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Impact of Resistance Training on Body Composition and Kinematics of Volleyball Service of Female Players

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Abstract

The aim of this study was to compare experimental and control groups of female volleyball players in their body composition, physical fitness, and volleyball serves. The selected participants were the (n = 17) experimental group and the (n=17) control group of female volleyball players. Eight weeks strength training program was implemented for the experimental group and the control group remain at the routine volleyball practice. The selected variables for this study were body mass, stature, eight skinfolds, eight girths, five lengths, and kinematics analysis of volleyball service. The kinematics of volleyball serving skills were assessed with two video cameras and software. Repeated measures of ANOVA were applied for statistical analysis to compare the experimental and control groups. Results exhibited that the players of the experimental group were significantly affected after eight weeks of strength training in the following measures triceps skinfold, abdomen skinfold, thighs skinfold, calf skinfold, elbow angle, and knee angle than the control group. It is concluded that the lesser skinfold measures show the reduction of fat percentage of experimental groups and straightening the elbow angle and knee angle improves the accuracy of volleyball service. Therefore, it is recommended that beginner female volleyball players should be trained with game skills along with resistance training programs.

Keywords: Female volleyball players, volleyball service, physical fitness, kinematics analysis

Introduction

The performance of volleyball players depends on body physique, physical fitness, and game skills which play keys to successful performance (Gangey & Kerketta, 2006; Sahin et al., 2015). Volleyball skills required accuracy in jumping, ball striking, agility, flexibility, strength, and endurance capacity to enhance volleyball performance (Lidor & Ziv, 2010). Each player must perform

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a given role according to his playing position (Hong et al., 2018), which required a good ability in vertical jumping to perform good service, defense, and smashing (Sheppard et al., 2009). Therefore, appropriate training is required to enhance the performance of volleyball players. Various training programs enhance physical strength and improve performance in blocking, smashing ball settings, and service (Bale & Mcnaught, 1983). Strength training is concerned with the ability to control the movements of ballistic and sport-game performance (Ivashchenko, et al., 2016). Resistance training would also be considered more important to improve the performance of volleyball players as recovery time, reaction time, and physiological adaptation to achieve optimal performance (Haff et al., 2008; Qadir et al., 2020). This training program is a cluster set of work with short periods of rest between first and second repetitions that slow fatigue-induced, increase speed and improve the offensive and defense performance of players in competitions (Oikonomopoulou et al., 2022). This training program is associated with physical fitness, increases muscular strength, and neuromuscular coordination which is associated with the performance of volleyball service, smash, digging, and block (Fischetti, et al., 2018; Petrigna et al., 2019). Resistance training also positively impacts to reduces the body fats, and strength of the upper and the lower limbs to improve the performance of female players (Chatterjee & Bandyopadhyay, 2022). Previous studies have compared the body composition of skilled and unskilled female volleyball players (Malousaris et al., 2008). There is a lack of scientific literature focused on studying the kinematic properties of female volleyball players while performing volleyball services (Cabarkapa et al., 2022). Few studies compare the kinematics of various volleyball skills (Reeser et al., 2010; MacKenzie et al., 2012; Waqas et al., 2020; Rusdiana, 2022). A study discovered the angular displacement of the head, trunk, and shoulder during volleyball service and their impact on volleyball performance (Acar & Elar., 2019). Therefore, a study is needed to examine the emphasis on body composition and kinematics of volleyball service of female volleyball. There was no experimental study that examined the resistance training effects on the performance of female volleyball players in Pakistan. Investigation of the body composition and service skills would assist the officials and coaches in team selection as well as in learning the effects of resistance training on the performance of female volleyball players. This study is required to fill the research gap through the anthropometric measures, kinematic analysis, and resistance training's impact on the performance of female volleyball players.

Research Methodology

The study was carried out with the following participants (experimental group = 17) and (control group = 17), age of all female volleyball players was (age =

20.23 ± 5.23 years). Consent letters were obtained from all participants to confirm their voluntary participation in the study. All data were collected pre-experimental and post-experimental, on the premises of the Islamia University of Bahawalpur, Pakistan. The first phase of this study was to measure the anthropometric characteristics of female volleyball players of both groups.

Measurements of the Anthropometric and Physical Fitness

The selected variables of the study were stature, body mass, eight skin folds, nine girths, seven lengths, five breaths, and the kinematics of volleyball service (Gulati et al. 2021). Before starting all anthropometric measurements body marking of each subject was applied as guided by (Kouchi, 2014). Stadiometer was used to measure height and body weight (Gabbett et al., 2007). Skinfolds were measured by using a Harpenden skinfold caliper (British indicators, UK) calibrated to 0.1 mm as guided by (Ekinci et al., 2015). The caliper was used to measure the thickness of the skin by grasping with the thumb and index finger. Measurements were triceps skinfold, biceps skinfold, subscapular skinfold, ill-crest skinfold, supraspinal, abdomen skinfold, medial thigh skinfold, and calf skinfold. The person's arms were hanging loosely at his sides and standing in a relaxed position without physical support. The biceps skinfold is taken on the front of the upper arm which is elbow flexed at a 90-degree angle, with the palm facing up. The measurement site is on the front of the arm, approximately halfway between the shoulder and the elbow. Using a skinfold caliper, gently grasp the skinfold with the thumb and index finger about 1 centimeter above the marked site. The subscapular skinfold is taken just below the lower tip of the scapula, at an approximately 45-degree angle downwards. Ask the person being measured to raise their arm slightly to allow better access to the measurement site. Using a skinfold caliper, gently grasp the skinfold with the thumb and index finger about 2 centimeters below the site's location.

