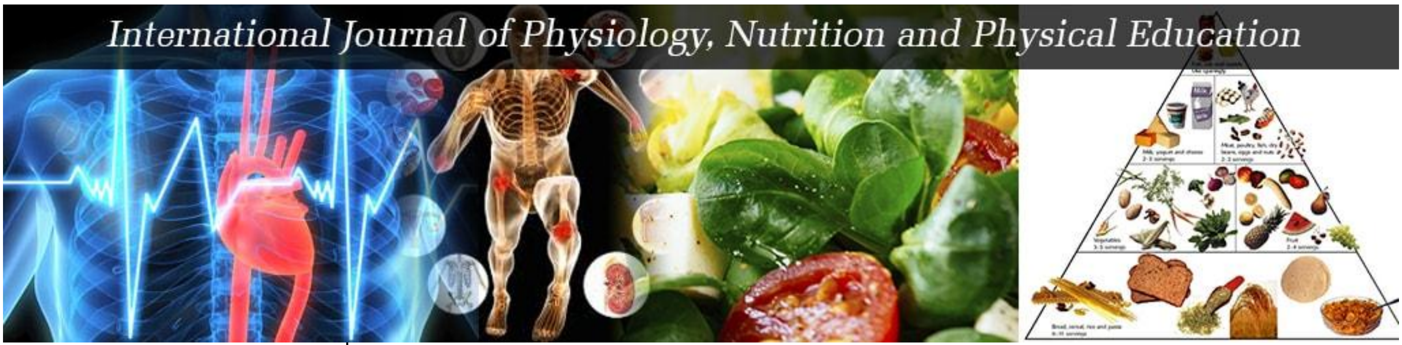

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Sreeja U Bhasi
PhD Scholar, SAI, LNCPE, Thiruvananthapuram, Kerala, India

Dr. Sadanandan CS
Associate Professor, SAI, LNCPE, Thiruvananthapuram, Kerala, India

Corresponding Author:
Sreeja U Bhasi
PhD Scholar, SAI, LNCPE, Thiruvananthapuram, Kerala, India

Analysis of jump serve takeoff velocity among national level male volleyball players

Sreeja U Bhasi and Dr. Sadanandan CS

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Abstract
Serve is one of the most important skills a player needs to have when they step onto the volleyball court. A serve starts every play in volleyball, which is why it is important to know how to do it if you want to play volleyball. In volleyball the players uses different types of serves. The jump serve is highly effective, whenever the player puts power into the serve and attacks opponent. In jump serve, the higher the point of impact, the sharper the downward angle of the serve, and the more margin for error there is for the server to utilize a higher ball velocity. The more extended the body at take-off, the higher the server will jump, as the height of the CG at take-off contributes to maximum jump height. Take off velocity will be the most important contributing factor along with the combination of other kinematic variables that can result in attaining maximum reach height during jump serve. Considering the importance of take off velocity in the execution of jump serve the researchers made an attempt to find out the relationship between the selected kinematic variables and the take-off velocity of jump serve among national level male volleyball players. The present research was intended to find out the relationship between the selected kinematic variables and the take off velocity of jump serve among national level male volleyball players. The purpose of the study was achieved with participation of 10 national level male volleyball players from Kerala and the assessment done on the selected kinematic variables of jump serve which can describe the characteristics of take off velocity. The objectives of the study – to find out how the take-off velocity of jump serve related with the selected independent variables jump serve approach phase – was accomplished through a scientifically planned and executed two dimensional video analysis using the captured serve trials (N= 20 trials) of selected participants. The Kinovea motion analysis software was used as the tool for the same. The data collected through the video analysis method was statistically assessed using Pearson's Product Moment Correlation Coefficient and found that Takeoff velocity in jump serve had a significant positive relationship with the angle of hip and the angle at shoulder at cross step and significant negative relationship with the angle of hip at penultimate step among national level male volleyball players.

Keywords: Jump Serve, Take off Velocity

Introduction
The volleyball serve is used to commence the game by delivering the ball across the net to the opposite side of the court. The ideal outcome of the serve is to execute an un-returnable serve. Although this is optimal, it cannot always be achieved. A jump serve, nevertheless can increase the difficulty for the opposing team to make an effective attack, as this style is displayed to create the highest ball speeds in volleyball (Mackenzie, Kortegaard, LeVangie & Barro, 2012) [3]. To do this, the server must strike the ball with maximum force at the peak of the jump. In the jump serve, the entirety of the serve is determined by the ball toss. Once the server has released the ball in front of them, they must run the distance to begin the jump phase behind the service line with as much forward momentum as possible. The run up consists of 3 to 4 steps where the body moves towards the court with increasing speed. During the approach the kinetic energy in the steps are used as a loading mechanism to transfer the multiplication of the kinetic motions to execute a high vertical jump. In this sense, a stopping motion in the transition from the run up phase to the jump phase results in a loss of kinetic energy, creating a smaller amount of potential energy and a smaller jump height (Blazevich, 2012) [1]. As a result of taking large strides, during the three-step phase, the centre of mass lowers as the hips, knees and ankles contract.

