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Comparative Analysis among Skilled and Novice Female Table Tennis Players in the Components of Physical Fitness and Kinematics of Forehand Drive

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Abstract

This research compared the physical fitness and performance of the skilled and novice table tennis female players. Skilled female table tennis players (n = 14) and novice female (n = 14) from Government Women Graduate College satellite Twon Bahawalpur, Pakistan. The measurements were obtained as agility, flexibility, reaction time, hand grip strength, skinfolds, breadths, limb length, and angular kinematics of the forehand drive. A repeated measure ANOVA was applied to compare the skilled and novice players in the selected variables. The results showed skilled players were significantly higher in flexibility, hand grip strength, coordination, agility, elbow angle, and shoulder angle than novice players. It was concluded that the skilled players are better at physical fitness, forehand drive, and less body fat. Coaches may establish the most effective training protocols for female players to improve their table tennis skills and physical condition.

Keywords: Table Tennis, Female Player, Physical Fitness, Forehand Drive, Body Compositions

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Title

Comparative Analysis among Skilled and Novice Female Table Tennis Players in the Components of Physical Fitness and Kinematics of Forehand Drive

Abstract

This research compared the physical fitness and performance of the skilled and novice table tennis female players. Skilled female table tennis players (n = 14) and novice female (n = 14) from Government Women Graduate College satellite Twon Bahawalpur, Pakistan. The measurements were obtained as agility, flexibility, reaction time, hand grip strength, skinfolds, breadths, limb length, and angular kinematics of the forehand drive. A repeated measure ANOVA was applied to compare the skilled and novice players in the selected variables. The results showed skilled players were significantly higher in flexibility, hand grip strength, coordination, agility, elbow angle, and shoulder angle than novice players. It was concluded that the skilled players are better at physical fitness, forehand drive, and less body fat. Coaches may establish the most effective training protocols for female players to improve their table tennis skills and physical condition.

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Keywords: Table Tennis, Female Player, Physical Fitness, Forehand Drive, Body Compositions

Contents

Introduction

Among the several techniques in table tennis, forehand drive is considered one of the non-stop strokes during competitions (Iino & Kojima, 2016). In addition, table tennis players should be good in foot position, balance, and trunk rotation to respond to various ball trajectories (Bańkosz & Winiarski, 2018). The movement of the lower limb coordinates with the upper limb's movement for the forehand drive-in table tennis (Lam et al., 2019). Therefore, proper information about the body composition and the capacity of table tennis players in their physical fitness plays a significant role in performance. The racket velocity of the forehand drive is associated with trunk rotation, shoulder flexion, elbow flexion, and extension (Iino & Kojima, 2009). Like body segments and physical fitness, the mechanical attributes me is associated with the performance of female table tennis players (Malousaris et al 2008; Tseng et al., 2011). The size of the body segments and capacity for physical fitness plays a significant role in the performance of table tennis players (Faber et al., 2017; Wang, 2021) and the mechanics of table service and shots (Zhao et al., 2022). Vargas and colleagues (2021) have proposed investigating the mechanical and physical fitness role in the performance of table players. Previous studies have investigated and reported that the upper limb associated with racket swing for ball control is supported by the strong balance of the lower limb and footwork balance (Qian et al., 2016; Le Mansec et al., 2018; Lam et al., 2019; Yang et al., 2021; Chen et al., 2022).

The conclusions of these studies that were conducted the primary objective of this research is to investigate the kinematics differences that exist between inexperienced players and experienced players during the forehand service to ascertain whether there are any such differences. This study will be valuable to all parties concerned, including coaches, professionals of table tennis and researchers. This is because it will improve their understanding of the quantitative description of the forehand service provided.

Methods and Materials:

Participants

The study targeted a group of 28 female table tennis players, divided into two groups (n=14) skilled and (n=14) novice groups of players aged 19 ± 39 years. The participant was selected by GOVT Graduate College for Women, Satellite Town Bahawalpur. The selected participants were based on objectivity and reproducibility. The present study aimed to find out the effect of strength training on the performance of women's table tennis players. Purposive sampling was the mode of sampling that was utilized in this investigation. This information was gathered with the approval of the academic ethics research committee of the Islamia University of Bahawalpur, Pakistan.

