



INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

Volume 2; Issue 2; 2024; Page No. 81-86

Received: 08-12-2023

Accepted: 13-01-2024

A theoretical analysis of biomechanics in volleyball sports

¹Vinay Joshi and ²Dr. Pradeep Kumar

¹Research Scholar, Department of Physical Education, Monad University, Hapur, Uttar Pradesh, India

²Assistant Professor, Department of Physical Education, Monad University, Hapur, Uttar Pradesh, India

DOI: <https://doi.org/10.5281/zenodo.12737407>

Corresponding Author: Vinay Joshi

Abstract

Whilst coaches recognize how forces paintings on muscular tissues and have an effect on motion in sports activities, they have got a clear benefit over individuals who lack this know-how and its applications. Athletes who know the fundamental standards have a cause for getting to know the correct way to execute talents. Understanding the cause at the back of getting to know a tough technique offers them greater motivation to master it. The key to success is locating effective educational cues that assist the athlete acquire accurate mechanical approach. Volleyball is a crew game, and the purpose of this recreation is to drop the ball on the opposing team's courtroom. Volleyball carrier is one of the maximum considerable actions that may be visible as a strategic benefit for the squad over the competitors. Without the proper procedures and pacing, the carrier cannot successfully hit the opponent. Various issues, inclusive of arm begin and stop angle, electricity and duration of arm, thus have an effect on the flight distance of the ball. There are strong correlations between the right application of kinematics elements and the serve consequences. Volleyball is a dynamic artwork which could range due to man or woman wishes, talents and matching situations. This intervention has a tendency to be a decisive issue within the final results of a sure game. Therefore, at a excessive level, the participant can determine to generate a excessive ball velocity to restriction their combatants' attack skills.

Keywords: Volleyball, biomechanics, sports, participant, muscular

Introduction

The volleyball game is one of the maximum famous sports activities international. The volleyball game turned into invented by way of William G. Morgan in 1895. When you consider that that time, the sport of volleyball has gained greater prominence with numerous opportunity guidelines and codes. The recognition of the Olympic games become very high after participating in the 1964 Olympics (Stevens, 1983) ^[1]. Athletes had been no longer handiest taking part inside the Olympics for physical interest and fitness, but additionally they had a remarkable ardour for competition. Competitive environment has been created in the entire world with the using sports generation. Volleyball sport is now prepared recreationally as a aggressive recreation for individuals of every age and all sexes. The principle aim of this observe changed into to investigate and recognize several sides of different volleyball serve, which include how it's far performed, how its ball speed effected via impartial decided on variables, the skills of various age

agencies, and inconsistencies in performances. A volleyball sport required physical health, motor fitness, accuracy, timing, ball coping with potential, or knowledge in ball coping with, in keeping with this description.

The participant's depth and ardour decreases by way of constantly participating in sports, then to hold the intensity, we have to have stability in among the games and gamers fitness. (Kunstlinger, Ludwig, & Stegemann, 1987) ^[3]. The majority of inexperienced volleyball gamers or novices would simply focus on warding off trying to strike the ball on the floor. Definitely, kinematics parameters of serve have high stages of overall performance elements on the upward push, which necessitate high degrees of physical, intellectual, and area efforts. Throughout the last few a long time, clinical schooling program has become a key thing in the advancement and success of the game. Volleyball game is an Olympic event practiced for more than (10) ten decades. Humans round the world enjoy the competition in team sports activities, and it's far anticipated to be very a hit

ball sport.