The iliac crest skinfold is taken just above the hip bone on the right side of the body. The investigator gently grasps the skin with thumb and index figure 2 centimeters above the site's location, where it was marked at the above of the hip joint to measure the skinfold. Using a skinfold caliper, gently grasp the skinfold with the thumb and index finger. For the measurements of the abdomen skinfold, the investigator placed a caliper five centimeters to the right side of the belly button, grasp the skin with thumb and index finger, and apply the caliper horizontally to measure the skinfold thickness. Investigator stood in front of the subject to measure supraspinal as the caliper was placed 45 degrees above the ilium's vertical axis. The skinfold of the frontal thigh was obtained as the participant was asked to sit at 46 centimeters box with her leg bent at a 90-degree angle, one person would assist an index finger to grasp the upper central marked

point of the mid-thigh. For and calf skinfold the subject remained seated throughout the measurement, which was inside the calf muscles.
The girth measurements were made with a one-meter measuring tape to determine how far around each bodily component was. The participant should be standing relaxed, with their hands at their sides. Maximum calf, thigh, forearm, wrist, mesothermal chest, waist, relaxed arm, flexed arm, hip, and minimum waist circumferences were measured as guided (Selimi et al., 2019). All measurements were obtained from the right side and the maximal measurements were obtained from the upper arm, forearm, chest, pelvises, thigh, and calf size. The minimal measurement was obtained wrist waist and ankle. The length measurement was obtained for the upper and lower arm, hand length, upper leg, and lower leg. Subjects were asked to stand erect with their feet together, and their hip maximum was determined using the cross-hand technique (Bekele et al., 2022).

The Performance of Volleyball Skills

The server stands behind the end line of their team's court, within the serving zone (Gabbett, 2008). There are various serving techniques, but the most common ones are the overhand serve and the underhand serve. The player stands with one foot slightly forward for overhand serve, and the ball in their non-dominant hand. The dominant hand is drawn back, and the ball is tossed into the air. As the ball reaches its peak, the server swings its dominant hand forward, contacting the ball's lower part (Singh, 2018; Rusdiana et al., 2021). This causes the ball to travel over the net with topspin, making it dip sharply as it approaches the opponent's court. Underhand serve is typically used by beginner players or those who prefer a more controlled (Palao et al., 2009). The player stands with one foot slightly forward and holds the ball in their non-dominant hand. The dominant hand is used to strike the bottom of the ball, sending it over the net motion (Rusdiana et al., 2021).

Resistance Training Program

An eight-week resistance training program elastic band increases some performance-related parameters in pubertal male volleyball players.

Week	Set × Repetitions	Exercise
1-2	3×12	Standing shoulder press Chest fly Triceps French press Biceps curl Rhomboid squeeze Knee flexion Mini squat

3×4	3×12	Ankle plantar flexion Trunk twist Reverse flies Elbow Kick Back Concentration curl scapular Retraction Lunge Quick kicks
5×6	3×12	Leg press Straight arm pulldown Chest press Wrist flexor Triceps kickback
7×8	3×12	Lying Hamstring curls Trunk curl-up Upright row Dynamic Hug Front raise Squat Knee extension Calf Raise

(Hoffman et al., 2006)

The Procedure of Data Collection of Kinematic of Volleyball Service

The height of the volleyball net for women is 2.24 meters. Each participant was given a normal warm-up time before the start of trials. Then, 5 to 10 attempts were given for practice setting toward a target. The serve was called before the ball was thrown. Each subject's total number of trials was six. For kinematic analysis in the earlier research, the Performa sheet was marking the points as well to confirm videos in slow motion. Each trial was recorded using a high-definition video camera (Power Shot SX530, Canon Inc., Tokyo, Japan) placed 10 m perpendicular to the subject's plane of motion (Raiola et al., 2013). Kinovea software was used to analyze the video data to determine the relevant kinematic parameters.

Descriptions of the Kinematics Variables

Islamia University of Bahawalpur's indoor gymnasium for videography of the volleyball services. Two cameras, set up at right angles, were placed 6 meters away from the participants and 1.12 meters above the ground surface. Cameras were positioned 90 degrees to the right of the server's lateral line. The area where the subjects were stationed was shot to get a 2-D position measurement for use in scaling and calibration. The video recording was set to 60 frames per second (Lu., 1994). This kinematic variable was studied in the first four stages. The first part of stance, the second in the backswing, the third at impact, and the fourth when driving the ball. The X-axis horizontal toe-to-heel distance was used as the standard for determining stride length. Vectors from the toe and the ankle were intersected at the knee joint to get the corresponding ankle angles on the left and right sides of the body. Angles at the knees were measured at the point where the vector from the ankle joints to the knees met the vector from the knees to the hips. The angle formed by the forearm and the upper arm, measured from the elbow to the wrist. Moreover, complete joint extension was defined as 180 degrees, while complete joint flexion was defined as 0 degrees. The joint angle was calculated by calculating the angular difference between two neighboring body segments located inside (Cabarkapa et al., 2022).