Instrument and Procedure of the Anthropometric Measurement

The skinfolds were measured in millimeters by using a Harpenden skinfold caliper as triceps, biceps, subscapular, abdomen, and medial calf skinfold. With the help of a measuring tape measuring one meter, measures of the girth were taken at the wrist, forearm, chest, calf, ankle, arm girth relaxed, arm girth flexed, and waist girth (Pradas, et al 2021). With the use of a measuring tape in centimeters, the length of the complete arm, the length of the upper arm, the length of the forearm, the length of the hand, and the length of the total leg were all measured. To determine the level of strength that the physical fitness possessed, the handgrip dynamometer was utilized. Agility, coordination, flexibility, leg power, handgrip, and response time are all qualities that are part of fitness. The variables that were used to measure performance were the forehand drive and the ball speed. According to Behdari et al. (2015), all the data were collected both before and after the test.

The anthropometry method is the measurement of skinfold thickness for estimating the quantity of adipose tissues has become part of standard anthropometric techniques. Warner et al. (2004) measured skinfolds by using a Harpenden caliper as a triceps skinfold, biceps skinfold, subscapular skinfold, abdominal skinfold, and medial calf skinfold (Tahir et al., 2018). The subject is in a relaxed and upright standing position, with her arms hanging naturally by their sides. Apply a caliper to the marked site and read the measurements in millimeters. For accurate results, measured 2-3 times (Kim, 2013). **S**kinfold in the subscapular region is the area just below the shoulder blade (scapula) on the back. The thumb and index finger are used to raise the subscapular skinfold on the marked subscapular skinfold side. A diagonal skinfold on a line that extends from the lower angle of the scapula downwards and backward at an angle of about 30 degrees to the vertical. Biceps skinfold: the amount of subcutaneous fat (fat located beneath the skin) in the upper arm. The biceps skinfold mark with the midline of the muscle belly over the front surface of the biceps at the mid-acromial-radial line. Apply a caliper to the marked site and read the measurements in millimeters. For accurate results, measured 2-3 times (Blagus et al., 2023). Abdominal skinfold: The thickness of the subcutaneous layer may be underestimated—horizontal skinfold in the anterior abdominal wall. Apply a caliper to the marked site and read the measurements in millimeters. For accurate results, measured 2-3 times. Medial calf skinfold: a vertical form has the widest point of the calf at the medial inner aspect of the calf. The foot is placed flat on an elevated surface with the knee flexed at a 90-degree angle (Lohman & Pollock, 2013).

Figure 1

Measurements of skinfold (Lohman & Pollock, 2013).

Wrist girth: measurement of the distance around the wrist. Note the measurements where the tape meets itself (Lohman & Pollock, 2013). Forearm girth: The maximum girth of the lower arm. Which is estimated to be 6 centimeters laterally from the radial. The subject was instructed to stand in a relaxed position. Hold the tape securely and take measurements in centimeters where the end of the tape meets the other part of the tape (Daniell et al., 2012). Chest girth: this measure was taken at the level of the middle of the sternum (breastbone), with the tape passing under the arm (Haq et al., 2019). The researcher read the measurements at the point where the measuring tape meets itself (Pluta et al., 2021). Calf girth: the maximum girth or distance around the calf muscle of the lower leg. Measuring tape should not push the calf muscles, just lightly touch the skin of the subject. The researcher read the measurement where the tape was met (Mohadjer et al., 1996).