Further, the provider may be made with the aid of standing or leap carrier. Topspin participant starts off evolved with a bounce in courtroom to spike the ball closer to opponents' courtroom into the air from the baseline. Because of the aerodynamics of the volleyball's top spin and facet spin, the volley moves in a unique manner for the duration of the serve. Warding off giving them an clean possibility to get hold of the ball? In a soar serve and spin serve, the volleyball moves in up and down instructions at a decreasing or growing pace. In the sport of volleyball, its key overall performance element is simply to prevent the spin at the ball. Basically, the server pursuits to deliver the ball in the courtroom; in addition it would be extra applicable if the ball's route, speed and so went arranged acceleration tough to handle nicely the ball by using the receiver. Constitute the factors in the determination distance to serve the ball to maintain a aggressive stage of skill ability in the sport; the player must give you the proper angle of the arm with the perfect degree of ball placing hand. Consequently, this study will have a look at biomechanical evaluation of volleyball serve: correlation among segments movement and ball speed. The volleyball game is a competitive & clean game that nearly got here into lifestyles. Disputing the long length of its lifestyles, insufficient attention has been given to its biomechanical element. "Digitization" is the 5 factors of "pace", "trajectory perspective", "overall performance mechanics" and "correlation" that volley ball serves to have a look at in movement biomechanically. Those factors will as it should be investigate the effectiveness of the offerings that can be measured in various approaches. A danger to win the game by lowering errors than competitors higher which increases the velocity as a concern inside the volleyball game.

Scoring the sport is the most effective ability at a essential time which places the ball in play. Additionally, is the full manipulated of the player at some point of the execution. Kinematic factors inclusive of velocity, movement and site were demonstrated to be critical traits of aggressive carrier. Moreover, Ragossi believes that kinematics factors are the maximum crucial in growing a terrific service due to the fact they could disrupt a crew's offensive choices when gaining a strategic role. As a end result, provider may be seemed as the maximum critical skill in figuring out whether a volleyball game is gained or lost.

In view that its inception in 1985, it now not simplest has a slow improvement in a quick-transferring sport, however has additionally come to be a spectator. The speed of provider in a volleyball sport is 45 meters in keeping with 2nd on the worldwide level and TT's significantly quicker than the pace of the sport, making it feasible for velocity, patience, energy, strength and versatility to be developed concurrently. Irrespective of age and physical ability in volleyball has the delivered gain for all (each sexes), as it variety of adaptability is very excessive (Devi & Singh, 2014) ^[14]. Fulfillment of an athlete relies upon on how he's educated for crowning glory and play. The maximum essential element in that is to observe the plan and awareness on the elements that have an effect on our performance. Volleyball serve performance is characterized by means of the search for a balance between person responsibilities, complexes or levels of the sport (ie balance

at some point of provider acquire, balance at some stage in block- attack-, attack-protection balance, stability among each rotation, and so on.) Palao, Manzanares, & Ortega, (2009) ^[2].

Idea of the hassle

The sport of volleyball begins with a provider. It is also an overhead service and can be in the form of topspin or float serve. Volleyball is a game that protects towards assault (Fernandez-Echeverria, Moreno, Claver, & Moreno, (2015) ^[7]. As a end result, the legal guidelines of the sport have regularly been barely in prefer of protection: the services have advanced at the same time as the numbers of recent members have multiplied. Marra, Aquino & Altavilla, (2019) ^[15] the welcome advent of Libro and the incorporation of it were the beneficial while moves and imbalances nonetheless remain. this imbalance between attack and defense, teams of sport responsibilities that can serve to improve their effectiveness can keep away from the creation of any anti-attack (Sanders, Boos, Peacock, Peveler & Lipping (2017) ^[16].

Serve in Volleyball

In a sport of volleyball, service can be considered the extremely critical component of every rally. It is able to be considered as first most enormous offensive movement with the aid of the server. The opponent can't guard it successfully without proper timing and techniques. So, many biomechanical, anthropometrical and mental factors affect the rate, path, and distance of the ball flight. Amongst those factors are deeply involved and will acquire achievement if they are implemented correctly. (Mohammadi & Malek, 2012) ^[6].

The primary purpose is to must be an ace or score for the opposing team to make it as tough as viable for the ball. Four number one functions of the service team to assess trouble levels are summarized as: Time of flight, service velocity/velocity of ball, trajectory prediction (the amount of random motion within the flight course). Like attacking and blocking, an goal provider-determining the nature and can be decisive in the crew's performance. Benefits of carrier are scored at once a factor that now not only, however alternatively, the impact of the provider on the game's next improvement. Thus, it's been determined that an awesome service (performance electricity or execution of a strategic rationale), reception performance and the alternative facet of the offending choice. First reducing pace attacks and will increase the second tempo assaults. This impact blockading performance of service alternatives of assault, ends in an increase in triple blocks, on the way to facilitate the protection.

