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ANTHROPOMETRIC, PHYSICAL FITNESS AND KINEMATICS ANALYSIS OF THE JUMP SHOT OF FEMALE HANDBALL PLAYERS - A CASE STUDY OF THE ISLAMIA UNIVERSITY BAHAWALPUR, PAKISTAN

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ABSTRACT

Background: This study was designed in two poles, 1st to examine the kinematic parameters of the handball jump shot and 2nd to compare the anthropometric, and physical fitness of novice and skilled female handball players of the university level.

Methods: This study design was cross-sectional, and a purposive sampling method was adopted for selecting the participants. The sample consisted of (n = 20) novice, and (n = 20) university female handball players. The selected variables were standing broad jump, vertical jump, flexibility, 30-m dash, agility, stride length, stature, body mass, arm length, upper arm girth, leg length, chest girth, waist girth, hip girth, thigh girth, calf girth, hand length, handbreadth and shoulder breadth, pelvic breadth, transverse breadth, elbow and knee breadth, handgrip and arm span, left and right knee angle, left and right elbow angle. An Independent t-test was applied to examine differences between skilled and novice players in kinematics and anthropometric variables.

Results: Results showed the skilled female players were significantly higher than the novice players in the following as right elbow angle at the start of movement (<. 03), left elbow angle at the start of movement (<. 00), right knee angle at the start of movements (< .03), stride length at release (< .01), 30-meter dash (< .04), handgrip strength(< .02), agility (< .03), forearm girth (< .03), thigh girth (< . 03) and arm span (< .04).

Conclusion: It was concluded the higher angle of elbows, right knee along with more prolonged stride increase the movement capacity of skilled female handball player while attempting the jump shots than novice female players. On the other hand, the anthropometric and fitness measures as arm span, thigh girth, running speed, handgrip strength, and agility increase the performance of skilled players than the novice. The female handball coaches may enhance the performance of novice players by focusing on the specific training of extension and flexion of elbows and stride movement as well as enhancing the physical fitness of female handball players. Future studies would focus on the training of handball players to increase the jump shot performance of players.

Keyword: kinematics, handball, jump shot, anthropometry, physical fitness, handball performance, female handball players

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INTRODUCTION

The jump shot is a typical technique in handball for shooting the ball at the goal. Post important performance factors in handball are high throwing speed and precision on goal. The velocity of ball release has been linked to anthropometric variables such as height, body mass, hand size, girths, and lengths of the body segments [1]. Various factors involved in the success of handball jump shoot as body size, backward and forward movement of the body segments, and sequence of the movement. The acceleration of the ball in handball overarm throws is the primary function of the shoulder rotation and elbow extension [2,3]. The jump shot action starts from the take-off at the opposite leg of throwing hand - as of right thrower take-off jump from the left leg [4]. The shooting arm raises up and backward and swings forward to throw the ball at goal [5]. The accuracy of the jump shot depends on the running, jumping, maximum ball velocity, which reduces the stopping chance of the goalkeeper. To achieve a higher speed of throwing ball depends on the arm's length, strength, and sequence movement of the body segments, which starts from the leg, transferred into the ball through trunk, shoulders, arms, and hand. Several studies reported skilled players produces faster ball speed compared to novice players [2,6, 7]. On the other hand, Granados et al. [7] no differences in the throwing speed of national and international female handball players. However, the jump shot is the most effective technique in handball, which starts with the take-off from the left leg and swing of the right arm [4,9].

There is a lack of research in Pakistan which measure the kinematics, anthropometric, and fitness of female handball players. The goal of this study was, therefore, to quantify possible differences in throwing ability as a function of anthropometry, physical fitness, and jump shot kinematics.

In some, this study focusses on comparing the basic kinematic parameters of Jump shot between the novice and skilled handball female players, anthropometric measures, and physical fitness of the female handball players of the Islamia University of Bahawalpur.

METHODS AND MATERIAL

Participants

The nature of the study is a cross secessional and purposive sampling method was adopted for data collection. Twenty participants, female handball players 2-to- 3 years playing experience, and (n = 20) skilled with 8-10 years playing experience were selected for this study. Age (Novice = 21.33 ± 1.50 years; skilled = 22.21 ± 1.19 years), Weight (Novice = 55.20 ± 8.22 kg; skilled =57.86 ± 6.44 kg), Height (Novice = 163.83 ± 1.55cm; skilled = 166.48 ± 1.45cm). A consent letter was obtained from all participants to ensure their willingness to participate.

The Procedure of Data Collection

A standard weight balance was used to measure body mass [10]. A stadiometer was used to measure the stature from the ground surface to the vertex [11, 12]. A 1-meter measuring tape was used to measure the girths of arm flex, arm relax, forearm, wrist, chest, waist, hip, thigh, and calf. A large sliding bone caliper was used to measure the lengths of the upper arm, lower arm, hand, upper leg, lower leg [10]. The breadth variables were measured as shoulder, pelvis, chest, elbow, and knee. The arm span was measured by using a wall pasted meter chart at the horizontally at the wall. A 46 cm bench was used to measure the sitting height. The physical fitness variables were measured as, standing broad jump, flexibility by using flex meter, t-shape zigzag run for agility test, the 30-meter race for speed, and vertical jump for leg strength. The handgrip dynameters were used to measure grip strength in the following of [13].