In the study conducted by Poorhassan et al. (2017), the length of the forearm was determined by measuring the distance between the tip of the olecranon and the midpoint between the radius and the ulnar tuberosity. According to de la Fuente et al. (2023), the measurement should be read in inches at the point where the instrument stops at the base of the subject's palm. To ensure that the jaws of the caliper are firmly in contact with the bone, it is necessary to progressively squeeze them. The width of the humerus is the measurement that is being used here. Height is often a measurement of a person's height from the feet to the top of the head when standing upright. The subject's height was measured using a stadiometer. The subject position was standing upright and comfortable (Scafoglieri et al., 2013). The subject was instructed to stand on a machine with even weight distribution at the right and left foot, head straight, looking forward, and barefoot. A minimum reading pattern of 0.1kg was used. Body mass (BM) was measured using a digital scale (Mala et al., 2015).

Measurements of The Physical Fitness of Female Table Tennis Players

You might also try switching hands or using lateral movement to give some variety and a new level of difficulty to the exercise. The equipment used for the sit and reach test is the sit and reach box. The subject was instructed to sit on the floor in a position in which their back touches the box with both feet and hands for 3 seconds with the help of bending shoulder and head (Picabea et al., 2021).

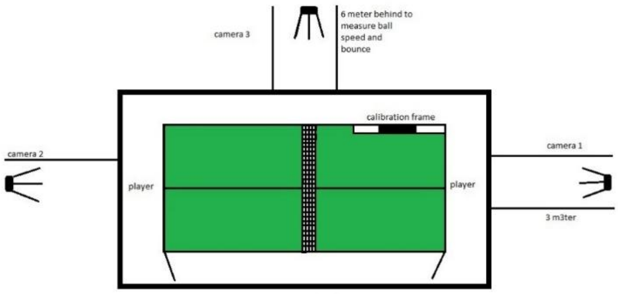
Figure 2

Flexibility Sit and Reach Test (Picabea et al., 2021)

The quickest value was used for the statistical analysis after this test was run three times with a three-minute gap between measurements. The test's closest measurement was 0.01 seconds. The T-Test is an athletic mobility test that includes backward, sideways, and forward motions. The subjects were asked to put the horizontal line on the wall at a 90-degree angle from the floor. Face the wall, feet are on the floor and the subject's arms extended above her head. Where the fingertip touched the wall, it put a mark. The length of the jump was measured from the ground up to the mark line on the wall. Time was measured through a stopwatch how long it took for both feet to leave the ground until they touched again. The subject was instructed to perform two maximal voluntary contractions with fully extended arms. The dynamometer's hilt was adjusted to the subject hand. The two best repetitions were measured (Pradas et al (2021).

Reaction time was measured to recognize the difference in cognitive efficiency. The subject was instructed to sit on the chair with the hand which they used to write. The investigator drops the ruler without informing them about the subject and she must catch it. When the subject catches the ruler, record the number displayed just over the thumb. The lower the number is, the faster her reaction time (Castellar et al., 2019).

Figure 3



Set up of Data Collection

The procedure of data collection of table tennis players

The data collection process was carried out with the approval of both the coach and the players. To ensure that each participant had adequate time to warm up before the trials began (Haq et al., 2017). All the players were allowed to experience maximal deliveries from the ball during the warm-up period so that they could become accustomed to the experimental requirements. According to Bańkosz and Winiarski's 2018 research, the action of table tennis was broken down into four distinct phases. Afterward, the accuracy of each free drive was verified by analyzing slow-motion films (Qian et al., 2016). The precision of each free drive was recorded on the performance sheet. To analyze the data, the motion analysis software Kinovea, version 0.8.27, was subsequently taken into consideration. All the participants were instructed to drive at their highest possible speed. Players were expected to engage in practice before taking six forehand drives that were successful respectively.

Data Treatment

To import footage from the first and second cameras, the video editing software Kinovea was deployed. To conduct additional analysis, the movies were aligned to locate points of similarity between the primary and secondary cameras. The trimming started ten frames before the beginning of the backswing and continued until ten frames after the backswing was finished. Every single frame of the table tennis game was digitized by hand using a stick figure as a representation. To determine the point at which the hand contacted the ball, the movement of the ball was also digitized in the frames. A conversion from two-dimensional coordinates was performed on the digitized data. Within the transformation program, the equation for direct linear transformation is carried out. To smooth out the raw digitized data of the forehand drive, a digital low-pass filter was taken into consideration.

