



Journal of Physical Education for Secondary Schools

Journal homepage: <https://ejournal.upi.edu/index.php/JPESS>



The Role of Motion Analysis to Reduce Injury Risk in Volleyball Game Learning

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ABSTRACT	ARTICLE INFO
<p>Volleyball is one of the core components in physical education curricula, commonly taught by sports teachers to improve students' motor skills and teamwork. However, the nature of the sport also presents a risk of injury, particularly when students lack proper understanding of body mechanics and safe movement patterns. This study aims to analyze the impact of motion analysis as an instructional strategy to reduce injury risk and simultaneously enhance volleyball playing skills among students. The research employed an experimental method, involving two groups of students: one receiving standard instruction and the other integrated with motion analysis strategies. Instruments used included a questionnaire to assess students' knowledge regarding injury risks and prevention, and a rubric-based assessment to evaluate basic volleyball motor skills. Data were analyzed using the independent sample t-test to determine the significance of differences between groups. The findings revealed a significant reduction in the risk of injury and a notable improvement in volleyball skills among students who received instruction enhanced with motion analysis. These results demonstrate that understanding correct movement patterns not only minimizes injury but also facilitates more effective skill execution. Therefore, it can be concluded that the integration of motion analysis into physical education learning effectively reduces the risk of injury and contributes to the development of students' performance in volleyball.</p>	<p>Article History: <i>Submitted/Received 19 Aug 2024</i> <i>First Revised 05 Sep 2024</i> <i>Accepted 24 Sep 2024</i> <i>First Available online 28 Sep 2024</i> <i>Publication Date 01 Oct 2024</i></p> <p>Keyword: <i>motion analysis,</i> <i>game learning,</i> <i>injury prevention,</i> <i>volleyball.</i></p>
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1. INTRODUCTION

Volleyball is one of the sports events with simple games and therefore easily played by all manner of persons to relieve themselves from stress and fatigue; this is because of the simplicity nature of the game itself (Charalampos et al., 2015). Despite the nature of the game, the sport Volleyball can also yield an injury risk. Volleyball sport involves the entire working of the body repeatedly in motion and therefore requires maximum movement. In this respect, there is always a prevailing risk of type of injury that it is important to identify (James, Kelly, & Beckman, Injury Risk Management Plan For Volleyball Athletes, 2014). In general injuries that occur during the jumping phase to landing occurs in a sprained ankle this is because when landing the foot stepped on the player who was doing the same. So in other words in the implementation of sports or in student learning, must perform basic techniques well so that sports injuries do not occur which is not desirable (Terada & Gribble, 2015).

Other injuries that can be caused by sports during the game of volleyball game, namely acute trauma to the ankle and sprained foot with ligament lengthening or even tears. Furthermore, rupture of the achilles tendon and wounding of the joint is caused by overuse (Wilson & Best, 2005). In general, students have experienced injuries during physical education learning that takes place at school. This disrupts the learning process for both teachers and students. Injuries can occur during sports both during learning, training or competing, strenuous daily activities and these events are difficult to avoid (Kolbe et al., 2001). Injuries may include cuts, burning, pain, swelling, or malfunctioning of other parts of the body. A first aid practitioner must be able to overcome these things, so the thing to do is to eliminate chaos and plan the next rescue action (Tiwari, 2012).

In order to manage this risk, specific injury prevention strategies are necessary and should serve as an important component of the Volleyball lesson plan for students. There must be an effective injury prevention plan directed towards those students at greatest risk the greatest risk (Smith et al., 2008). However, the risk management plan targeted injuries, showing students in risky volleyball learning has not been presented in the literature (Hewett et al., 2006). One of the area of development to reduce and injury prevention is biomechanics in the new paradigm. Biomekanik memiliki tiga peran utama dalam paradigmanya sebagai pencegah dan pengelola cedera olahraga : (1) membantu dalam pencegahan cedera dan trauma yang berhubungan dengan olahraga muskuloskeletal, (2) evaluasi pengobatan, baik operatif atau konservatif, dan (3) evaluasi hasil jangka Panjang untuk memantau rehabilitasi jangka Panjang kemajuan, dan untuk menunjukkan apakah seorang atlet pulih dengan cukup ke tingkat yang memuaskan untuk kembali ke olahraga (Chan & al, 2008).

Injuries in volleyball are considerable because it is a highly demanding sport including quick movements and jumps, fast changes of direction-in the case of learners or amateur players. In general, prevention of injuries will ensure safety and lengthen the sports career as well as participation continuity (Reeser et al., 2006). So far, the analysis of motion has developed as one of the most fundamental biomechanical means for locating hazardous movements and wrong techniques, which are a major source of injury (Garg & Kapellusch, 2009). Now, coaches and educators can involve learning in volleyball games with deeper insight into the player's biomechanics through motion analysis and thus target their interventions to correct the adverse techniques for performance optimization and injury risk reduction. This would improve players' safety and, thus, be one of the factors contributing to more effective and long-lasting learning processes about volleyball (Audiology, 2011).