Volley ball service influences the overall performance-reception balance. In height overall performance volleyball, this balance suggests reception. Hence, 62.zero % to seventy two.6% of receptions are ideal in guys's volleyball (allowing all attack alternatives to be set), and fifty 3.0%-70.5% of women's (Palao, Santos, and Urena, 2004) ^[17]. With reference to performance, indoor volleyball has an inclination to serve power jumps for men and for women to apply everlasting carrier. Within the 2000 Olympic video games, there found a 9-10% increase in bounce serve for each girls & men (Palo *et al.*, 2004) ^[17]. Agelonidis, (2004)

^[11] done this by way of employing the leap serve for gamers in ecu membership competition, in particular for male teams competing in the very last segment. Struggling to effectively shield the great provider team will significantly lessen your probabilities of triumphing the healthy. The service has extra importance in guys's worldwide volleyball. Sturdy carrier is a effective offensive weapon for direct scoring factors and to assist blocks and defenses for scoring points. The technique and pace of service in volleyball vary on the basis of overall performance.

Importance of precise fitness for volleyball

Recreation is one of the factors determining the bodily traits of people, on which performance relies upon, whether or not it is group recreation or person sports located that elite lengthy jumpers have been best for positive ranges of volleyball. The assessment between Indian volleyball players and their international opposite numbers. They may be the absolute best jumps on the net, mainly with regard to vertical jumping capacity and bodily and performance ability that volleyball gamers are accountable for.

Ball games require a extensive variety of talents, consisting of bodily, technical, intellectual & tactical abilities. Amongst them, the physical capability of players has an effective impact on the capabilities and crew approach of the players. Consequently, players ought to have bodily fitness or precise motor fitness to meet the demand of the volleyball game. Elite volleyball players need to be aggressive, with a excessive level of attention, brief wondering, and motion. In addition to the speed of the sport; gamers are required to make short decisions due to the unexpectedly converting circumstances of attack and protection. An awesome volleyball player ought to have upper and lower body strength, as well as neuromuscular coordination and technical electricity and muscle energy. Numerous studies have examined their outcomes on teenagers and physiological and anthropometric traits of grownup volleyball gamers and volleyball overall performance. Preceding research has located that volleyball gamers' overall performance is significantly related to their frame kinematics, back power, weight, peak, B.M.I, and vertical bounce and so forth.

The role of biomechanics in volleyball

Kinematic analysis has come to be a usually used approach in sports that allows us to obtain a performance goal. Outcomes of kinetic analysis enable a extra objective version to determine the kinetic barriers to optimum movement and speed performance. The movement of a volleyball participant and spikes in blocks changed into analyzed via the 3D video-photograph approach. Overseas literature deals with volleyball abilities investigated with the aid of kinematic evaluation.

How We carried out sports activities Biomechanics for the Olympic video games, written via King Wang in 2005, mentioned the education of medical evaluation in sports activities. He said that the clinical implications of biomechanics play a substantial function within the education application of elite athletes, mainly in designing scientific education and physical conditioning packages. Sports activities Biomechanics schooling structures for the athletes of the chinese elite is one of those regions that offer

a scientific basis. The destiny function of biomechanics in sports activities schooling strategies and strategies affects our expertise of the techniques and training and depends on breakthroughs in our creativity.

One of the important ideas of displacement volleyball, which have to provide an explanation for the reason why you need to apprehend the subsequent standards: there are six (06) players on the volleyball courtroom and have a delegated role for each participant. However, due to a fixed rotation, a participant has to now not constantly begin at his location and flow it to that location. Modifications in the function are called displacement. "Displacement is defined as the alternate in function of an object and the place to begin may be based on the high-quality or terrible direction". Now that the displacement of the ideas considered the velocity and acceleration can be observed. The average acceleration advert velocities are interdependent and both are critical variable of volleyball serve.