Two video cameras, a 1-meter calibration frame, Tripod, reflective markers, and standard handball were used for collecting the videos of the jump shot. Two digital video cameras were placed 6 meters away from the volume, where the thrower attempt jump shot towards the goal post. The height of the camera was 1.30 meters above from the ground surface to capture the movement of the sagittal plane from the right side of the throwers along with video capturing speed was 30 frames/second, as suggested by [14]. Reflective markers were pasted at the toe, ankle, knee, hip, shoulder, elbow, wrist, and hands of the throwers. A 1-meter calibration frame was placed in between the camera and volume of action. Each player was given proper warm-up time, and warm-up throws before the commencement of the original trial. Six trials were given to each player for data collection. The handball coaches were requested to watch videos of all trials in slow motion and selected two best throws.

On the other hand, a chart was prepared to mention the accuracy of throw during the time data collection. These selected trials were transferred into the computer and used Kinovea software for further kinematics analysis. Kinovea software for 2-dimensional analysis for linear and angular kinematics of jump shot. The kinematics data were considered at the initial movement of throw and at the time of ball release. The angular kinematics variables were knee, hip, shoulder, elbow angle along with the stride movements of throwers.

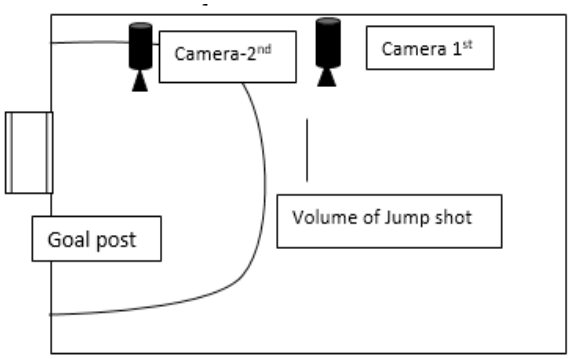

Figure 1: Jump Shot volume of action with data collection set-up at the handball court

After the data collection and data management, the next process was testing the reliability and validity of the data. The inter-rater reliability method was adopted to test the

reliability of the investigator and the selected instruments. An interclass correlation was applied to examine reliability.

Statistical Analysis

The means and standard deviations of the study were calculated. An independent *t*-test was applied to examine the difference between skilled and unskilled female handball players in anthropometric, physical fitness, and kinematics of the jump shot. The significance value was adopted at $p < 0.05$.

RESULTS

The data was consisting of (n = 20) novice and (n = 20) skilled university female handball players. Table 1 shows no significant differences among the groups in age, stature, and body mass. Table 2 shows the significant differences in the anthropometric measurements of forearm girth, thigh girth, leg length, and arm span. Table 3 shows no significant differences among the groups in broad stand jump, vertical jump, flexibility, 30-meter race, and agility. Table 4 shows the significant differences in the left and right elbow angle at preparatory, Stride length at release, right knee angle at the time of preparatory and ball release.

Table 1: Demographic comparison of novice and skilled university female handball players

Variables	Groups	Mean	St.D	*t.*	*Sig*
Age (year)	Novic	21.33	1.50	-1.41	.18
	Skilled	22.21	1.19		
Stature (cm)	Novic	163.83	1.85	.41	.68
	Skilled	166.48	1.45		
Body mass(kg)	Novic	55.20	8.22	.09	.93
	Skilled	57.86	6.44		

P. value < 0.05

Table 2: Anthropometric comparison of novice and skilled university female handball players

Variables	Groups	Mean	StD	*t.*	*Sig.*
arm girth (cm)	Novic	31.86	1.72	1.89	.07
	Skilled	28.81	3.73		
Forearm girth (cm)	Novic	18.52	1.38	2.30	.03
	Skilled	21.02	2.48		
Chest girth (cm)	Novic	81.36	6.24	1.28	.22
	Skilled	84.81	5.21		
Waist girth (cm)	Novic	70.70	17.71	.48	.64
	Skilled	74.61	16.26		
Thigh girth (cm)	Novic	53.35	6.63	2.30	.03
	Skilled	45.25	5.56		
Calf girth (cm)	Novic	31.53	6.87	.11	.92
	Skilled	31.26	4.22		
Hand length (cm)	Novic	18.69	1.212	.54	.60
	Skilled	21.21	11.22		
Arm length (cm)	Novic	65.20	10.10	.35	.73
	Skilled	63.71	8.30		
Leg Length (cm)	Novic	87.85	3.80	2.10	.04
	Skilled	81.74	4.12		
Handbreadth (cm)	Novic	3.88	1.75	1.51	.15
	Skilled	3.11	1.14		
Shoulder breadth (cm)	Novic	9.04	2.19	1.62	.12
	Skilled	7.61	1.64		
Pelvic breadth (cm)	Novic	15.34	1.75	.73	.47
	Skilled	14.50	2.55		
Transverse breadth (cm)	Novic	32.84	6.53	1.67	.11
	Skilled	20.95	7.89		
Elbow breadth (cm)	Novic	6.68	2.82	.33	.75
	Skilled	6.24	3.21		
Knee breadth (cm)	Novic	6.69	2.81	.60	.56
	Skilled	8.11	5.75		
Arm span (cm)	Novic	171.00	5.32	2.26	.04
	Skilled	155.22	4.66		