Processing of the Video Analysis

The subject was filmed from two views, the side perspective was captured at 60 frames per second and the back perspective at 60 frames per second (Parsons & Alexander 2012). A video camera was also employed to record the sequence of the movement of a participant. Three successful trials were used for the kinematics analysis among six from each participant. Each track from the side perspective was manually digitized. The pre-contact phase was observed to begin 15 frames before contact. The contact phase comprised absorption, and the follow-through lasted seven frames following release. Linear displacements and average velocities were determined for each phase. The contact time was computed from the rear perspective film. Logs of each experiment were made from the films and calculated. Significance at the 0.05 level was determined using analysis of variance as differences were identified (Northrip et al., 1974).

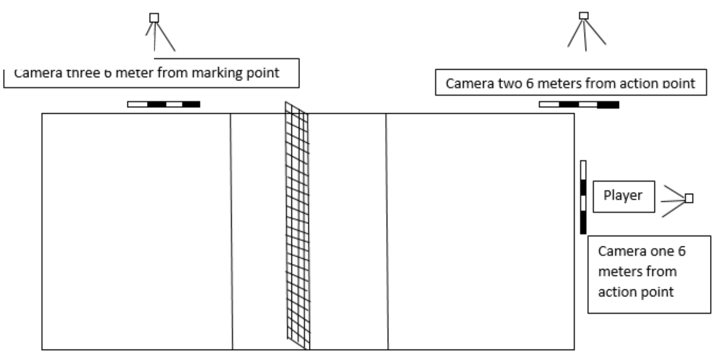

Figure ***Error! No text of specified style in document.****.1.* Two-Dimensional camera setup

Reliability of the Anthropometric Variable

The intra-rater test was chosen because it has high validity and reliability coefficients (Sattler et al., 2015). Using the intra- investigator approach, we ensured that the instruments and the subject's anthropometric measurements were accurate. These same measuring devices were employed in an earlier investigation. As proposed, we used an intra-examiner approach to gauge examiner skill. Thirty-five to forty people were surveyed and measured twice, one day apart, for this purpose (Gantois et al., 2022).

Statistical Analysis

Various statistical methods were used to analyze the variables of anthropometric, physical fitness, and the performance of volleyball service. The descriptive statistics mean, and standardized deviation were obtained. To assess the group comparison between the experimental group and control groups at pre-test and post-test measurements repeated measures ANOVA was applied. An independent sample t-test was applied to examine differences among groups in demographic measures and pre-test measurements. Tukey's post hoc was used to find significant differences between group comparisons at the pretest and posttest stages. The assumption of repeated measures was pursued as data normality, and multicollinearity was followed. The significance values were adjusted at $P < .05$. Statistical analysis was performed using the SPSS version 22 statistical program (SPSS Inc., Chicago, IL, USA) (Batez et al., 2021).

RESULT

Table** Error! No text of specified style in document.**1: Demographic measures of experimental and control groups of female volleyball players

	Pre data				Post data					
	Experimental Group		Control Group		Experimental Group		Control Group			
Variable	***Mean***	***STD***	***mean***	***STD***	***mean***	***STD***	***mean***	***STD***	***F***	***Sig***
Height (cm)	166.25	5.57	165.79	4.85	166.25	5.57	166.05	4.71	1.27	0.27
Weight (kg)	55.01	16.25	52.16	11.86	55.11	17.21	53.81	10.19	0.29	0.59
Arm span(cm)	166.05	4.60	165.50	4.06	166.79	14.62	162.56	2.42	0.43	0.52
Sitting height(cm)	86.58	8.92	81.38	3.53	86.19	3.27	74.63	7.14	7.19	0.01

Table one showed significant differences between groups comparison at pre and post- test measurements of sitting height $P > 0.01$.

Table 2: ***Skinfold measurements of experimental and control groups of IUB female volleyball players***

Variable	pre data Experiment group mean	pre data Experiment group STD	pre data control group mean	pre data control group STD	post data Experiment group mean	post data Experiment group STD	post data control group mean	post data control group STD	*F*	*Sig*
Triceps skinfold (mm)	15.02	4.88	14.62	4.26	16.02	4.63	15.64	4.26	6.45	0.02
Subscapular skinfold (mm)	15.78	5.33	14.15	5.01	16.51	3.87	16.87	4.35	8.22	0.01
Biceps Skinfold(mm)	9.87	4.24	8.13	3.73	9.60	5.06	9.56	3.80	0.95	0.34
Ilic crest skinfold (mm)	13.04	4.98	12.85	3.58	13.19	3.96	12.69	3.40	0.00	0.99
Superaspinal Skinfold (mm)	14.37	3.23	13.31	3.86	15.63	4.35	13.29	2.85	1.50	0.23
Abdominal Skinfold (mm)	18.73	4.68	18.18	4.29	19.89	4.45	19.26	4.38	4.73	0.04
high Skinfold (mm)	19.82	4.64	19.17	3.78	20.93	3.08	20.18	4.33	7.12	0.01
Calf Skinfold (mm)	14.64	4.32	13.45	3.98	14.98	4.33	13.66	3.03	0.27	0.61

Table two showed a significant difference between groups in comparison of pre and post-data of experimental and control groups in the measurements of triceps skinfold $P < 0.02$, subscapular skinfold $P < 0.01$, abdominal skinfold $P < 0.04$, frontal thigh skinfold $P < 0.01$.