Pace is described because the displacement at a given time. Displacement may be discovered speed divided by using time. So equation of pace: $V = D/T$. This identical we are able to calculate the rate of volleyball serve and to find out is flow faster from one vicinity to other vicinity. A train constantly wants to come inside the participant as quickly as possible courts. Acceleration is described as charge of changes in pace. Adjustments inside the speed of volley ball at some point of serve this is called acceleration of ball due to serve. Acceleration also used to look at pace growth or decrease at some point of the serve or ball in motion. Acceleration in both course & magnitude, they've superb acceleration whilst a ball or gamers flow with continuously increases the ball/participant pace. If a ball/player movements forward with slows charge they have got a negative acceleration. The common acceleration formula $A_{avg} = (V_f - V_i)/(t_f - t_i)$. Every other very basic idea which influences volleyball is gravitational physics. It influences every issue of the sport; participant, Ball, net. If there's no gravity, so the ball by no means comes down and there may be no sport.

At this factor, there may be greater emphasis on one-dimensional aspects of volleyball serve. A volleyball service relies upon on two dimensional components of biomechanics (both above and underneath). Volleyball serve additionally impact with gravitational force, velocity of serve and horizontal motion, it's miles referred to as projectile movement. The projectile movement can be described as free-fall body with the preliminary horizontal pace. These projectiles movement comply with a parabolic trajectory. Volleyball at some stage in serve will journey in air under a parabola. But, the air resistance and volleyball travel with a small route.

Biomechanics

Kinematics: Kinematics is a scientific department of mechanics which describes the movement of objects without consideration of the causes leading to the motion. The other branch is dynamics, which studies the connection between the motion of objects and its reasons. Kinematics is not to be pressured with kinetics, and dynamics as used in current day physics; this time period is no longer in lively use. Kinematics is the branch of biomechanics concerned with

the look at of motion without reference pressure and with regards to the quantity of time, pace, acceleration, angular and linear displacement to carry out the hobby. Biomechanics is a scientific observes of kinematics and kinetics with describing the motion of an object. Kinematics is the examiner of movement without reference of forces, for this reason kinematics observe cope with things like how speedy it actions, how a ways a frame movements, and the way constantly it moves. In different words we are able to say – The kinematics is that branch of biomechanics, which involved with description of the movement of phase of the frame without regard to the forces and reason due to the movement occurred.

Kinematic evaluation: We're concerned with the relation and end of different kinematics variables. In the volleyball serve with the distinct technique of the volleyball serve, frame movement like the movement of upper extremities (higher arm, forearm, hand) and ball, how tons upper arm actions, how a lot forearm movements, how a good deal hand movements, from preliminary point and the way accurate ball moves.

Angular kinematics: Angular/rotational kinematics is the described examine of rotation of an object. The description of rotation requires some technique for describing orientation, for instance, the Euler angles. In what follows, attention is restricted to easy rotation around an axis of constant orientation. The z-axis has been selected for convenience.

The description of rotation then entails these 3 quantities: Angular role: The orientated distance from a specific starting place at the rotational axis to some extent of an object is a vector $r(t)$ finding the factor. The vector $r(t)$ has some projection (or, equivalently, a few factor) $r(t)$ on a aircraft perpendicular to the axis of rotation. Then the angular position of that factor is the attitude θ from a reference axis (normally the superb x-axis) to the vector $r(t)$ in a acknowledged rotation experience (typically given by means of the righthand rule).

Angular speed: The angular pace is the price at which an angle of joints adjustments in relation to time. Angular pace = angular displacement \div time

Two-Dimensional evaluation: two-Dimensional video analysis typically used minimal one digital camera. Complicated sports motion/movement has been required a couple of digital camera (2nd/three-D analyses) for recording with proper marker role at the concern. While it has drawbacks, was the primary method employed with the aid of the researchers and sports biomechanics, and continues to be used nowadays by means of a large variety of movement analysis testing laboratories. It is also with no trouble adaptable for pupil studies.

Video-analysis: As soon as footage or video has been captured, it must be processed. Video captured by means of camera and transfer it to private laptop for in addition evaluation. In the motion analysis of volleyball serve, silicon coach pro-8 movement evaluation software program become used to digitize marker points that make up an

perspective between the shoulder, elbow and wrist of volleyball players. Given that videography presents a permanent and visible report of results, it's far the most often applied information collection method in biomechanics. There are nonimaging assessment biomechanical techniques that examine enormous biomechanical facts for goal movement studies. At instances, it might be most suitable to explicitly calculate a few dimensions of a motion's kinematics as opposed to deriving the measures from movie or videotape.