Reliability of Anthropometric Variables

Using the intra- and inter-investigator approach, we ensured that the instruments and the subject's anthropometric measurements were accurate. The reliability coefficient of 0.807 suggests that measurements of the skinfolds are highly consistent over time, making them reliable for assessing body fat in both skilled and novice players. A 0.813 correlation shows good reliability in forearm girth measurements, making it useful for assessing muscular development and physical performance. The reliability of 0.799 suggests that waist girth measurements are stable but could be affected by factors like body composition changes. This measure (reliability = 0.828) reflects stable limb length measurement, which could influence performance, particularly in sports that rely on leg strength and speed. A coefficient of 0.822 suggests moderate reliability, indicating forearm length is a stable measurement and useful for determining limb proportions. A 0.819 reliability coefficient also indicates moderate consistency in wrist breadth measurements.

Statistical Analysis

All variables of the body composition, physical fitness, and kinematics were analyzed to obtain descriptive statistics. In the second phase one-way analysis of variance, ANOVA was applied for body composition and fitness variables to find the meaning difference between the analysis. For the kinematics, variables repeated ANOVA was applied because forehand shot data was dived in for phases such as stance, backswing, bat-ball impact, and follow through. Tukey's post hoc statics test was applied to examine exact differences among groups in pre-post measurements. Data normality was tested with a Q-Q plot along all assumptions were considered. The values of significance were adjusted at $< .05$.

Results

Table 1

Demographic data on skilled and novice female table tennis players

	Skilled Group				Novice Group					
Variables	**Pre-data**		**Post Data**		**Pre data**		**Post data**		**f-value**	**Sig.**
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Stature(height)	117.78	7.61	117.85	7.55	116.14	6.81	116.07	2.00	0.16	0.06
Sitting height	79.71	6.30	79.71	6.30	76.50	4.60	76.57	4.66	1.00	0.32
Body mas	51.35	7.35	50.85	6.87	53.35	4.76	51.64	3.99	5.12	0.03

Note. $p<.05^*$ *indicates a level of significance*

Table 1 shows that skilled and novice players' body mass is significant with an F-value of 5.12 and a p-value of less than 0.03. According to Tukey's post hoc analysis, the skilled players are higher than the novice players.

Table 2

Comparison among skilled and novice players in skinfold measurement of female table tennis players

	Skilled Group				Novice Group					
Variables	**Pre-data**		**Post Data**		**Pre Data**		**Post Data**		**f-value**	**Sig.**
	M	SD	M	SD	M	SD	M	SD		
Triceps sf (mm)	11.30	3.45	10.90	3.32	11.90	5.43	11.59	4.98	0.01	0.89
Subscapular sf (mm)	11.63	4.10	10.85	4.95	10.90	3.28	9.80	4.00	0.18	0.67
Biceps sf (mm)	7.35	3.90	7.03	3.99	6.88	3.27	6.32	3.18	0.53	0.47
Abdominal sf (mm)	12.75	4.69	11.90	4.67	12.37	4.17	10.26	3.40	2.53	0.12
Medial calf sf (mm)	11.32	2.87	10.16	2.73	11.65	3.65	11.22	3.93	0.57	0.45

Note. $p<.05^*$ *indicates a level of significance*

Table 3

Comparison among skilled and novice players in girth measurement of female table tennis players

	skilled group				novice group					
Variables	**pre data**		**post data**		**pre data**		**post data**		**F value**	**sig**
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Wrist girth	12.22	1.51	12.20	1.50	12.24	2.31	12.23	2.31	0.12	0.72
Forearm girth	19.86	2.01	19.81	1.98	19.52	1.46	19.29	1.30	2.50	0.12
Chest girth	79.12	4.07	78.35	4.33	80.1	7.48	79.96	7.44	6.11	0.02
Calf girth	27.82	2.77	27.03	2.55	27.66	2.35	27.15	2.83	0.42	0.52
Ankle girth	20.07	1.67	20.05	1.65	21.98	2.06	21.97	2.05	0.22	0.63
Arm girth relaxed	22.39	2.59	21.35	2.82	22.07	3.26	21.3	3.12	0.56	0.46
Arm girth flexed	23.88	2.92	24.52	2.93	24.45	4.33	24.49	4.29	6.52	0.01
Waist girth	64.32	7.07	63.3	6.85	65.76	2.97	64.67	4.38	0.00	0.93