Table 3: *Girth measurements of experimental and control groups of female volleyball players*

Variable	Pre data				Post data				*F*	*Sig*
	Experimental group		**Control group**		**Experimental group**		**Control group**			
	Mean	***STD***	***Mean***	***STD***	***Mean***	***STD***	***Mean***	***STD***		
Arm girth relaxed (cm)	23.16	4.75	21.55	2.82	24.48	4.28	21.11	4.31	1.1	0.3
Arm girth flexed (cm)	25.22	5.54	23.39	2.54	25.98	4.17	23.73	3.03	2.7	0.11
forearm girth(cm)	21.77	3.17	21.03	1.34	21.41	2.6	21.17	1.22	0.1	0.76
wrist girth(cm)	15.01	1.82	14.32	1.53	14.86	1.38	14.66	1.72	0.2	0.65
chest girth(cm)	67.38	27.6	79.22	5.72	77.34	19.68	76.13	16.21	1.4	0.24
waist girth(cm)	70.94	8.27	69.43	10.25	66.14	9.54	67.02	7.46	3.8	0.04
hip girth(cm)	73.22	31.58	89.71	6.89	82.93	24.75	88.74	8.68	1.1	0.31
thigh girth(cm)	45.17	7.7	43.78	4.24	46.66	5.9	46.34	9.9	1.9	0.18
calf girth(cm)	33.1	3.15	32.72	2.23	31.45	2.3	31.72	2.47	3.6	0.05

Table 3 showed significant differences between groups in comparison of pre-post data of experimental and control groups in the measurements of waist girth $P > 0.04$, and calf girth $P < 0.05$.

Table 4: ***Length measurements of experimental and control groups of IUB female volleyball players***

	pre data				post data				*F*	*Sig*
	Experimental group		**control group**		**Experimental group**		**control group**			
	Mean	***STD***	***Mean***	***STD***	***Mean***	***STD***	***mean***	***STD***		
Hand length(cm)	17.26	1.12	17.2	0.82	17.62	1.21	17.61	1.04	8.7	0.01
Total leg length(cm)	88.09	20.18	84.28	19.74	91.93	6.23	89.14	18.18	1	0.32

upper leg length(cm)	49.68	4.02	49.61	3.07	51.21	8.62	48.26	5.26	0	0.94
Lower leg length(cm)	37.38	4.91	36.29	2.89	40.23	4.83	39.79	6.77	7.7	0.01

Table 4.4 showed that significant difference between groups' comparison of pre and post-data hand length *P* > 0.01, lower leg length, *P* > 0.01.

Table 5: ***Breath measurements of experimental and control groups of IUB female volleyball players***

Variable	**pre data**				**post data**				***F***	***Sig***
	Experimental group		**control group**		**Experimental group**		**control group**			
	mean	***STD***	***mean***	***STD***	***Mean***	***STD***	***mean***	***STD***		
Chest breadth (cm)	33.95	2.5	32.8	3.23	34.31	2.71	34.3	3.08	1.79	0.19
Hip breadth (cm)	35.33	10.4	34.5	4.1	39.21	4.15	35.8	3.78	4.55	0.04
Elbow breadth (cm)	5.85	0.77	4.99	0.65	5.35	0.83	4.88	0.51	6.94	0.01
Knee breadth (cm)	7.46	1.48	6.84	0.94	7.18	1.04	6.99	1.01	6.94	0.01

Table 5 showed significant differences between groups' comparison of pre and post-data hip breath was *P* >0.04, Elbow breath, *P* > 0.01, and knee breath, *P* > 0.01.

Table 6: *Kinematics measurement experimental and control groups data of female volleyball players*

Variable	**pre data**				**post data**					
	Experimental group		**Control group**		**Experimental group**		**Control group**			
	Mean	***STD***	***Mean***	***STD***	***Mean***	***STD***	***Mean***	***STD***	***F***	***Sig.***
Toe-toe distance at stance (m)*	11.34	16.78	7.54	3.48	4.77	3.04	4.54	2.36	3.67	0.06
Elbow angle stance	181.2	10.51	178.7	20	179.54	10.51	167	12.75	3.32	0.08
Right knee angle stance	180.5	9.23	177.8	15.2	178.69	8.43	177	7.53	0.1	0.6

Left knee angle stance	176.6	9.03	178	8.37	176.92	9.06	176	8.49	80.19	70.66
Toe-toe distance backswing	14.42	18.83	9.06	3.86	14.6	6.97	5.64	3.12	0.07	0.79
Elbow angle backswing	9.06	3.86	14.42	18.8	5.64	3.03	14.6	36.97	0.07	0.79
Knee angle backswing	185.2	7.96	183	17.5	179.95	7.56	179	8.22	5.29	0.03
Toe-toe distance ball contact	8.57	4.14	21.12	35.3	7.04	5.61	7.14	3.58	2.31	0.14
elbow angle ball contact	183.5	12.63	177.2	15.1	173.15	10.85	171	17.69	5.03	0.03
Right knee angle ball contact	184.3	9.04	179.1	11.6	184	8.41	180	5.25	0.01	0.93
left knee angle ball contact	176.3	9.78	173.7	10	176.54	9.47	180	13.92	1.22	0.28

Table 6 showed significant differences between groups comparison at the pre and post-data experimental and control groups in the measurements of the toe to toe distance stance position *P* < 0.06, elbow angle stance position *P* < 0.08. knee angle backswing position *P* > .0.03.