This contraction will develop flexion and therefore stretch the leg muscles moving in to the jump phase where further contraction will be required. This will be an important aspect of the run up as the goal is to transfer the energy from one movement phase to the next fluently to ensure as little energy is lost as possible. Although the server will benefit from taking large strides, they will need to ensure that the speed of their run up is not compromised. A faster horizontal velocity of the centre of gravity produced by a more rapid run up will in turn increase the speed of the ball leaving the hand. Therefore, the server should accelerate off the balls of their feet so that force application occurs in a backwards direction. Considering the importance of take off velocity in the execution of jump serve the researchers made an attempt to find out the relationship between the selected kinematic variables and the take-off velocity of jump serve among national level male volleyball players.

Methodology

The present investigation was carried out with 10 national level male volleyball players with an age range from 19 to 25 years. For the kinematic analysis of take-off velocity of jump serve the serve trials are filmed using Sony Alpha 7sii. The data captured was fed to the computer for analysis. The take-off velocity of the serve was calculated by dividing the displacement of the centre of gravity from the last moment of contact with ground to the moment the body left the ground during take-off by the time taken for the same with the help of Kinovea motion analysis software. The data on selected linear and angular kinematic variables were also assessed with the help of Kinovea motion analysis software. The details of the variables considered for the present study is given in Table 1. The data was analysed using statistics such as Arithmetic Mean (AM), Standard Deviation (SD), in order to get basic idea about the data distribution. Pearson Product Moment Correlation Coefficient was calculated to find out significance of relationship between the dependent variable (Take off Velocity) with the selected independent variables and the level of significance was set at 0.05.

Table 1: Analysis of selected linear kinematic variables of Jump Serve

Variable	Mean	Std. Deviation	N
Distance between Foot (Stance)	0.76	0.03	20
Height of CG (Stance)	1.22	0.07	20
Approach Distance	4.39	0.27	20
Duration of Approach Run	1.45	0.16	20
Length of Penultimate Step	1.34	0.11	20
Height of CG (Penultimate Step)	1.04	0.06	20
Height of CG (Cross Step)	1.02	0.03	20
Duration of Take Off	0.16	0.02	20

The mean of distance between feet was 0.76m with a standard deviation of 0.03m. The mean of height of CG at stance was 1.22m with a standard deviation of 0.07 m. The mean approach distance was 4.39m with a standard deviation of 0.27m. The mean duration of approach run was 1.45s with a standard deviation of 0.16s. The mean length of penultimate step was 1.34m with a standard deviation of 0.11m. The mean height of CG at penultimate step was 1.04 m with a standard deviation of 0.06m. The mean height of CG at cross step was 1.02m with a standard deviation of 0.03m. The mean duration of take-off was 0.16s with a standard deviation of 0.02s.

Table 2: Analysis of selected angular kinematic variables of Jump Serve

Variable	Mean	Std. Deviation	N
Take Off Velocity	2.94	0.46	20
Velocity of Approach Run	3.06	0.39	20
Angle at Knee of the Lead Leg (Stance)	172.85	3.39	20
Angle at Hip (Stance)	145.00	8.72	20
Angle at Knee of the Lead Leg (Penultimate Step)	136.35	3.00	20
Angle at Knee of the Rear Leg (Penultimate Step)	133.20	4.82	20
Angle at Hip (Penultimate Step)	118.90	8.29	20
Angle at Shoulder (Penultimate Step)	77.20	6.45	20
Angle at Knee of the Rear Leg (Cross Step)	120.90	7.09	20
Angle at Knee of the Lead Leg (Cross Step	151.35	10.52	20
Angle at Hip (Cross Step)	116.85	9.39	20
Angle at Shoulder (Cross Step)	74.65	6.19	20
Angle of Take Off	44.35	4.63	20
Angle at Hip (Take Off)	151.50	10.38	20
Angle at Shoulder (Take Off)	140.60	6.84	20