Digitization: Digitization pictures, whether film or video, need to be processed right into a layout that the pc can use. Video capture playing cards used to seize video and translate it into a digitized form, prepared for evaluation. The game researcher additionally uses this time period in reference to taking pictures the coordinates of markers located at the frame for motion evaluation. The procedure for movement analysis with measurement in motion entails "digitizing" markers on an athlete's arm to create an perspective that may be used for evaluation.

high speed video: nowadays, eminent pupils test with machine getting to know and pc imaginative and prescient the use of high decision video cameras capable of recording 30,000 to 100,000 photographs in line with 2nd (fps). Digicam technology which can dynamically manage "automatic" identifiers, with new approaches, time-saving techniques, the time from filming to records processing has been reduced to days.

Calibration attitude: This attitude is a measure of hyper flexion and hyperextension whiles the problem serve the Volleyballl. The maximum common condition is for the problem to exhibit a moderate high quality perspective.

Videography device: inside the "early days" of sport, research and movement evaluation scientists used cameras that could shoot 16mm movie at rates extra than 100 frames consistent with 2d. This allows researchers to capture information from occasions that arise very rapid. The down side to using film is that it's miles costly, each to purchase and broaden, and takes more time and unique gadget to investigate.

Human biomechanics is a branch of technology reading the impact of inner and external forces on human body

From time to time biomechanics is identified with kinesiology. Kinesiology studies physiological, mental, and mechanical rules in relation to the motions of living organisms. Consequently, kinesiology is superior to biomechanics. McGinnis (2005) described biomechanics of recreation and bodily exercise within the following manner:

Biomechanics of game

by way of recreation it is meant an organized, competitive, fun hobby, requiring talents, capacity, determination, approach, and fair play, wherein the winner can be decided by goal means within a firm set of policies.

Bodily Exercise: by using physical exercising it is supposed any intentional bodily activity which enhances or keeps bodily fitness, overall performance, fitness, or health. The

secondary intention of recreation biomechanics is strongly associated with the main aim due to the fact a healthy athlete will perform better than an athlete plagued with common injuries. How can biomechanics fulfill its goals.

Competencies strategies in volleyball: Schinkel-Ivy, Pardisnia & Drake, (2014) ^[18] studied out distinct positions for maximum trunk tour. Despite the fact that spinal motions had been visible to go with axial twists, head positions had been standardized to prefer top body flexion, lateral bends, and maximal voluntary ones for trunk motion. The number one objective of this study changed into to decide a correlation between the head and arm movement kinematics in the spine that allows most effective variety of motion. Twenty-four topics, various their head and arm positions, exhibited most movement of the aircraft of gazes. Usually, the higher trunk perspective becomes fixed, at the same time as the lower areas of the body moved or have been at rest. Department posts frequently have an effect at the maximum spinal angles, with the highest perspective taking place when the hands have been hanged on the floor (flexion), hijacked at ninety degrees (axial bend), or held on the ground. Previously, it changed into used to go or pass over the chest (lateral bend).

Hussain, Mohammad & Khan, (2019) ^[9] conducted a "visual graphical assessment of arm swing on spike bounce consequences of separate practical groups of 'volleyball individuals." The examine's primary goal became to evaluate the soar performance disparity between intercollegiate and college male spike volleyball gamers. For this evaluation, fourteen male proper passed volleyball players from Aligarh, India were chosen. The have a look at's findings indicated that there was a statistically critical hole in volleyball spike bounce achievement among intercollegiate and intervarsity volleyball male groups.

In volleyball spiking, investigated the connection among anthropometrical and kinematical traits of volleyball serve. The studies became located in the the front row so as to have a look at brief-row and high-set ball spiking behavior and to better hold close the relationship among take-off and spiked ball speed. 8 (08) male intercollegiate volleyball players (1.78, zero.05 m, 65.09 eighty three 6.83kg, and 22. five y 2. zero yrs) had their quick and excessive set ball spiking conduct filmed for the evaluation via a virtual video digicam from East quarter Intersvarsity Volleyball. Following spiking, the momentum and ball pace were resolved using enough motion evaluation equipment. The facts were evaluated using the suggest, widespread deviation, and correlation coefficient. The findings indicated a bad correlation between ball speed of spike and take off (good sized), with a co-efficiency fee of zero. forty five for huge and zero.30 for quick set balls. In keeping with the findings of this analysis, take-off velocity could have an indirect impact on ball velocity. He assumed that the bad association among taking the velocity and the ball pace changed into insufficient for front row spiking in volleyball, and that players with a higher most advantageous speed might be unable to deliver the spiked ball with a better velocity.