Discussion

This study was designed to examine the effect of resistance training on the performance of female volleyball players in the following measures anthropometrical, physical fitness, and kinematics analysis of volleyball service. To achieve this purpose (n = 34) female volleyball players were selected and divided into experimental and control groups.

Anthropometric Characteristics of Female Volleyball Players

The primary purpose of this research was to examine the physical attributes of female volleyball players. Skinfold measurements of triceps, subscapular, biceps, illiccrest, supraspinal, abdominal, front thigh, and medial calf, upper arm circumference, forearm circumference, chest circumference, waist circumference, hip circumference, thigh circumference, calf circumference; total leg length, thigh length, lower leg length, hand length, and breadth measurement. The effect of resistance training on volleyball performance in this study.

Statistical analysis revealed no discernible height difference between the study and control groups (height). Considering that skeletal growth slows or stops entirely by the age of 18, the experimental and control groups were of similar height despite the seven-year age gap. Body fat can be roughly estimated by taking skinfold measurements (Palao et al., 2009; Pacholek et al., 2021). There was no discernible change in skin folds between the experimental and control batters. It may be concluded that the test subjects had a higher absorption level than the players in the control group, who are able to eliminate body fat less effectively.

In terms of the upper arm, forearm, chest, waist, and hip circumference, the experimental group was ahead of the control group. The circumference of the upper and lower extremities increases with age and with consistent exercise, while the circumference of one's boot and abdomen increase with belly fat percentage (Malousaris., 2008). As expected, the individuals' arm and leg muscle sizes increased with age and training duration. The current study confirms previous research showing that both limb and muscle size increase with age and consistent training (Bandyopadhyay, 2007). A comparison of grip strength between the experimental group and the control group revealed that the experimental group of female players had significantly greater grip strength. The results of the test showed that the heightened players had greater grip strength than the female volleyball players. There was a significant difference in grip strength between the experimental groups and the pre-posttest groups of female players because the experimental groups were heavier and had bigger upper and lower limb girths. The results of the current study collaborate with previous findings of (Visnes & Bahr, 2013) that found larger volleyball players in the experimental group had a strength advantage as reported (Trajkovic, 2011) showing that training improves players' hand grip strength.

Kinematics of the Volleyball Players at Stance Position

When a female volleyball player serves, should be good in stance position which would be ready posture on their front and back feet if their weight is distributed evenly between their left and right feet. It was determined that there was a statistically significant distinction in the average distance between each group's feet in each position. The current study's findings run counter to the common coaching recommendation that players' shoulder widths should be equal to the space between their feet (Tsoukos et al., 2019) and other metrics (Oliveira et al., 2020). This research lends credence to the idea that players could benefit from training to improve their reaction times and get into better serving positions. Left and right knee angles while standing varied significantly across groups. Coaching advice (Hank et al., 2015) that players' legs should be bent in the position (Bekele, Adane & Kabiso, 2022). These results are consistent with other research showing that training can have a considerable impact on individual player performance. Elbow-angle stances did not differ significantly between the groups. Forearm motion occurs around midway across the range of motion for each joint's angular velocity. Upon ball contact, the hand's linear velocity owing to elbow movement is greatest. The results of this study lend credence to the recommendation that players adopt a stance with their elbows flexed (Mann et al., 2013). The results of the current study corroborate those of previous research (Tsoukos et al., 2019) showing that training leads to noticeable changes in athletes.

Kinematics of the Volleyball Player at Back Swing

Toe-to-heel distance in the backswing posture is the starting point for performance (Oliveira et al., 2020). Not much of a distinction could be made between the groups according to the findings. With the help of an analysis of the volleyball backswing (Singh & Rathore 2013), the current study additionally evaluated the percentage of stride length in relation to height. It was determined that the players in the experimental groups had wider toe spaces, while the players in the control groups took shorter strides in relation to their height. While comparing elbow angles during the backswing, there was a clear disparity between the groups. Forearm motion occurs around midway across the range of motion for each joint's angular velocity. Upon ball contact, the hand's linear velocity owing to elbow movement is greatest. The results of this study lend credence to the recommendation that players adopt a stance with their elbows flexed (Mann et al., 2013). The results of the current study corroborate those of (Singh & Rathore 2013), which found that players underwent substantial transformations because of training.

In Figure 4.3, we see the left knee and right knee in the backswing posture. Knee angulation was significantly different between the left and right sides of the sample population. Weight is transferred from the left to the right leg as the left knee extends and the right knee bends (Hank et al., 2015). The results of the current research corroborate those of a 2003 study (Kelly et al., 2003) that found that the right knee should be flexed back while the left knee was straightened.