The mean take-off velocity of the selected subjects was 2.94m/s with a standard deviation of 0.46m/s. The mean velocity of approach run was 3.06m/s with a standard deviation of 0.39m/s. The mean of angle at knee of the lead leg at stance was 172.85° with a standard deviation of 3.39°. The mean of angle at hip at stance was 145° with a standard deviation of 8.72°. The mean angle at knee of the lead leg at penultimate step was 136.35° with a standard deviation of 3.00°. The mean angle at knee of the rear leg at penultimate step was 133.20° with a standard deviation of 4.82°. The mean angle at hip of the penultimate step was 118.90° with a standard deviation of 8.29°. The mean angle at shoulder of the penultimate step was 77.20° with a standard deviation of 6.45°. The mean angle at knee of the rear leg at cross step was 120.90° with a standard deviation of 7.09°. The mean angle at knee of the lead leg at cross step was 151.35° with a standard deviation of 10.52°. The mean angle at hip at cross step was 116.85° with a standard deviation of 9.39°. The mean angle at shoulder at cross step was 74.65° with a standard deviation of 6.19°. The mean angle of take-off was 44.35° with a standard deviation of 4.63°. The mean angle at hip at take-off was 151.50° with a standard deviation of 10.38°. The mean angle at shoulder at take-off was 140.60° with a standard deviation of 6.84°.

Table 3: Correlation between the Takeoff Velocity and kinematic variables of jump serve

Variable		N	r	Sig.
Take Off Velocity	Distance between Foot (Stance)	20	0.129	0.589
	Height of CG (Stance)	20	-0.190	0.422
	Approach Distance	20	-0.342	0.140
	Duration of Approach Run	20	0.027	0.910
	Length of Penultimate Step	20	-0.388	0.091
	Height of CG (Penultimate Step)	20	0.139	0.560
	Height of CG (Cross Step)	20	0.110	0.644
	Duration of Take Off	20	-0.327	0.160
	Velocity of Approach Run	20	-0.165	0.488
	Angle at Knee of the Lead Leg (Stance)	20	-0.029	0.902
	Angle at Hip (Stance)	20	-0.134	0.572
	Angle at Knee of the Lead Leg (Penultimate Step)	20	-0.228	0.333
	Angle at Knee of the Rear Leg (Penultimate Step)	20	0.008	0.975
	Angle at Hip (Penultimate Step)	20	*-0.908*	*0.000*
	Angle at Shoulder (Penultimate Step)	20	0.124	0.602
	Angle at Knee of the Rear Leg (Cross Step)	20	0.030	0.899
	Angle at Knee of the Lead Leg (Cross Step)	20	0.088	0.711
	Angle at Hip (Cross Step)	20	*0.463*	*0.040*
	Angle at Shoulder (Cross Step)	20	*0.956*	*0.000*
	Angle of Take Off	20	0.009	0.971
	Angle at Hip (Take Off)	20	-0.101	0.673
	Angle at Shoulder (Take Off)	20	-0.330	0.155

Table 3 illustrated that takeoff velocity showed significant positive relationship with angle at hip at cross step (r =0.463, $p < 0.05$) and angle at shoulder at cross step (r = 0.956, $p < 0.05$). Takeoff velocity showed significant negative relationship with angle at hip at penultimate step (r = - 0. 908, $p < 0.05$). The results indicated that the takeoff velocity had no significant relationship with distance between feet at stance, height of CG at stance, approach distance, duration of approach run , length of penultimate step, height of CG at penultimate step, height of CG at cross step, duration of take off, velocity of approach run, angle at hip at stance, angle at knee of the lead leg at stance, angle at knee of the lead leg at penultimate step, angle at knee of the rear leg at penultimate step, angle at shoulder of the penultimate step, angle at knee of the lead let at cross step, angle at knee of the rear leg at cross step, angle of takeoff, angle at hip at takeoff, and angle at shoulder at takeoff.

Conclusions

1. The Takeoff velocity in jump serve had a significant positive relationship with the angle of hip and the angle at shoulder at cross step among national level male volleyball players.
2. The Takeoff velocity in jump serve had a significant negative relationship with the angle of hip at penultimate step among national level male volleyball players.
3. The takeoff velocity had no significant relationship with distance between feet at stance, height of CG at stance, approach distance, duration of approach run , length of penultimate step, height of CG at penultimate step, height of CG at cross step, duration of take off, velocity of approach run, angle at hip at stance, angle at knee of the lead leg at stance, angle at knee of the lead leg at penultimate step, angle at knee of the rear leg at penultimate step, angle at shoulder of the penultimate step, angle at knee of the lead let at cross step, angle at knee of the rear leg at cross step, angle of takeoff, angle at hip at takeoff, and angle at shoulder at takeoff among national level male volleyball players.

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