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The Effectiveness of a Training Program Using Vertical Jump Device (Vertimax) on Some Biomechanical Variables in Performance of Undulating Serve Skill in Volleyball for Players

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ABSTRACT

Development of biomechanical elements associated with performance and precision of some fundamental volleyball skills is where research is most important using exercises on training device (vertimax), which considers demands of particular talent when training on it, as training is carried out according to motor paths of each skill independently to advance physical elements of trained skills, which are reflected in biomechanical aspects of each skill, which differs from traditional methods of giving physical exercises, as physical and skill training on this device is closer to nature of players' talent performance on field. In addition, exercises have been built on a mechanical basis that matches character of skill's real on-field performance. research's objectives are to design exercises with Verti Max device that are appropriate for research sample's abilities and to determine how these exercises affect development of certain biomechanical markers of young volleyball players' proficiency with undulating serve from jump. research community consists of young volleyball players from Babylon clubs (Al-Mahaweel Club) youth category, numbering (16) players. following criteria were used to choose research sample: They will be Al-Mahaweel Sports Club's young players for 2022-2023 season, and there will be ten of them. players were split up into two groups by researcher: a control group and an experimental group, which was assigned several five, numbering (5), and they constitute (63%) of total community. This was done by drawing lots, as investigator came to conclusion that suggested workouts have an effect in developing skill of crushing in some biomechanical variables (angular velocity of striking arm, shoulder angle now of striking, instantaneous velocity of ball's exit, and torso angle at moment of striking).

Keywords: Effectiveness of training programs; Vertimax; Biomechanical variables; Undulating serve skills; Volleyball player performance

ABSTRAK

Pengembangan elemen biomekanik yang terkait dengan kinerja dan ketepatan beberapa keterampilan bola voli dasar adalah di mana penelitian paling penting menggunakan latihan pada perangkat pelatihan (vertimax), yang mempertimbangkan tuntutan bakat

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tertentu saat berlatih di atasnya, karena pelatihan dilakukan sesuai dengan jalur motorik dari setiap keterampilan secara mandiri untuk memajukan elemen fisik keterampilan terlatih, yang tercermin dalam aspek biomekanik dari setiap keterampilan, yang berbeda dari metode tradisional untuk memberikan latihan fisik, karena pelatihan fisik dan keterampilan pada perangkat ini lebih dekat dengan sifat kinerja bakat pemain di lapangan. Selain itu, latihan telah dibangun berdasarkan dasar mekanis yang sesuai dengan karakter kinerja nyata keterampilan di lapangan. tujuan penelitian adalah untuk merancang latihan dengan perangkat Verti Max yang sesuai untuk kemampuan sampel penelitian dan untuk menentukan bagaimana latihan ini memengaruhi pengembangan penanda biomekanik tertentu dari kemahiran pemain bola voli muda dengan servis bergelombang dari lompat. komunitas penelitian terdiri dari pemain bola voli muda dari klub Babilon (Klub Al-Mahaweel) kategori pemuda, berjumlah (16) pemain. Kriteria berikut digunakan untuk memilih sampel penelitian: Mereka akan menjadi pemain muda Al-Mahaweel Sports Club untuk musim 2022-2023, dan akan ada sepuluh dari mereka. Pemain dibagi menjadi dua kelompok oleh peneliti: kelompok kontrol dan kelompok eksperimental, yang ditugaskan beberapa lima, bernomor (5), dan mereka merupakan (63%) dari total komunitas. Ini dilakukan dengan mengundi, karena peneliti sampai pada kesimpulan bahwa latihan yang disarankan memiliki efek dalam mengembangkan keterampilan menghancurkan dalam beberapa variabel biomekanik (kecepatan sudut lengan pukulan, sudut bahu sekarang memukul, kecepatan seketika keluar bola, dan sudut batang tubuh pada saat menyerang).

Kata Kunci: Efektivitas program pelatihan; Vertimax; Biomekanik; Keterampilan servis bergelombang; Performa pemain bola voli

INTRODUCTION

Volleyball is a sport characterized by multiplicity and diversity of its offensive and defensive skills, which are unique according to rules of game and nature of performance specific to each situation. This is due to game's requirement of speed and constant change in team's position from attack to defense and vice versa, depending on changing playing positions. Volleyball requires comprehensive preparation for physical, functional, skill-based, psychological, and tactical aspects, which together work to develop skill and technical performance to a higher level. (Saleem Radhy, et al. 2025). Given development in sports training and use of modern training equipment, which works to increase mastery of all skill performance by developing physical aspects of performance and raising its level through use of modern equipment to develop vertical jump height, as well as horizontal motor speed training with or without equipment, this is what can be achieved when training all skills, including offensive skills, which certainly complete an attack beautifully and at desired point (Hala et al. 2025). Training this skill is one of difficulties faced by many coaches. undulating jump serve is a crucial offensive skill, as performing it well can result in a direct point. As a result of development in skill performance in this game, experts and coaches have sought to find training methods and tools to develop these skills, which are characterized by high difficulty and complexity, and require high precision in timing when hitting ball. Therefore, they require a lot of continuous training until player reaches a good level of performance in terms of control and mastery, as well as speed of movement. Therefore, training on these skills has