Kinematics of the Player at Connect Ball with Hand

The outcome demonstrated a statistically significant distinction between the experimental and control groups in toe-to-toe spacing upon ball contact. After contacting the ball, a player should switch their weight from their back foot to their front foot. It is the shoulder and elbow that start the forward motion of the hitting arms. The player whips their hand in front of them by using these parts of their body as a lever (Tsoukos et al., 2019). The elbow angle at ball contact was significantly different between the experimental and control groups. Such plants were typical and mirrored other forms of proficient hand-shaking. The ball should be hit before the player's elbow is fully extended. The data clearly differentiated between the right and left sides of the knee when extending. When compared to prior testing of volleyball players, the subjects tested had more right knee extension. Right knee bending is attributed to increased thoracic angulation over the right leg, which was observed in both the experimental and control groups of volleyball players. However, the experimental group can draw the conclusion that a wider girth requires more force to expand the right at impact.

Kinematics of the Player at Follow-Through

A longer elbow angle was used in the volleyball serve by both the control and experimental groups. When it came to following through, one group fared noticeably better than the other. As they prepare to serve, volleyball players might straighten up by extending their elbows to the side (Cabarkapa et al., 2022). The results of the current research corroborate the study (Alexander et al., 2009), which found that extending the elbow joint helped players modify their serving stance. Arm posture modification is also thought to be crucial for volleyball success (Kutac & Sigmund, 2017). A look at reveals that the pass ball performance of groups with different left and right knee angles varied significantly. The results of the current study corroborate those of earlier research showing a difference in the left and knee angles of the follow-up throw between the two groups (Visnes, 2013; Milic, 2017). It was determined that the passing-related player difference between the experimental and control groups was stable.

Physical Fitness Measurement of Female Volleyball Players

Significant correlations emerged in the 1-minute sit-up test between the control and experimental groups. Results from the current study corroborate those of (Singh & Rathore, 2013) showing that when body mass index (BMI) increases, fat deposits in the waist, belly, and thighs, and the likelihood of doing more sit-ups and maintaining muscular endurance falls. Results from a t-test comparing the control group with the experimental group are shown to be statistically significant. The T-test demonstrated a correlation between several body measurements, including mass, BMI, arm, chest, waist, hip, and total skinfold thickness. The t-test revealed a statistically significant correlation between the body-length factors (Milic, 2017). There were notable changes in vertical jump performance between the experiment and control groups. Strength success during a vertical jump was found to rise dramatically after 8 weeks of training in a previous study (Arazi, 2018).

Conclusion

The purpose of this research was to compare the abilities of two sets of female volleyball players. The researchers in this study aimed to accomplish three things. The primary goal was to examine the impact of resistance training on the efficiency and physique of female volleyball players. The second goal was to investigate how resistance training affects volleyball players' fitness levels. The third goal was to compare the kinematics of serving between expert and novice volleyball players based on their anthropometric characteristics. Female volleyball players at Islamia University Bahawalpur had their anthropometrics taken and their skills evaluated. Stature (height), bodily mass (weight), the total of eight skin folds, seven circumferences, nine lengths, five breaths, right grasp, and left grip were the anthropometric measurements taken. Results showed that following exercise, both the experimental and control groups saw continual changes in their waist circumference, body mass, and skin folds. There were notable size differences between the test and control groups, particularly in terms of body length and width. Throughout puberty, the process of lengthening and widening the body began and was completed. It was hypothesized that the kinematic factors would allow for a meaningful comparison between skilled and unskilled volleyball players.

References

Acar, H., & Eler, N. (2019).The Relationship between body composition and jumping performance of volleyball players. *Journal of Education and Training Studies,7(3), 192-196.*

Alexander, M., Honish, A., Center-Manitoba, C. S., & Center, K. (2009). An analysis of the volleyball jump serve. *Coach Info,-(0)*, 1-10.

Arazi, H., Khanmohammadi, A., Asadi, A., & Haff, G. G. (2018). The effect of resistance training set configuration on strength, power, and hormonal adaptation in female volleyball players. *Applied physiology, nutrition, and metabolism, 43(2), 154-164*

Bale, P., & McNaught-Davis, P. (1983). The physiques, fitness and strength of top class women hockey players. *The Journal of sports medicine and physical fitness*, *23*(1), 80-88.

Bandyopadhyay, A. (2007). Anthropometry and body composition in soccer and volleyball players in West Bengal, India. *Journal of physiological* *anthropology, 26(4)*, 501-505.

Batez, M., Petrusic, T., Bogataj, S., & Trajkovic, N. (2021). Effects of teaching program based on teaching games for understanding model on volleyball skills and enjoyment in secondary school students. *Sustainability, 13(2), 606.*

Bekele, B. A., Adane, A. K., & Kabiso, T. A. (2022). Anthropometric characteristics of volleyball players with respect to playing positions: In Ethiopian female premier league. *Central European Journal of Sport Sciences and Medicine*, *39*, 65-73.

Cabarkapa, D. V., Cabarkapa, D., Fry, A. C., Whiting, S. M., & Downey, G. G. (2022). Kinetic and kinematic characteristics of setting motions in female volleyball players. *Biomechanics*, *2*(4), 538-546.

Chatterjee, P., & Bandyopadhyay, A. (2022). Electromyographic Representation of Vastus Lateralis in Volleyball Players and Its Relationship with Lower Limb Anthropometric Measurements. *International Journal of Kinanthropometry, 2(1), 31-39.*

Ekinci, N. E., & Bajorek, W. (2015). Effects of during six months volleyball training on some anthropometric measurements. *International Journal of Physical Education, Sports and Health 2015; 1(4)*: 81-84.

