	3.98	25.22	2.93	26.73	4.23	6.743	<0.001
Percent lean body mass	72.56	3.62	71.52	3.98	74.78	2.93	73.27	4.23	6.731	<0.001
Right handgrip strength kg	88.66	14.29	85.44	15.44	56.88	11.25	59.68	10.92	81.016	<0.001
Left handgrip strength kg	86.30	14.80	86.48	14.49	50.56	10.06	54.66	10.52	119.502	<0.001
Stork balance test(sec)	9.96	7.33	10.98	7.79	10.20	7.95	9.44	7.08	0.360	0.782
Standing balance test (sec)	162.24	110.12	177.02	116.56	111.38	53.84	141.28	95.37	4.298	<0.006

Table 2 showed the correlation coefficients of static balance tests with selected anthropometric variables in Indian inter-university archery players. In standing balance test, statistically significant positive correlations (p≤0.025 - 0.001) were found with weight, BMI, percent body fat, right and left handgrip strength, and statistically significant negative correlation (p≤ 0.025) with percent lean body mass. However, no significant correlations were found between stork balance test and selected anthropometric variables in Indian inter-university archery players.

Table 2 Correlation coefficients (r) of stork balance test and standing balance test with selected anthropometric variables in archer players

Variables	Stork balance test		Standing balance test	
	r-value	p-value	r-value	p-value
Height (cm)	-0.072	0.474	0.167	0.097
Weight (kg)	0.090	0.372	0.266	<0.008
BMI (kg/m^2)	0.186	0.065	0.228	<0.023
Percent body fat	0.180	0.073	0.225	<0.025
Percent lean body mass	-0.180	0.073	-0.225	<0.025
Right handgrip strength kg	0.102	0.314	0.361	<0.001
Left handgrip strength kg	-0.025	0.801	0.381	<0.001

DISCUSSION

In archery, as in many other sports, the proximity of the competition is cause for anxiety, which, depending on the competitive level, may impose a great stress, this intervening factor in the athlete precision degree and therefore decisive performance. The accumulation and interaction of stressors during periods of training and intervals can help to explain how the changes occur in athletic performance [3] in fact; stress must be expressed in different ways in each individual. The anthropometric profile of an athlete plays an important role in determining his or her potential for success within a sport [16, 13-15, 20]. Not much literature is available towards static balance and anthropometric variables in archery, especially in Indian context. Thus, to fulfill the lacunae of knowledge, the present study was undertaken.

The findings of the present study showed significant inter and intra-group differences in all the variables (except stork balance test) among archery players and controls. It was also found that off the two static balance tests, standing balance test had statistically significant positive correlations with weight, BMI, percent body fat, right and left handgrip strength, and statistically significant negative correlation with percent lean body mass. In this connection, Koley and Gupta [24] reported the correlations of static balance test and selected anthropometric variables in Indian shooters. Era *et al*. [25] reported that male top level shooters could stabilize their posture significantly better than female top level or male national level shooters who were, in turn, much more stable than naïve shooters. Aalto *et al*. [26] also opined that trained shooters had significantly better stability than untrained controls, when tested without supportive clothing. In contrary, it was also reported that gymnasts and soccer players did not differ in terms of static and dynamic balance, basketball players displayed inferior static balance compared with gymnasts and inferior dynamic balance compared with soccer players [27].

CONCLUSION

From the findings of the present study it might be concluded that though stork balance test had statistically no significant correlations with any of the anthropometric variables in Indian inter-university archery players, standing balance test had strong association with dominant and non-dominant handgrip strength and selected anthropometric variables.

Practical Application

The data presented in the present study carry immense practical application and may be useful in future investigation on player selection, talent identification and training program development in archery.

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