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recently become a large part of training units, and these offensive skills have become more widely used in matches by players to decide points significantly. significance of this study resides in in developing biomechanical aspects related to skill performance and accuracy for some basic volleyball skills using exercises on Verti Max training device. This device considers specific skill requirements when training on it. Training is conducted according to specific motor paths of each skill individually, for purpose of developing physical attributes of skills being trained, which are reflected in biomechanical aspects of each skill. This differs from traditional methods of providing physical exercises, as physical and skill training on this device is closer to type of skill performance of players on field. In addition, exercises were built on a mechanical basis that aligns with character of skill performance itself on field.

Volleyball, like any other sport, has certain aspects that, if not considered, can lead to errors and weakness in players' abilities. To avoid these problems, coaches and specialists must adhere to scientific principles and consider them when preparing volleyball players. Through researcher's observation of local volleyball matches and competitions, as a keen observer of game, he found weaknesses in physical and skill preparation of players, which impacted their performance levels. research problem crystallized from fact that all current training methods used various resistances, such as carrying added weights, weight training, various boxes, and medicine balls, all of which affected results to similar degrees. However, use of vertical jump device (verti max), which applies resistance to every working part of body simultaneously, to advance mechanical and physical elements of skills trained in volleyball, has not been considered at present. Therefore, researcher decided to use exercises on Verti Max device to improve mechanical performance of jumping-based undulating serve technique in research sample by following biomechanical foundations that would contribute to execution of jumping undulating serve technique in volleyball players and address weakness in motor performance and stages of skill performance in volleyball.

Research objective:

1. Preparing workouts with Verti Max gadget to suit research sample's abilities.
2. Identifying impact of Verti Max gadget exercises on creating some biomechanical indicators of undulating jump serve skill for youth volleyball players.

Research theories: pre- and post-test results for experimental and control groups differ statistically significantly in some biomechanical indicators of undulating jump serve skill in volleyball. Some biomechanical measures of undulating jump serve competence in post-tests between experimental and control groups varied statistically significantly.

Research fields:

1. Human field: Al-Mahaweel Club youth volleyball players
2. Time frame: July 12, 2022, to March 29, 2023
3. Spatial field: Al- Mahaweel Sports Club's indoor sports hall

METHODS

Nature of phenomenon identified by researcher determines nature of methodology used. Therefore, research problem necessitated use of an experimental methodology, as it suited character of issue. study used a two-group design with pre- and post-tests for an experimental group and a control group. Selection of a sample is

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always linked to its representativeness of original community from which it was taken and possibility of generalizing its results to community from which it was chosen. Therefore, portion of sample that reflects initial community or model that researcher uses as basis for his research.

16 young volleyball players in youngest division from Babylon Clubs (Al-Mahaweel Club) make up research community. Ten young athletes from Al-Mahaweel Sports Club for 2022–2023 season made up purposefully chosen research sample. Players were split into two groups by researcher: a control group and an experimental group (5), representing 63% of total population. This was done by drawing lots. Next, as indicated in Table (1), researcher examined homogeneity of a few variables. researcher then divided players into two groups, matching experimental and control groups in skill tests to control for all variables that might affect stability of research results.

In order must steer clear of factors that could skew research findings because young players differ from one another and to achieve a uniform and equal sample standard, some variables representing sample specifications were identified to ensure homogeneity in those variables considered influential in experiment and that must be controlled. Therefore, statistical processing was conducted using coefficient of variation, according to Table (1).

Table 1. Displays Homogeneity of Sample and Anthropometric Measurements

No.	Variables	Unit of measurement	Mean	Std. Deviations	Skewness
1	Age	Year/Month	16.92	0.79	4.69
2	Training age	Year	18.67	4.42	23.67
3	Mass	Kilogram	66.16	9.99	15.09
4	Length	Cm	180.59	6.36	3.52

Sample Equivalence:

Researcher measured these indicators to ascertain actual biomechanical characteristics in experimental and control groups. As indicated in Table (2), an independent samples t-test was employed between two groups to ascertain significance of variations in previously mentioned variables and to guarantee equivalency of control and experimental groups. As seen in table below, this made it possible for researcher to carry out his investigation and use particular activities. Biomechanical variables' equivalency results for control and experimental groups' pre-tests are displayed in Table (2) for undulating jump serve skill.