P Value < 0.05

Table 3: Physical fitness of novice and skilled university handball female players

Variables	Groups	Mean	Std. D	*t.*	*Sig.*
Vertical jump (m)	Novic	2.68	0.51	-0.61	.55
	Skilled	2.81	0.40		
Stand broad jump (m)	Novic	19.10	2.40	0.09	.93
	Skilled	17.71	2.83		
Flexibility (inch)	Novic	8.17	1.72	0.01	.99
	Skilled	8.16	1.77		
Race 30 Meter (sec)	Novic	6.41	1.66	2.03	.04
	Skilled	5.03	1.44		
Handgrip strength (kg)	Novic	30.01	9.56	2.67	.02
	Skilled	39.83	7.03		
Agility (sec)	Novic	11.42	1.82	-2.15	.03
	Skilled	9.81	1.63		

P value < 0.05

Table 4: Angular kinematics of novice and skilled university handball female players

Variables	Groups	Mean	Std. D	*t.*	*Sig.*
Left knee at preparatory (^{0})	Novic	148.33	21.11	.24	.86
	Skilled	152.78	41.22		
Right knee at preparatory (^{0})	Novic	121.33	25.73	2.53	.03
	Skilled	147.07	28.84		
Left elbow at preparatory (^{0})	Novic	105.17	34.38	3.76	.00
	Skilled	148.64	17.98		
Right elbow at preparatory(^{0})	Novic	91.17	10.50	2.60	.02
	Skilled	70.00	12.20		

Stride length at preparatory(m)	Novic	0.43	0.18	.09	.92
	Skilled	0.44	0.10		
Left knee at release (^{0})	Novic	158.00	16.37	.37	.72
	Skilled	151.00	44.65		
Right knee at release (^{0})	Novic	91.17	12.17	2.26	.03
	Skilled	107.57	13.71		
Left elbow at release (^{0})	Novic	88.17	30.64	1.01	.32
	Skilled	107.43	41.66		
Right elbow at release (^{0})	Novic	150.17	16.82	.31	.76
	Skilled	154.43	31.23		
Stride length at release (m)	Novic	0.55	0.05	2.72	.01
	Skilled	0.46	0.07		

P Value < 0.05

DISCUSSION

Forty female handball players were selected and divided into two groups according to their playing experience. Each participant performed six trials of a jump shot. The result shows that the skilled female thrower was significantly higher in forearm girth, thigh girth, leg length arm span, handgrip strength, 30-meter dash, and agility than the novice female handball throwers. In the comparison of the kinematics analysis, a significant difference was found regarding the left elbow at preparatory, right knee angle at preparatory and ball release position, and in the stride length at throwing time. Results of female handball players to tested anthropometric and physical variables. The finding of this study a line with (Lindner et al. 2012) [15] that physical fitness as like handgrip strength, 30-meter race, and agility. Would assist handball players in throwing jump shot with higher speed and throwing accuracy. The current study confirms that players the findings of (Peña et al. 2018) [16] athletes who perform jump shots would be stronger in anthropometric measures. It is confirmed the significant differences were found regarding forearm girth. The comparison of linear, angular kinematics among the groups. The right knee angle plays a significant role in the performance of the jump shot. The extension of the right knee keeps the body position of thrower upright, which increases the ball speed and accuracy. On the other hand, stride length enhances the performance of the athlete while it takes a larger distance with faster action toward the goal post.

CONCLUSION

It is concluded the forearm girth, thigh girth, leg length, and arm span are associated with a higher throwing ball speed of jump shot. These specific parts of handball players produce a burst of force at jumps shot at the time of ball release from the hand. On the other hand, the physical capacity as speed, handgrip strength, and agility assist of female university handball players are associated with maintaining the balance position and backward swing to gain energy for getting higher velocity of ball throw. Finally, the higher extension of the right leg and elbow is associated with higher ball speed after releasing from the hand of the throwers. Therefore, these finding and key points of the study may be noticed for the selection and training of female handball players

Future Recommendations

In light of the findings of the present study, the following recommendations are made to the coaches, physical educators, and players. The result of the study can be used by the coaches and physical education teachers for screening and selection of the female handball players. It is recommended that a similar study may be conducted by selecting a different age, height groups, and level of achievement. To improve the standard of handball players talent hunt scheme should be launched specially for the rural areas and should be selected based on their anthropometric and physical parameters and given training.

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