Overall Performance Development

Approach development: Development of method with the

help of biomechanics may be utilized by instructors and coaches to correct motions of students or athletes. Moreover, research employees within the field of biomechanics may also develop a new and extra effective method for better execution of a sport movement. Inside the former case instructors and coaches employ the strategies of qualitative biomechanics analysis of their regular practice to produce adjustments within the technique utilized by their prices. Within the latter case research employees inside the area of biomechanics use quantitative biomechanics strategies to broaden new techniques which could then be applied into coaching and education procedures. As an example if a gymnastics teach sees that her price has problems to show a somersault she can give you 3 guidelines to assist the gymnast execute this exercise efficiently:

- To jump better
- To fling hands with extra power before commencing,
- To curl up extra tightly.

A lot of these recommendations can assist to execute this mission efficiently and are based totally at the standards of biomechanics. If the gymnast jumps better, she has extra time to finish the turn at some stage in the flight phase. To curl up more tightly manner to boom the speed of rotation even as retaining the equal angular momentum. To fling palms with more electricity will increase the angular momentum which helps the gymnast to rotate quicker. Among sport activities that saw in the past widespread changes in method are javelin, excessive jump.

Gadget development: Use of biomechanics also can cause a better look and higher functioning of game system. As an instance ski boots will have a actual effect on sport performance. Sophisticated recreation system offers advantage to each elite and leisure athletes. Researchers have currently additionally advanced a brand new swimming healthy which helped swimmers at the Sydney Olympics in 2000 better several international facts as it has a favorable influence on the draft pressure and buoyancy of water this is appearing against swimmers. This swimming match had such a power on sport performance in swimming, in truth, that its use become later banned.

Injury Prevention: The concept of harm prevention is part of public health and its goal is to enhance the overall health of the population and as a consequence to boom the fine of lifestyles. Biomechanics is a tool that may be used in game remedy to identify forces and mechanical energy that purpose accidents. It facilitates to recognize how injuries originate, the way to avoid them during sport overall performance, and a way to discover workout appropriate for harm prevention and rehabilitation. Biomechanics gives possibilities to create opportunity techniques of executing particular actions, using new equipment, and sporting out extra effective education strategies, which additionally contributes to damage prevention

Damage reduction through modifications to gadget function: One of the examples of the usage of the effects of biomechanics research for improving the functioning of game equipment may be found in going for walks. The wide

variety of individuals who realize the importance of healthful existence style is these days developing. Running, as an basic human locomotion, is a legitimate a part of wholesome life-style. However the growing numbers of people engaged in running also added higher incidence of accidents. Walking footwear at the start of the Seventies have been too stiff for in skilled runners. Some of the accidents with developing incidence had been stress fractures and shin bone ache. Shoe manufacturers consequently started out to marketplace shoes with tender soles. But, smooth soles did not provide correct stability and motor manipulate. Runners started out to be afflicted by ankle, knee and hip accidents. Biomechanics research has made it possible to manufacture walking footwear which lessen impact forces and, at the same time, provide excellent stability and motor control. With the help of biomechanics it's far even viable to propose custom made footwear for person athletes. Incidence of accidents in strolling has reduced again.

Conclusion

Isn't human frame itself the nice device for strolling? People who wear footwear from very early age in general contact the ground first with their rear foot once they walk. Lieberman *et al.* (2010) ^[19] studied the fashion of running in Kenyans who in no way wore shoes and assert that during barefoot strolling humans obviously touch the ground first with their forefoot. This produces slower loading fee in foot as compared to walking in footwear and touching the floor first with rear foot. Grand response forces in the course of jogging may also motive persistent injuries that runners regularly suffer from.