Tabel 2. Biomechanical Variables' Equivalency Results for Control and Experimental Groups' Pre-Tests

Variables	Unit of measurement	Group under control		Group under experimentation		T value computed.	Type Sig
		arithmet ic average	Typical deviati on	arithmet ic average	Typical deviati on		
Translation al velocity	m/s	3.39	0.16	3.14	0.82	0.67	Non sig

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Angle of shoulders when striking ball	min	158,23	16,84	171,41	11,75	1,44	Non sig
Instantaneous velocity when ball is struck	m/s	12,74	1,87	13.13	2.03	0,32	Non sig
Angular velocity of hitting arm	min /s	615.92	19.83	628.15	18.97	1.94	Non sig

With $N - 2 = 8$ degrees of freedom and below significance level of 0.05.

Tools, Devices, and Aids

Data Collection Methods: Arabic and international scientific references, Sources Websites, Form for registering information, experiments and observation, Employee support; in-person interviews, Exploratory experiments.

Tools Used: Drawing scale (1 meter), (1) Fita measuring tape, Leather measuring tape, (2) tripods, (50) cm high bench, Adhesive tapes, (15) legal volleyballs (MIKASA), Indicators

Equipment Used: (Lenovo) laptop, (QBF) medical scale for measuring mass - SONY video camera with a frame rate of 300 frames per second, (1) SONY video camera, (1) Nikon camera, (1) Diamond electronic timer measuring up to 0.001, Software and applications used on computer for analysis purposes, (1) Sharp hand calculator, (1) Verti Max device, Legal network.

Verti Max Vertical Jump Machine and its Specifications:

It is world's leading sports training device for achieving maximum speed, vertical jump, and overall athletic performance at highest levels (Iman Faeq Abdul Hussein Shandal. 2015), according to Figure (1).



Figure 1. Illustrates Verti Max device.

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This device is a modern device that is rarely used in sports field. It is utilized through exercises performed on it, maximizing training time. This device develops physical aspects such as strength, speed, explosive power, and others. Performance on it is similar to skill performance and is designed for this purpose. Therefore, it is possible to develop biomechanical aspects of skills under study.

This device, with its special specifications, was used to provide exercises to sample. This device is one of devices used worldwide to train teams from juniors to senior levels. It contains a platform (180) cm long and (120) cm wide, and a foam platform in middle of device (90) cm wide, (150) cm long, and (5) cm thick. This platform benefits player during jumping, due to its ability to absorb jump correctly. All shoes are used on this device, except for spike shoes, which can cause damage to device. weight of device is (75) kg. On back of device, there are a number of pulleys that direct movement of ropes from inside to outside. two long front ropes are for speed exercises that are sometimes outside device and have high elasticity that reaches twice length of original rope. same applies to four side ropes for vertical jumping exercises that help in enhancing legs' explosive power. Pulleys from which ropes are pulled, whether forward or upward, connect ropes to each other. device ports differ in (verti max) device, as there are two types of ports in this device, which are v6-v8, with six ports and eight ports, as seen in Figure (2).

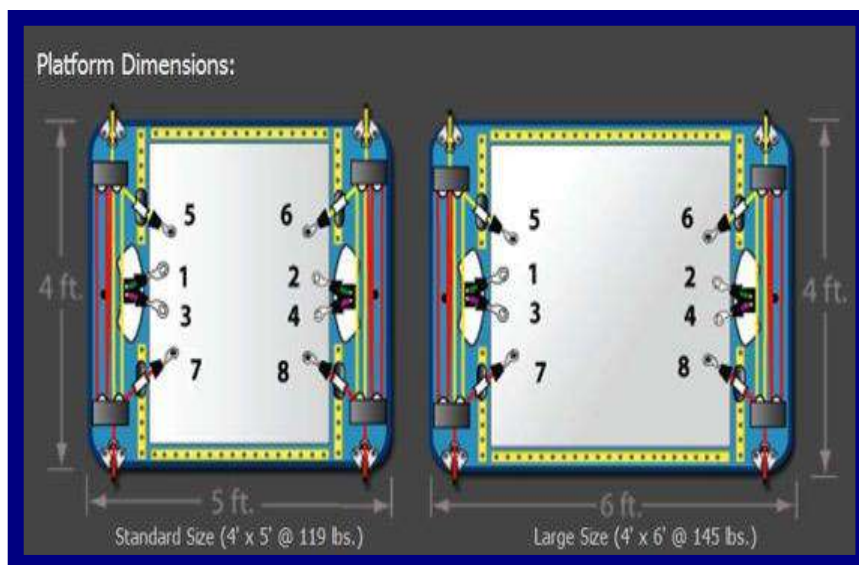


Figure 2. Verti Max Device's Ports are Displayed

Device contains auxiliary bands that connect to body's joints to develop muscular function of each muscle in body that needs to be developed.

Determining Biomechanical Indicators.

Researcher identified a number of biomechanical indicators specific to undulating serve skill from a jump in volleyball, to serve research objectives and available capabilities and requirements for measuring these studied indicators, as explained below:

Determining Biomechanical Indicators for undulating serve skill from a jump.