Note. $p<.05^*$ *indicates a level of significance*

Table 3 shows a significant difference between the group's comparison of skilled and novice players in measuring chest girth F = 6.11, P<0.02. The skilled players were significantly higher than the novice players. In measuring the arm girth flexed F=6.52, P<0.01, the skilled was significantly higher than novice players.

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Comparison among skilled and novice players in length measurement of female table tennis players

	skilled group				novice group					
Variables	pre data		post data		pre data		post data		F value	Sig
	M	SD	M	SD	M	SD	M	SD		
Total arm length	55.86	3.08	55.85	3.07	54.66	2.90	54.64	2.90	0.22	0.63
Upper arm length	32.73	2.30	32.70	2.28	33.08	2.02	33.01	2.05	1.28	0.26
Forearm arm length	23.50	1.35	23.43	1.35	22.13	0.73	22.12	0.71	3.51	0.07
Hand length	16.80	2.18	16.80	2.17	16.96	1.24	16.93	1.25	2.20	0.14
Total leg length	89.98	3.25	89.93	3.27	87.37	5.14	87.36	5.16	5.20	0.03

Note. p<.05 indicates a level of significance*

Table 4 skilled and novice players had significant differences between skilled and novice table tennis players in leg length. A p-value of less than 0.03 made F = (5.20) skilled players significantly higher than novice players.

Table 4

Comparison among skilled and novice players in breadth measurement of female table tennis players

	skilled group				novice group					
Variables	pre data		post data		pre data		post data		F value	sig
	M	SD	M	SD	M	SD	M	SD		
Handbreadth	7.06	0.43	7.05	0.45	7.02	0.36	7.01	0.36	0.10	0.74
Wrist breadth	4.64	0.39	4.63	0.38	4.75	0.28	4.75	0.28	0.13	0.71
Humerus breadth	5.42	0.74	5.42	0.75	5.64	0.74	5.60	0.77	4.50	0.04
Femur breadth	6.76	1.37	6.75	1.36	7.38	0.99	7.35	1.00	0.85	0.36

Note. p<.05 indicates a level of significance*

Table 5 showed a significant value difference between the group comparison among the skilled and novice players in the measurement of humerus breadth data F (4.50); P<0.04, was significantly higher than the novice players was significantly higher than the skilled players.

Table 5

Comparison among skilled and novice groups in fitness measurement of female table tennis players

	skilled group				novice group					
Variables	pre data		post data		pre data		post data		F value	sig
	M	SD	M	SD	M	SD	M	SD		
Coordination(minutes)	6.42	4.97	11.21	3.53	6.07	4.87	8.00	4.36	5.32	0.02
Flexibility(cm)	23.65	6.63	24.82	6.43	20.25	3.38	23.45	3.51	13.52	0.00
Agility(minutes)	16.22	1.33	15.47	1.44	22.51	3.17	20.82	2.17	4.41	0.04
Leg power(cm)	25.93	4.74	28.57	5.44	24.44	5.61	25.62	5.84	3.77	0.06
Handgrip	24.68	3.96	25.67	3.64	20.38	2.88	23.39	3.26	8.10	0.00
Reaction time(cm)	18.53	4.53	13.85	3.54	19.96	5.93	16.96	5.34	2.73	0.11

Note. p<.05 indicates a level of significance*

Table 6 showed a significant difference between the group comparison among skilled and novice players table tennis players in the coordination F = (5.32); P < 0.02, the skilled players were significantly higher than the novice players. In the flexibility between skilled and novice players F = (13.52); P < 0.00, the skilled players were significantly higher than the novice players. The agility between skilled and novice players F = 4.41, P < 0.04, on pre- and post-data. Novice players were significantly higher than skilled players. The hand grip F = (8.10); P < 0.00, the skilled players were significantly higher than the novice players.