Fischetti, F., Vilardi, A., Cataldi, S. & Greco, G. (2018). Effects of Plyometric Training Program on Speed and Explosive Strength of the Lower Limbs in Young Athletes. *Journal of Physical Education and. Sport, 18(4),* 2476 - 2482

Gabbett, T. J. (2008). Do skill-based conditioning games offer a specific training stimulus for junior elite volleyball players .*The Journal of Strength & Conditioning Research* ***22****(2): 509-517.*

Gabbett, T., & Georgieff, B. (2007). Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players. *The Journal of Strength & Conditioning Research, 21(3), 902-908*

Gabbett, T., et al. (2006). "Changes in skill and physical fitness following training in talent-identified volleyball players." *The Journal of Strength & Conditioning Research* ***20****(1): 29-35.*

Gangey, O., & Kerketta, I. (2006). Relationship between selected motor fitness and playing ability of volleyball players. *Sciences, 29(1), 6-11*.

Gantois, P., Batista, G. R., Fortes, L. S., Mortatti, A. L., Dantas, M., Machado, D. G. D. S., & Cabral, B. G. D. A. T. (2022). Short-term effects of repeated-sprint training on vertical jump ability and aerobic fitness in collegiate volleyball players during pre-season. *International Journal of Exercise Science, 15*(6), 1040-1051.

Gulati, A., Jain, R., Lehri, A., & Kumar, R. (2021). Effect Of High And Low Flexibility On Agility, Acceleration Speed And Vertical Jump Performance Of Volleyball Players. *European Journal of Physical Education and Sport Science*, *6*(11).

Haff, G. G., Burgess, S., & Stone, M. H. (2008). Cluster training: theoretical and practical applications for the strength and conditioning professional. *Prof Strength Cond, 12, 12-17.*

Hank, M., Zahalka, F., & Maly, T. (2015). Comparison of spikers distance covered in elite female volleyball. *Sport Sci, 8*(2), 102-106.

Haq, M. Z., Habib, M. B., Khalil, H. I., Ahmad, S., Maqbool, A., & Qayyum, M. A. (2021). 3-D Motion Analysis Of The Upper Body Of Cricket Batsman At The Execution Pull Shot. *Ilkogretim Online, 20(1)*, 5461-5470.

Hodge, K., Lonsdale, C., & Ng, J. Y. (2008). Burnout in elite rugby: Relationships with basic psychological needs fulfilment. *Journal of Sports Sciences, 26(8),* 835-844.

Hoffman, J., Ratamess, N., Kang, J., Mangine, G., Faigenbaum, A., & Stout, J. (2006). Effect of creatine and ß-alanine supplementation on performance and endocrine responses in strength/power athletes. *International journal of sport nutrition and exercise metabolism*, *16*(4), 430-446.

Hong, S., Weon, B. M., Nakanishi, Y., Kimachi, K., Seo, K., & Asai, T. (2018). Aerodynamic effects of a panel orientation in volleyball float serve. *ISBS Proceedings Archive*, *36*(1), 877.

Ivashchenko, O., Khudolii, O., Yermakova, T., & Iermakov, S. (2016). Factorial and discriminant analysis as methodological basis of pedagogic control over motor and functional fitness of 14–16 year old girls. *Journal of Physical Education and Sport,* 16(2), 442-451.

Kelly, K. L., Coronado, E., Zhao, L. L., & Schatz, G. C. (2003). The optical properties of metal nanoparticles: the influence of size, shape, and dielectric environment. *The Journal of Physical Chemistry B, 107(3),* 668-677.

Kouchi, M. (2014). Anthropometric methods for apparel design: Body measurement devices and techniques. In *Anthropometry, apparel sizing and design* (pp. 67-94). Woodhead Publishing.

Kraemer, W. J. and N. A. Ratamess (2004). "Fundamentals of resistance training: progression and exercise prescription." *Medicine & science in sports & exercise* ***36****(4)*: 674-688

Kutac, P., & Sigmund, M. (2017). Assessment of body composition of female volleyball players of various performance levels. *Journal of Physical Education and Sport*, *17*(2), 556.

Lidor, R., & Ziv, G. (2010). Physical and physiological attributes of female volleyball players-a review. *The Journal of Strength & Conditioning Research*, *24*(7), 1963-1973.

Lu, J. (1994). Biomechanical analysis of the volleyball overhand floater serve. Western Michigan University,

MacKenzie, S., Kortegaard, K., LeVangie, M., & Barro, B. (2012). Evaluation of two methods of the jump float serve in volleyball. *Journal of applied biomechanics*, *28*(5), 579-586.

Maessen, K. M., & Holt, L. E. (1986). A cinema/video analysis of setting in volleyball. In *ISBS- Conference Proceedings Archive*.

Malousaris, G. G., Bergeles, N. K., Barzouka, K. G., Bayios, I. A., Nassis, G. P., & Koskolou, M. D. (2008). Somatotype, size and body composition of competitive female volleyball layers. *Journal of science and medicine in sport*, *11*(3), 337-344.

Mann, T., De Ridder, D., & Fujita, K. (2013). *Self-regulation of health behavior: social psychological approaches to goal setting and goal striving* (Vol. 32, No. 5, p. 487). American Psychological Association.