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1. Transitional Velocity: distance covered by player's body during transitional movement divided by time taken to cover that distance, measured in meters per second.
2. Shoulder angle at moment of hitting ball: line of torso from shoulder joint to hip joint point and angle formed by humerus from point of shoulder joint to point of elbow joint on one side on other side during ball strike phase, measured in degrees.
3. Instantaneous Velocity = Smallest Difference in Distance / Smallest Difference in Time.
4. Angular velocity of hitting arm: It is calculated as angle cut from moment of maximum backward bend during flight to point at which ball is struck and is quantified in (degrees/second).

Test used in research.

To ensure accuracy and objectivity in results of tests used, researcher reviewed all available sources to select best tests for trait to be measured.

Jumping Wave Serve Test (1):

1. Test's objective is to gauge how accurately a volleyball player can serve.
2. A legal volleyball court, a court that is ready as depicted in Figure (3), and other equipment are included.
3. Performance requirements: ball is sent to zones A, B, C, and D by examiner using jumping wave serve.

Situations:

1. Every player gets ten chances in a row.
2. Player's attempt is counted (out of ten attempts) and no point is given if ball strikes net and travels outside or to allocated half of court.

Recording:

1. Every effort made inside zone (A) earns four points.
2. Every effort made inside zone (B) earns three points.
3. Every effort made inside Zone C earns two points.
4. Every effort made inside Zone D earns one point.
5. If ball lands outside of these zones, score is zero.
6. Greater zone score is given if ball lands on a line that is shared by two zones.
7. Attempt is voided if tester commits a legal foul.

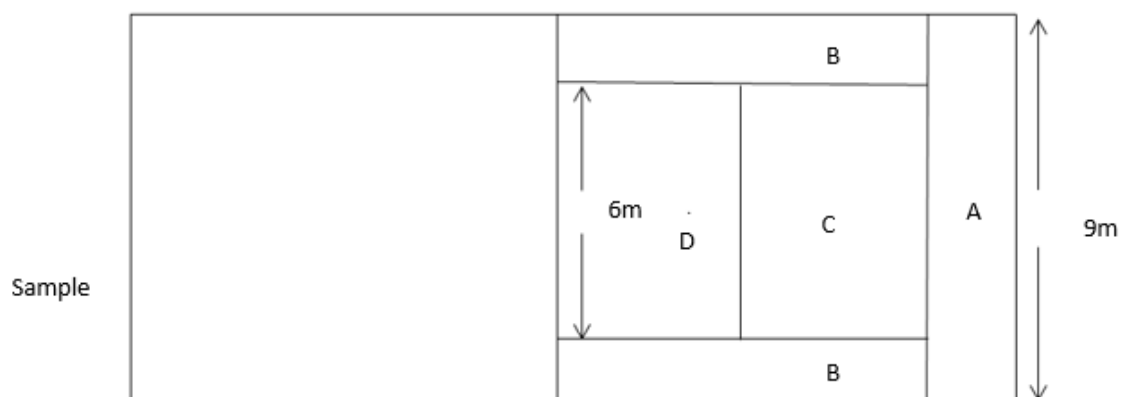


Figure 3. Shows test of Jumping Wave Serve Test.

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Exploratory experiment.

To confirm scientific research steps and to determine accuracy of study and reliability of tests, exercises, and equipment used, it is important to conduct an exploratory study or a set of exploratory studies. This will provide an initial picture of structure (basics) of main experiment, determine reliability of instruments and apparatus utilized, and uncover most important aspects of work. This will involve how players are interacted with and help us arrive at optimal application approach. This will seek to reinforce positives and address negatives when implementing research. Therefore, it is imperative to conduct an actual exploratory experiment.

Initial exploratory experiment:

initial investigation was carried out on Wednesday, December 7, 2022, at 3:00 PM, in presence of a support team. purpose was to determine validity of tests in terms of difficulty and players' ability to perform them, as well as to control duration of every test. researcher also took body measurements of all players, including their masses, biological ages, and training status. He also determined appropriate distance for camera from performance point of volleyball players for (jumping serve) skill. appropriate height for focus of video camera lens above ground was determined (appropriate camera height above ground and camera distance from player's rise point for each skill).* experiment was conducted after positioning camera and determining appropriate height, which was 1.25 meters, and 5.60 meters away from player's rise point. This demonstrated full performance of (jumping serve) skill for volleyball players, with a high degree of clarity for body as a whole and a high degree of clarity for player's center of gravity, enabling us to then conduct an accurate analysis. experiment was performed by three players representing Al-Mahaweel Sports Club in volleyball.

Second Investigative Test:

researcher carried out second exploratory experiment at 3:00 PM on Tuesday, December 20, 2022. purpose of experiment was to familiarize device's contents, how to operate it, and how to determine training intensity for research sample, as well as appropriate time spent on exercises and rest. Some obstacles were identified, including lack of belts on device. These were overcome by having three players perform exercises on device: first from front port and strapped with a palm belt; second on device strapped with a waist belt; and third from back port and strapped with a thigh belt. goal was to give more than one player opportunity to work on device and reduce time required for training session to achieve specified time.