Table 6

Comparison among Skilled and novice Players in performance measurement of Female Table Tennis Players

	skilled group				novice group					
Variables	pre data		post data		pre data		post data		F value	sig
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
forehand drive	21.57	2.97	22.50	3.82	20.14	4.46	21.85	3.82	6.31	0.01
ball speed	1.08	0.54	1.26	0.49	0.80	0.311	0.88	0.30	4.84	0.03

Note. *p*<.05* indicates a level of significance

Table 7 showed no significant difference between the group comparison of skilled and novice players in the measurement of forehand drive F = (6.31); P < 0.01. The skilled players were significantly higher than the novice players. The ball speed F = (4.84), for skilled players was significantly higher than the novice players.

Table 7

Comparison among skilled and novice players in kinematics measurement of female table tennis players

	skilled group				novice group					
Variables	pre data		post data		pre data		post data		F value	sig
	M	SD	M	SD	M	SD	M	SD		
elbow angle stance	76.5	3.71	76.9	3.86	75.8	3.72	77.1	3.96	6.21	0.01
shoulder angle stance	84.7	2.36	86.3	2.77	84.1	2.18	85.1	2.64	3.88	0.05
foot angle stance	58.4	2.23	60.6	2.47	57.9	1.63	59.3	2.54	1.60	0.21
elbow angle backswing	71.2	6.48	74.5	6.49	71.6	6.94	72.8	6.58	4.00	0.05
shoulder angle backswing	77.3	5.90	81.2	5.95	77.4	6.20	79.3	6.73	5.29	0.03
foot angle backswing	76.5	8.11	78.7	7.98	76.2	8.18	77.7	7.90	2.46	0.12
elbow angle connect	67.5	2.26	68.8	2.72	68.6	2.25	71.0	2.72	8.21	0.00
shoulder angle connect	67.5	2.26	69.1	2.83	68.6	2.25	71.0	2.72	4.09	0.05
foot angle connect	51.4	2.39	53.9	2.41	51.03	2.19	52.6	2.34	5.00	0.03
elbow angle following-throw	117.6	5.30	122.9	5.21	115.4	4.28	117.9	3.62	5.12	0.03
shoulder angle following-throw	119.33	3.53	122.02	3.22	118.83	3.44	120.88	3.69	1.66	0.20
foot angle following-throw	53.36	3.16	57.52	5.98	52.79	2.99	54.68	3.89	3.25	0.08

Note. P < .05 indicates a level of significance.*

Table 8 showed a significant difference between the group comparison among skilled and novice players in the kinematics of elbow angle stance data F = (6.21); P < 0.01. Tukey's post hoc result showed the skilled players than the novice players. The shoulder angle at the stance of skilled players was significantly higher than that of novice players. The elbow angle at the backswing of skilled players was significantly higher than that of novice players table tennis players. The shoulder angle at the backswing data F = (5.29); P < 0.03, the novice players were significantly higher than the skilled players. The elbow angle at the position of the bat-ball impact of skilled players was higher than the novice F = (8.21); P < 0.00. According to the finding of Tukey's post hoc, the novice players were lesser than the skilled players. The result showed that the novice group enhanced elbow angle contact than the skilled group. The shoulder angle contact data F (4.09); P < 0.05 of skilled players was significantly higher than the novice players. The foot angle contact data F = (5.00); P < 0.03. was significantly higher than the novice players. The elbow angle following through data F

(5.12); P < 0.03. was significantly higher than the novice players.