Biomechanical observe of the techno-technical elements of volleyball serve motion can help players in integrating the technical measurement of the game and reviving their essential notational capabilities. This examine might offer sports activities scientists, bodily educators, coaches, and athletes with the knowledge and competencies needed to maximize the mechanical gain of volleyball serves in the sport of volleyball. The clinical method in biomechanical evaluation of volleyball serve could offer a strategic useful guide for the coaches/physical educator in addition to volleyball expert/players to attain performance at some point of serve. The look at described the kinematic variations of the whole movement sample of volleyball serve.

References

1. Stevens KA. Surface tilt (the direction of slant): A neglected psychophysical variable. *Perception & Psychophysics*. 1983;33:241-250.
2. Palao JM, Manzanares P, Ortega E. Techniques used and efficacy of volleyball skills in relation to gender. *International Journal of Performance Analysis in Sport*. 2009 Aug 1;9(2):281-93.
3. Ansorge W, Sproat B, Stegemann J, Schwager C, Zenke M. Automated DNA sequencing: ultrasensitive detection of fluorescent bands during electrophoresis. *Nucleic acids research*. 1987;15(11):4593-602.
4. Haze H. The that means of the term biomechanics. *J Biomech*. 1974;7(12):189-190.
5. Nikolas KJ. *Plant Biomechanics: An Engineering*

approach to Plant structure and function. 1st ed. New York, NY: University of Chicago Press; c1992. p. 622.

6. Mahrous AKMA. The relationship between the performance of some Offensive and defensive capabilities, and the effects Order of teams taking part in Olympics London 2012 for men's beach Volleyball. *Assiut J Sport Sci Arts*. 2014;114(1):418-435.
7. Fernandez-Echeverria C, Gil A, Moreno A, Claver F, Moreno MP. Analysis of the variables that predict serve efficacy in young volleyball players. *International Journal of performance analysis in sport*. 2015;15(1):172-86.
8. Hayrinen M, Mikkola T, Honkanen P, Lahtinen P, Paananen A, Blomqvist M. Biomechanical analysis of the jump serve in men's volleyball. In: *FIVB Volleyball Medicine Congress*; January 2011; Bled, Slovenia. pp. 13-15.
9. Khan H, Ahmad. Spatio-temporal analysis Of Volleyball Serve. *IJEDR*. 2019;7(3):ISSN: 2321-9939.
10. Marcelino R, Sampaio J, Mesquita I. Attack and serve performances according to the match duration and quality of competition in elite volleyball matches. *J Strength Cond Res*. 2021;26(12):3385-3391.
11. Agelonidis Y. The jump serve in volleyball: From oblivion to dominance. *Journal of Human Movement Studies*. 2004;47(3):205-214.
12. Palao JM, Valades D. Normative Profiles for Serve speed for the training of the Serve and Reception in Volleyball. *Sports J*. 2014;1(1).
13. Yiannis L, Panagiotis K. Evolution in men's volleyball skills and tactics as evidenced in the Athens 2004 Olympic games. *Int J Perform Anal Sport*. 2005;5(2):1-8.
14. Devi S, Singh N. Dental care during and after radiotherapy in head and neck cancer. *National journal of maxillofacial surgery*. 2014;5(2):117-125.
15. Altavilla C, Brugnolini L, Gürkaynak RS, Motto R, Ragusa G. Measuring euro area monetary policy. *Journal of Monetary Economics*. 2019 Dec 1;108:162-179.
16. Sanders GJ, Turner Z, Boos B, Peacock CA, Peveler W, Lipping A. Aerobic capacity is related to repeated sprint ability with sprint distances less than 40 meters. *International journal of exercise science*. 2017;10(2):197-204.
17. Palao JM, Santos JA, Ureña A. Effect of team level on skill performance in volleyball. *International Journal of Performance Analysis in Sport*. 2004;4(2):50-60.
18. Schinkel-Ivy A, Pardisnia S, Drake JD. Head and arm positions that elicit maximal voluntary trunk range-of-motion measures. *Journal of applied biomechanics*. 2014;30(6):689-696.
19. Lieberman DE, Venkadesan M, Werbel WA, Daoud AI, D'andrea S, Davis IS, *et al.* Foot strike patterns and collision forces in habitually barefoot versus shod runners. *Nature*. 2010;463(7280):531-535.

Creative Commons (CC) License

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY 4.0) license. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.