Researcher also conducted an exploratory training session, in coordination with training staff, on research sample before beginning main experiment. purpose was to:

1. Determine number of exercises used for each physical motor skill on device in training session.
2. Verify training session duration.
3. Determine intensity required for working on device.
4. Extent to which players accepted and comprehended researcher's prepared exercises. - Ensure safety of tools used and their suitability for sample.

Researcher reached several points through exploratory experiments:

1. Identify difficulties and problems faced by researcher during work.
2. Identify measurements of analysis camera, its height, and its distance from tested player.

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3. Identify players' ability to perform exercises prepared on VertiMax device.
4. Identify time required for each exercise and intensity at which it begins.
5. Verify support staff's proficiency.
6. Examine reliability of instruments and equipment being utilized.
7. Examine extent of sample's understanding and response to tests.

Scientific Conditions for Tests:

1. Test Validity:

In order to guarantee tests' validity, researcher relied on content validity, as he relied primarily on extent to which test could accurately and consistently represent situations and aspects it measures, achieving objective for which it was designed. Content validity consists of questionnaires distributed to specialists in sports training, measuring, and testing, and volleyball. tests that achieved highest agreement rate were selected, according to Table (3).

Table 3. Agreement Rate for Each Test Given to Experts and Specialists is Displayed

Test	Unit of measurement	Agreement rate
Jumping Wave Serve	Degree	82.62%

2. Test stability:

Test stability means, "providing same results if test is repeated under same conditions" (Ahmad Khater, Ali Fahmi Al-Bayk. 1987). researcher used test-retest method, in which test is administered to same sample individuals twice, separated by one to two weeks, under same conditions. degree of test stability is shown by correlation coefficient between first and second applications. (Ahmad Aribi Awda. 1999). high correlation coefficient value indicated that every test enjoys a high degree of stability, as shown in Table (4).

Table 4. Value of Simple Correlation Coefficient (Person) for Volleyball Skill Tests Under Study is Displayed

Test	correlation coefficient	Result
Jumping Wave Serve	0.93	High correlation

3. Test impartiality:

A high level of impartiality is one of a standardized test's most crucial characteristics. Clarity of instructions is what gives a test its objectivity provided by test administrator and scoring. A test is characterized by high objectivity when it produces same results, regardless of differences in examiners. (Dhuqan Obaidat et al. 1988) Objectivity is a shared understanding of test term and assessment. Cameras are used to photograph precise areas specified by numbers, and area number is recorded. This is undisputed, as is use of skill analysis using precise and standardized programs.

Main Experimental Procedures

Pretests and Videotaping:

With support team's help, researcher administered pretests for research sample on Sunday and Monday, January 22 and 23, 2023, at 10:00 AM, on floor of internal hall of

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Police Sports Club. Cameras were installed, according to dimensions and heights specified above. Specific attempts were assigned to each individual in tests, all of which were filmed, and achievements recorded. exercises are as follows:

Exercises used on device:

researcher prepared training exercises on Verti Max device, focusing on physical, skill, and mechanical aspects, with goal of developing certain biomechanical indicators and accuracy of offensive volleyball skills. researcher relied on principles of sports training science when developing exercises, as well as consulting a group of experts and specialists in training science and volleyball.

After considering Beginning on Tuesday, January 24, 2023, and concluding on Sunday, March 26, 2023, practical exercises were carried out based on reliable scientific observations of specialists who prepared them. following were all included in training program:

1. Practical exercises that were created by researcher and included in training program lasted for eight weeks, consisting of three units every week on Sunday, Tuesday, and Thursday, for a total of twenty-four training units. It should be mentioned that training unit's primary component included practical exercises.
2. Duration of training unit was (120) minutes, while main section lasted (90) minutes. researcher performed specific practical exercises during a period ranging from (30-60) minutes in main section.
3. nstruational strategies employed in curriculum's main part and practical activities ranged from:
 - a. Stations for low-intensity training to improve certain skill areas.
 - b. Training at a high intensity (stations) to develop physical aspects.
4. Given Moderate, submaximal, and maximum intensities and their oscillations were chosen based on characteristics of research sample and study's goal, with intensities ranging from (75% to 95%) of maximum intensity.
5. Researcher used oscillation principle in providing exercises. Muhammad Hassan Alawi. points out importance of oscillation in training load, "as this helps individual acquire ability to adapt and adapt to different requirements, practical application, and actual practice" (Muhammad Hassan Alawi. 1994.).

Duration of Experiment:

Research sample underwent special training exercises on Verti Max device, prepared by researcher. purpose was to develop biomechanical indicators and accuracy of offensive skills. prepared exercises were distributed across a number of training units. Verti Max exercise continued for (8) weeks, from Tuesday, January 24, 2023, until Sunday, March 26, 2023. (3) units were administered per week, totaling (24) training units.

Kinetic Analysis Program Used to Extract Biomechanical Indicators and Process Them Using Computers.