Discussion

In this study, the stature, sitting height, and body mass were significantly higher for the skilled female players than the novice players. The previous and present generate similarity in findings to (Chen et al., 2022). As well as in the findings of triceps and biceps skinfold that skilled players less than novice table tennis players which were supported by the findings of the previous study (Lidor & Ziv, 2023). The chest girth, arm flexed girth, and forearm girth of the skilled players are significantly higher than the novice female table tennis players. These findings are consistent with those of the earlier studies as reported similar results (Carrasco et al., 2011; Chen et al., 2022; Huang & Wei, 2023). The present study portrays that the total leg length and human breadths of skilled players were significantly higher than the novice female table tennis players. The findings are consistent with those of the earlier study (Pradas et al., 2021; Lidor & Ziv, 2023).In the physical fitness measures the flexibility, leg strength, and hand grip strength of the skilled players were significantly higher than the novice female table tennis players. These are supported by the results of past studies (Bańkosz & Winiarski, 2018; Chen et al., 2022; Wang, 2021; Lidor & Ziv, 2023). These findings show that regularity in table tennis players increases flexibility and upper body strength with repeated exercise with higher frequency. Flexibility, agility, and hand grip strength are associated with the accuracy and force of forehand drive of female table tennis players.

The skilled female table tennis players were significantly higher in the elbow angle, shoulder angle at the back swing, down swing, and bat-ball impact than the novice female table tennis players. The findings are similar to the findings of past studies (Fleisig et al., 2009; Bańkosz & Winiarski, 2018; Zagatto et al., 2015; Qian et al., 2016). The angular kinematics, the shoulder angle, elbow angle, and wrist angle while performing the forehand drive. It shows that skilled players can retain the proper flexion and extension of the shoulder joints while executing the forehand drive (Chen et al., 2022), which increases the force of the shot by executing the leverage of the joints.

Conclusion

This study examined the body composition, physical fitness, and kinematic parameters of the forehand service in novice and skilled table tennis players at the college level. The findings confirmed that skilled players generally demonstrated superior physical fitness features, linear and angular kinematics, and body composition than novice female table tennis players. This finding shows the higher range of movement of the joints, strength, and balance of the female skilled players than the novice female players. The comparative analysis of the body composition exposed that skilled female table tennis players lesser in body fat than novice female players. This finding shows that regular rotational practice in table tennis, like forehand drive reduces body fats in the trunk as well as the upper and lower limbs. Further, this regular practice also increases the strength of the arms by increasing hand grip strength, girth of the forearm, and upper arm. These findings conclude that skilled female players are more devoted to regular table tennis practice along with physical fitness training which reduces their body fat and increases muscular strength.

On the other hand, the long-time playing capacity of the skilled female table tennis players was higher along the measurements of coordination, flexibility, agility, and leg strength were higher than the novice female players. These findings show that hand-eye coordination plays a very important role in responding to the service of the opponent players also during the rally and preparing body position earlier to produce a good forehand drive. Flexibility along with agility increases the range of table tennis players for shots and quick response to all types of shots against the opponent players. Stronger legs increase the balance of athletes which is associated with the higher performance of the players of racket games. Therefore, it may be concluded that skilled and regular table tennis players are good in forehand drive and table tennis skills, so novice players require more practice on a regular basis along with an appropriate training program.

The table tennis forehand drive can be divided into five phases, stance, backswing, downswing, bat-ball impact, and follow-through. According to the coaching guidelines a good stance is key to good performance in table tennis which is associated with backswing bat-ball impact and the execution of good forehand shots. According to the findings of the present study, the skilled female player was higher in the angular position of the shoulders and elbows. Later in the phases of the forehand drive these angels' higher extension at the back swing and at the time of bat-ball impact increase the ball speed after colliding with the ball. This occurs because the kinetics chain which starts from the lower limb of the body transfers force into played ball through the shoulder, elbow, and hand joints. As a result, the novice players would be less in proper joint movement coordination which links to the ball accuracy and ball speed of the forehand drive. The angular position of the female players changes during different phases associated with the initial movement which starts from the kinetics chain as well as the coordination of the movement in table tennis shots.

Finally, this study recommends that coaches focus on the body composition, physical fitness, and kinematics of table tennis, especially female players. Coaches and players of all levels must capture their table tennis action to analyze their body position, ball speed, and accuracy in the service and shots. Future research may be conducted to investigate the training effects on the performance of various shots and the performance of the players.

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