The analysis of motion is essential for the understanding and improvement of performance by athletes, especially in those sportive events, such as volleyball, where injury rates can go very high due to the dynamic or high-impact nature of the game (Barris & Button, 2008). These athletes are often repeatedly engaged in activities such as jumping, landing, and changes in direction abruptly, all of which can result in overuse injuries or even acute traumatic injuries if poor techniques are used (Adirim & Cheng, 2003). By applying the method of motion analysis while learning volleyball gameplay, coaches and trainers can assess players' biomechanics, trace factors of causes for various risks, and apply special interventions that may be necessary to correct the ill manners of movement (Camomilla et al., 2018). Early prevention not only reduces the injury rate but also ensures optimum performance from the players to compete at their very best level with the least chances of acquiring an injury. That is, this is possible by developing volleyball trainings to be safer and more effective with the insertion of motion analysis for long-term welfare and success in athletes (Emery, 2005).

2. METHODS

The method used in this research This research is an experimental method with One Group Pretest-Posttest Group Design. Research experiment can be interpreted as a method of research method used to look for the effect of certain treatments on others under controlled conditions.

2.1 Participants

In this study the population was students who take part in extracurricular volleyball totaling 50 people. The sample amounted to 23 people students with sampling using purposive sampling.

2.2 Sampling Procedure

In this study using sampling through purposive sampling. So that a sample of 23 students was obtained. Criteria for selecting samples or research subjects:

1. Inclusion
 - a. BMI with normal category
 - b. No history of illness or severe or chronic injury
 - c. Participate in research at least 80% of the time meeting
2. Exclusion
 - a. Have a BMI > normal
 - b. Has a history of disease
3. Drop out
 - a. Injury occurs during treatment
 - b. Attendance does not reach 80%

2.3 Research Instruments

This instrument in the form of a questionnaire focuses on the types and efforts to prevent injuries in volleyball learning.

Table 1. Research Instruments

No	Factor	Indicator	Item
A. Types of injuries in volleyball			
1.	Head injury	Bruises, abrasions, bleeding, fractures, fainting	2,6,7,5,3,4, 1
2.	Body injury	Bruises, joint separation, cramps, sprain, fracture, bleeding.	8,12,9,14,1 5,11,13,10
3.	Injuries to arms and hands	Bruises, abrasions, loose joints, sprain, strains, cramps, fractures	16,17,23,21 ,19,20,24,2 2,18
4.	Leg and foot injuries	Bruises, abrasions, loose joints, sprain, strains, cramps, fractures	35,36,39,40 ,37,38
B. Injury prevention efforts in volleyball			
1.	Through skills	Player skills and attitudes, basic and advanced techniques	35,36,39, 40,37, 38
2.	Via practice	Exercise variation, training schedule, training load	41, 42, 43, 44
3.	Via food	Pre- and post-workout food intake, supplements, nutrients consumed	45,46,47,48 ,49, 50,51
4.	Via warming up and cooling down	Warming up before practicing, cooling down	52, 53, 54, 55, 56, 57
5.	Via environment	Changes in environment, field conditions, equipment and facilities	58,59,60,61,62
6.	Via clothing	Use of knee and ankle decker, dress shoes and socks	63,64,65,66
7.	Through help	Training buddy, help officials and medical team	67,68,69,70
8.	From the trainer	Coach's attitude, coach's knowledge about injuries.	71,72,73,74 ,75

2.4 Data Analysis Design

The analysis method used in this research is analysis or testing with the T-test with paired sample test using SPSS and supported by Microsoft excel.

3. RESULTS

The data obtained from the pre-test and post-test results are as follows:

Table 2. Demographics of Research Subjects Male

Parameter	$\bar{X} \pm sd$	Min	Max	N
Height	1,71 \pm 0,06	1,5	1,8	18
Weight	58,7 \pm 7,2	48	77	18
BMI	19,9 \pm 1,9	16,5	25,1	18

Table 3. Demographics of Female Research Subjects

Parameter	$\bar{x} \pm sd$	Min	Max	N
Height	1,59 \pm 0,05	1,5	1,6	5
Weight	55,8 \pm 7,8	48	66	5
BMI	22 \pm 3	18,7	26,1	5

Table 4. T test

x $\pm sd$	t	different	% drop	P value	conclusion
Pre-test	0.4	0.3	0.3%	0.3	H ₀ rejected
Post-test	0.1			0.4	H ₀ rejected

Table 5. Sequence of prevention efforts

NO	Efforts to reduce the risk of injury	The magnitude of the decrease
1	Through trainers	1,323
2	Through skills in volleyball game	0,759
3	Through warming up and cooling down	0,493
4	Through first aid	0,473
5	Through clothing	0,299
6	Through exercise	0,2
7	Through environment	0,147
8	Through food	0,062
Result		3,558