Researcher used Kinetic Analysis Program (KINOVEA) version 21. Data was transferred from camera to computer and processed by extracting biomechanical variables for all skills studied. For each player, best attempt was selected from experimental and control groups. Mechanical equations were used to extract a portion of variables based on laws to show their actual value. and reality.

Post-tests:

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Two experimental groups (numbering (6)) and control group had post-tests, numbering (6) players, on Tuesday and Wednesday, March 28 and 29, 2023, after end of training period. researcher ensured that Location, duration, and tool requirements were identical to those of pre-tests, and test implementation methods. It was possible to place cameras and appropriate dimensions used in pre-tests, calculate scores, and ensure presence of same support team as in preliminary exams. Methods of Statistics: statistical software SPSS was utilized by researcher.

RESEARCH RESULTS

Results are presented, analyzed, and discussed.

Results are presented, examined, and discussed in this chapter by presenting them in tables, which are an illustrative tool used by researcher to present findings he has reached. These results are also analyzed and discussed to determine their validity and their compatibility or inconsistency with research hypotheses.

Results of Biomechanical Variables of Jumping Wave Swing Skill are presented, analyzed, and discussed.

Presentation and Analysis of Control Group's Pre- and Post-Test Results for Biomechanical Variables for Jumping Wave Swing Skill.

Table 5. Shows Outcomes of Control Group's Pre- and Post-Test Biomechanical Factors for Jumping Wave Swing Skill.

Variable s	Unit of measurement	Prior to test		After test		Calculating mean of difference	standar deviation of discrepancies	T value calculated	Type Sig
		arithmetical average	Typical deviation	arithmetical average	Typical deviation				
Translational velocity	m/s	3.39	0.15	3.94	0.16	0.55	0.35	3.51	Sig
Shoulder angle at moment of hitting ball	min	158,23	16,84	163.25	12.30	5.02	3.14	3.57	Sig
Instantaneous velocity at moment of hitting ball	m/s	12,74	1,87	12.20	1.01	0.54	0.44	2.74	Sig

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Angular velocity of hitting arm	min /s	615.94	19.82	628.16	18.98	12.22	5.31	5.15	Sig
Jumping Wave Serve	min	17.54	1.87	23.67	2.25	6.13	2.68	4.79	Sig

With N - 1 = 4 degrees of freedom and below significance level of 0.05.

Results of experimental group's pre- and post-test biomechanical variables are presented and analyzed. for undulating jump serve skill.

Table 6. Biomechanical Variable Findings of Experimental Group's Pre- and Post-Tests Are Displayed in Undulating Jump Serve Skill.

Variables	Unit of measurement	Prior to test		After test		Calculating mean of difference	standard deviation of discrepancies	T value calculated	Type Sig
		arithmetic average	Typical deviation	arithmetic average	Typical deviation				
Translational velocity	m/s	3.14	0.82	4.21	0.16	1.07	0.48	4.98	Sig
Shoulder angle at moment of hitting ball	min	171,41	11,75	183.35	11.72	11.94	6.25	4.27	Sig
Instantaneous velocity at moment of hitting ball	m/s	13.13	2.03	14.20	1.01	1.07	0.95	2.52	Sig
Angular velocity of hitting arm	min /s	628.15	18.97	665.16	18.98	37.01	15.63	5.29	Sig

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Jumping Wave Serve	min	18.65	3.20	27.61	1.75	8.96	2.98	6.72	Sig
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Under significance level (0.05) and with $N - 1 = 4$ degrees of freedom.

Presentation and evaluation of biomechanical variable data for control and experimental groups' post-tests for undulating jump serve skill.

Table 7. Shows Outcomes of Biomechanical Variables for Experimental and Control Groups' Post-Tests for Undulating Jump Serve Skill.

Factors	Unit of measurement	Control group post-tests		Experimental group post-tests		T value calculated	Type Sig
		arithmetic average	Typical deviation	arithmetic average	Typical deviation		
Translational velocity	m/s	3.94	0.16	4.21	0.16	2.38	Sig
Angle of shoulders when striking ball	min	163.25	12.30	183.35	11.72	2.37	Sig
Instantaneous velocity when ball is struck	m/s	12.20	1.01	14.20	1.01	2.80	Sig
Angular velocity of hitting arm	min /s	628.16	18.98	665.16	18.98	2.76	Sig
Jumping Wave Serve	min	23.67	2.25	27.61	1.75	2.76	Sig

With $N - 2 = 8$ degrees of freedom and below significance level of 0.05.

Examining findings of post-tests comparing experimental and control groups' undulating jump serve skills.