Milić, M., Grgantov, Z., Chamari, K., Ardigò, L. P., Bianco, A., & Padulo, J. (2017). Anthropometric and physical characteristics allow differentiation of young female volleyball players according to playing position and level of expertise. *Biology of sport*, *34*(1), 19-26.

Northrip, J. W., Logan, G. A., McKinney, W. C., & Alexander, R. M. (1974). Introduction to biomechanic analysis of sport. *Physics Today, 27(9),* 58-61.

Oikonomopoulou, A., Barzouka, K., Sotiropoulos, K., Drikos, S., & Noutsos, K. (2022). Spatiotemporal analysis of setting per game complex and origin of the ball in junior female volleyball players. *Journal of Physical Education and Sport, 22*(3), 652-660.

Oliveira, L. D. S., Moura, T. B. M. A., Rodacki, A. L. F., Tilp, M., & Okazaki, V. H. A. (2020). A systematic review of volleyball spike kinematics: Implications for practice and research. *International Journal of Sports Science & Coaching*, *15*(2), 239-255.

Pacholek, M., Zemkova, E., Arnolds, K., & Sagat, P. (2021). The Effects of a 4-Week Combined Aerobic and Resistance Training and Volleyball Training on Fitness Variables and Body Composition on Steam Students. *Applied Sciences, 11(18),* 8397.

Palao, J. M., Manzanares, P., & Ortega, E. (2009). Techniques used and efficacy of volleyball skills in relation to gender. *International Journal of Performance Analysis in Sport*, *9*(2), 281-293.

Parsons, J. L., & Alexander, M. J. (2012). Modifying spike jump landing biomechanics in female adolescent volleyball athletes using video and verbal feedback. *The Journal of Strength & Conditioning Research*, *26*(4), 1076-1084.

Petrigna, L., Karsten, B., Marcolin, G., Paoli, A., D'Antona, G., Palma, A., & Bianco, A. (2019). A review of countermovement and squat jump testing methods in the context of public health examination in adolescence: reliability and feasibility of current testing procedures. *Frontiers in Physiology, 10, 1384*.

Qadir, N. A., Darweesh, N. H., & Jalal, N. J. (2020). Comparative analytical study of the approach stage to perform the spike skill of the volleyball game and its relationship to accuracy. *Journal of Physical Education and Sport*, *20*(1), 229-234.

Raiola, G., Parisi, F., Giugno, Y., & Di Tore, P. A. (2013). Video analysis applied to volleyball didactics to improve sport skills. *INSHS International Christmas Sport Scientific Conference, 2013*; 9-12

Reeser, J. C., Fleisig, G. S., Bolt, B., & Ruan, M. (2010). Upper limb biomechanics during the volleyball serve and spike. *Sports health*, *2(5),* 368-374.

Ridgway, M. E., & Wilkerson, J. (1986). A kinematic analysis of the front set and back set in volleyball. In *ISBS-Conference Proceedings Archive*.

Rusdiana, A. (2022). Three-Dimensional Kinematical Analysis of Jump Serve In Volleyball: Muscle Fatigue Effects. *Annals of Applied Sport Science, 10(3),* 0-0.

Sahin N, Bianco A, Patti A, Paoli A, Palma A, Ersoz G. (2015). Evaluation of knee joint proprioception and balance of young female volleyball players: a pilot study. *Journal of physical therapy Science, 27(2):*437-440.

Sattler, T., Hadžic, V., Derviševic, E., & Markovic, G. (2015). Vertical jump performance of professional male and female volleyball players: Effects of playing position and competition level. *The Journal of Strength & Conditioning Research*, *29*(6), 1486-1493.

Selimi, M., Gjinovci, B., & Miftari, F. (2019). Anthropometric Profile of Kosovo Elite Female Volleyball Players. *Bulletin of the Transilvania University of Brasov. Series IX, Sciences of Human Kinetics*, *12*(2), 9-14.

Sheppard, J. M., Gabbett, T. J., & Stanganelli, L. C. R. (2009). An analysis of playing positions in elite men's volleyball: considerations for competition demands and physiologic characteristics. *The Journal of Strength & Conditioning Research*, *23*(6), 1858-1866.

Singh, H. (2018). Investigating relationship between motor abilities and smash skill of volleyball players. International Journal of Yogic, *Human Movement and Sports Sciences, 3(1):* 1265-1269

Trajkovic, N., Milanovic, Z., Sporis, G., & Radisavljevic, M. (2011). Positional differences in body composition and jumping performance among youth elite volleyball players. *Acta Kinesiologica*, *5(1)*, 62-66.

Tsoukos, A., Drikos, S., Brown, L. E., Sotiropoulos, K., Veligekas, P., & Bogdanis, G. C. (2019). Upper and lower body power are strong predictors for selection of male junior national Volleyball team players. *The Journal of Strength & Conditioning Research*, *33*(10), 2760-2767

Visnes, H., & Bahr, R. (2013). Training volume and body composition as risk factors for developing jumper's knee among young elite volleyball players. *Scandinavian journal of medicine & science in sports*, *23*(5), 607-613.

Waqas, M. A., Kaynat, S., ul Haq, M. Z., Amin, Z., Abbas, G., Nave, M., ... & Amir, M. B. (2022). Evaluation of The Body Composition, Kinematics of Volleyball Service of Club And University Players of Bahawalpur City. *Elementary Education Online*, *19*(3), 4744-4744.