By presenting outcomes of biomechanical factors test for skill of wavy jump serve shown in Table (7), if (t) test was used, there was a significant effect on level of all biomechanical variables in post-test between experimental and control groups, favoring experimental group, and that biomechanical aspects of wavy jump skill help are related to motor control and good mastery when implementing and strength of movement of body parts, and in fact reflects states of tension and relaxation between muscle groups. researcher attributes this development to various exercises carried out by members of experimental group, especially special strength exercises prepared using Verti Max device using exercises in form of jumps, steps and leaps, which aimed to develop main physical abilities, as these special exercises helped in developing work of working muscles in overcoming resistance represented by rubber ropes. This principle is consistent with goal of skill of obtaining best mechanical position when performing and

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was reflected in development of kinetic energy and kinetic transfer, as well as giving a direct effect to it and giving greater strength. (Ahmed Sabaa Attia. 2012) points out that "speed of step is used to stop momentum rushing forward and body prepares to jump upwards with explosive force by pushing foot to obtain more ability through braking or stopping which converts horizontal momentum into vertical." Therefore, type of special exercises had an impact on developing biomechanical indicators by forming these exercises by integrating elements of strength and speed together in exercise, i.e. performing strength exercises at high speed, as pointed out (that strength increases shorter duration of muscle contraction and vice versa, i.e. longer duration of muscle contraction, more amount of strength changes, i.e. more strength increases, more speed can be increased (Qasim Hassan Hussein. 1998).

DISCUSSION

Analysis of biomechanical variable results for skill of undulating jump serve between experimental and control groups' pre- and post-tests.

By presenting outcomes of biomechanical factors test for skill of undulating jump serve, shown in Table (6), if (t) test was used, there was a significant effect on level of all biomechanical variables favoring post-test for experimental and control groups over pre-test. researcher ascribes this outcome to kind of exercises that were prepared. used by both trainer and researcher, which were developed according to scientific foundations through type of these exercises, special training methods, and training means used, and setting special ratios of intensities and sizes and forming them according to training goal, which was reflected in development of motor abilities, especially strength element, and was subsequently reflected in level of biomechanical variables for individuals of training sample in results of these post-tests, which is an indicator of development of strength. (Faten Ismail. 2008).

Muscle strength is most important physical component due to its direct impact on other physical components, as well as level of motor performance. Muscle strength reduces load on joints, which contributes to improving performance. Biomechanical variables are indicators of a player's movement performance. impact of these exercises was positive in developing functioning of working muscles, which contributed to changing values of biomechanical variables. biomechanical aspects of various skills focus on describing movement paths and related kinematic variables based on speed, angle, time, distances, and heights, whether linear or angular. Therefore, performing each skill requires specific training in its motor form, depending on its degree of difficulty. Here, points out that "technical performance is a mechanical process for solving a motor task based on mechanical characteristics and foundations, as well as mechanical conditions available in environment, in harmony with law of game, which is possibility of specific solutions to motor task" (Wajiha Mahjoub. 1987). Therefore, quality of exercises and training had an impact on developing mechanical variables. Therefore, it is logical that there would be a development between pre- and post-tests. It was found that there were varying differences between pre- and post-tests, and between two research groups (control and experimental), in undulating jump serve tests. We find that control group, although it achieved significant results in undulating jump serve tests, did not show significant development that would have led team to required level of achievement and highest levels in undulating jump serve. However, experimental group

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showed significant development with statistical significance in all undulating jump serve tests, because of impact of exercises prepared by researcher on training device, which consists of special exercises inspired by researcher from actual situations of motor performance of skill. researcher believes that these exercises have an effective impact on development of physical and skill capabilities of players. Consequently, motor performance of undulating jump serve skill in volleyball will develop for members of experimental group, because modern training methods enable player to address shortcomings, especially weaknesses of players, such as their lack of leg strength when jumping, strength of striking arm, slow speed, and other things that must be present in a volleyball player. Angular velocity is related to both trunk rotational inertia and muscular torque. larger rotation radius, lower angular velocity (force and resistance to rotational motion). This mechanical advantage can be leveraged to produce highest linear velocity of limb farthest from body (i.e., arm during ball-striking movement), which results in a significant increase in ball speed after release. This is what happened to research sample members through application of skill-based exercises, a point emphasized by researcher when developing training curriculum. Therefore, it is incumbent upon volleyball professionals and specialists to focus on modern training tools, methods, and equipment that will enhance their players' physical, motor, and skill levels.

Players' physical and technical abilities, developed through training equipment, helped players in experimental group develop their jump serve skill. This is because " use of quick movements helps refine performance, and consequently, jump serve skill will inevitably increase" (Volleyball about.com/spiketraining. 2005). Therefore, researcher believes that use of resistance exercises for legs and arms, characterized by strength, will help player master skillful performance of event to be more effective. Consequently, jump serve skill will be more accurate, directing ball to desired location and more effectively, without being preoccupied with reaching desired location from which skill is performed. Leg strength had already settled this issue, especially with regard to jump serve, as " ability to control performance of serve correctly is an important process..." (Eileen Wadih Farag. 1991). Thus, physical and technical exercises prepared on equipment, which led to development of players' physical, technical, and mechanical abilities, contributed to increasing performance of jump serve skill to appropriate location on opponent's court, thus achieving training goal.

As for shoulder angle variable, based on values above, we note that this group achieved a higher point of contact with ball, unlike control and experimental groups, which achieved lower angles. This means ball is further away from hitter. In order to achieve contact with ball, a reduced joint angle is required, which leads to a lower point of contact with ball, negatively impacting hitter's performance in volleyball. instantaneous velocity variable is speed and movement of objects, especially human body, which changes over short periods of time due to decreased energy reserves when physical effort is high. It is necessary to know body's speed over shortest distance and time, which is what is called instantaneous velocity. It was found that instantaneous velocity is greater than table value, and thus there is a significant correlation between instantaneous velocity of ball and accuracy of delivery. researcher explains this by saying that instantaneous velocity of ball plays a fundamental role in reaching appropriate delivery accuracy zones by controlling its variables, in terms of ball's height, represented by distance and time of arrival.

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Value of this variable achieved a significant correlation to achieve appropriate accuracy. By presenting results of undulating serve skill test from jumping, there is a significant effect on skill level between control and experimental groups in post-test, in favor of experimental group. serve variable is related to players' ability to control movement and how to use muscular system and central nervous system and employ it to achieve optimal result in serve. It is result of joint work between senses of sight and ability to control and command. researcher believes that use of (verti max) device worked to develop specific muscular strength for skill accomplished, which uses rubber ropes on device as an obstructing force when rising and jumping while accounting for demands of skill performance and unique mechanical conditions of volleyball players, as we previously mentioned. This evolution was later demonstrated by unique physical skills like as strength and speed, as development of strength and speed of working muscles due to force of intensity to which these muscles are exposed is related to obstructive force of movement from because every movement is result of muscles working on joints specific to that movement, and this force is what affects body until tension is created in order for a proper motor action to occur.

This is because "majority of methods of developing strength only come as a result of special training that depends on exercises." Particularly in young persons, contraction by stretching and shortening thighs or knees muscles clearly demonstrates a difference in muscle strength. (Sareeh Abdul Karim, Wahbi Alwan. 2007). This is what experimental group did in performing exercises through a training method based on similarity to performance, diversity in exercises, and differences in their implementation with different repetitions and greater stress through resistance. It works to master this skill, which researcher worked to develop through these terms, which in turn have a positive effect on skill, especially jumping when performing these skills. This is a correct expression of what researcher wants based on what explained, as he indicated, "higher jump, more accurate it is, because striker's height allows them to manage accuracy areas and hit ball onto court of opposing side at a sharp angle" (Ahmed Amin Akour. 2000).

This relationship was confirmed by, who said, "more vertical jump develops, more it leads to development of skill of serving and all volleyball skills" (Aisha Mustafa and Mahmoud Hamdi. 2009). That is, skills that require accuracy in volleyball often require great strength for jumping movements and require a great ability to concentrate and coordinate. mastery of skill performance reflects degree of accuracy that represents level of development of quality of skill, especially since performing this type of test requires a high jump and determining distance and location of scoring point as well as location of ball now of collision. result is success of performance, which is therefore directly reflected in accuracy of performance in subsequent tests. This is consistent with what was indicated.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. There is a positive effect of using Verti Max device on developing some biomechanical indicators and accuracy of offensive skills in youth volleyball.
2. Implementation of exercises using Verti Max device improves biomechanical indicators of undulating jump serve skill (linear and vertical velocity, linear and

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vertical momentum, dynamic flow variable, kinetic energy, kinetic transfer, and flight and inclination angles) among youth volleyball players.

3. Implementation of exercises using Verti Max device improves biomechanical indicators of blocking skill (height (m.s.g.) at moment of contact with ball, height (m.s.g.) at moment of propulsion, maximum hand height at moment of propulsion, vertical velocity, vertical momentum, flight angle, inclination angle, and propulsion time) among volleyball players.
4. Performing exercises using Verti Max device improves biomechanical indicators of smash skill, namely (maximum hand height at moment of striking, height (m.s.) at moment of contact with ball, torso angle velocity at moment of striking, arm angular velocity at moment of impact, height (m.s.) at moment of propulsion, ball drop angle, linear translational velocity, vertical velocity, linear momentum, vertical momentum, and dynamic fluidity) among young volleyball players.
5. Performing workouts using Verti Max gadget improves accuracy of flutter serve among young volleyball players.
6. Performing workouts using Verti Max gadget improves precision of volleyball players' blocking technique.
7. Performing workouts using Verti Max gadget has helped improve precision of young volleyball players' smash technique.

Researcher made a number of recommendations and proposals, including:

1. Need for volleyball players to use Verti Max device in order to advance their technical performance stages.
2. Requirement to create training activities utilizing Verti Max device for other skills among youth volleyball players.
3. Emphasizing creation of diverse training initiatives utilizing Verti Max device, consistent with skill performance.
4. Researcher suggests conducting similar studies to this study on other team and individual skills and games, for all ages and for both genders.
5. Designing a device similar to Verti Max device that is compatible with volleyball sample.

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