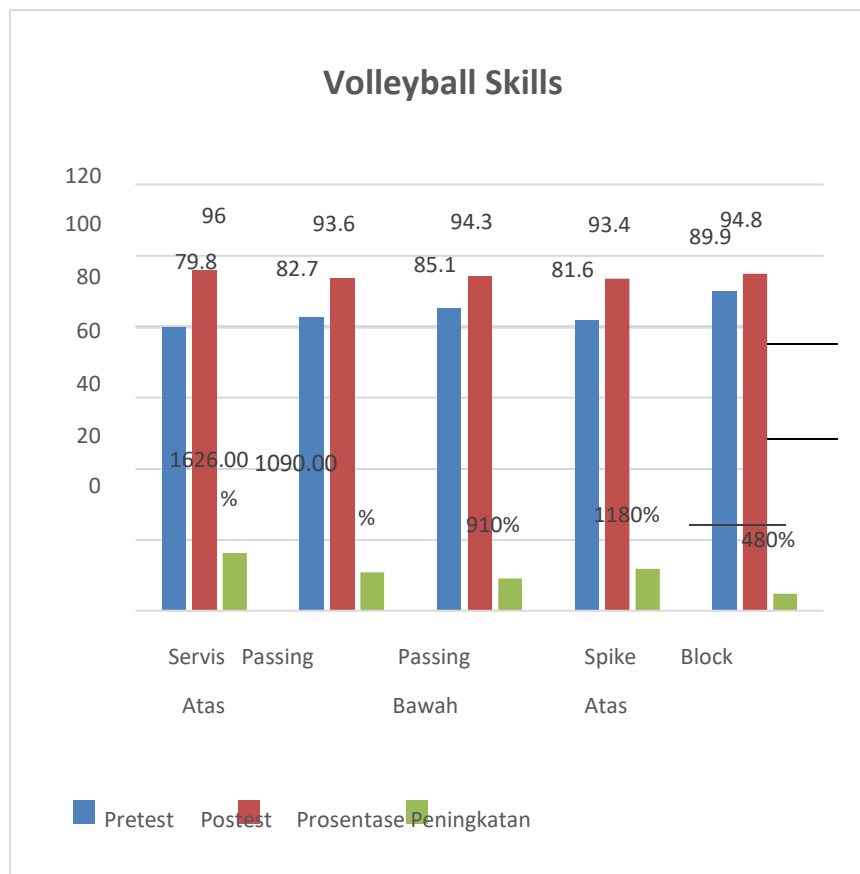


Figure 1. Volleyball Skill Diagram

4. DISCUSSION

Volleyball skills assessment, consisting of from the assessment of basic techniques in the game of volleyball, researchers chose several basic techniques, namely upper serve, lower pass, upper pass, spike, and block. After obtaining the results of the pretest and posttest results in writing using a questionnaire and obtained the average difference between pretest and posttest by 0.02, in this case it can be referred to as a decrease in the risk of injury. To clarify the data obtained from filling out the questionnaire, the researcher prepared a rubric that is useful for assessing basic technical skills of the volleyball game. The rubric is used to determine the possibility of changes in the ability of research subjects in performing basic techniques of volleyball game. As it turns out, the decrease in injury risk is in line with the improvement of skills of the research subjects in implementing the basic techniques of volleyball games. This can be seen from the percentage increase in student skills.

Based on the assessment the average pretest result on the technique amounted to 79.8, then after the given the treatment the results of the posttest amounted to 96, the increase obtained was 16.26%. Results the lower passing technique in the pretest was 82.7 and posttest 93.6, the percentage of increase by 10.9%. After the lower pass, the upper passing technique, pretest of 85.1 and posttest amounted to 94.3, the percentage of improvement by 9.1%. Then the spike technique obtained pretest results of 81.6 and posttest of 93.4, the percentage increase was 11.8%. Finally, the results of the block technique skill assessment the pretest was 89.9 and the posttest was 94.8, the percentage of skill improvement was 4.8%. skill improvement of 4.8%.

In addition to skill improvement reducing the risk of injury, another factor found in the field is the implementation of warming up and cooling down has an influence due to muscle readiness before the implementation of activities and cooling down after the implementation of activity. The role of the coach is also very important, trainers must understand the handling of injuries to athletes or teachers to students.

Coaches and teachers are the first people to handle minor injury. As there is research that aligned with this research, namely the handling of athletes with minor injuries are handled by the coach as the first person. Therefore injury management efforts made by players should be not only used medically but also use the services of someone massage. Handling that is done is by massaging and pulling on injured areas include sprained injuries, sprains, fractures, and dislocations (shifting of bones), while injuries treated by the bone), while injuries that are handled by medicine are severe injuries, namely injuries that alternative treatments cannot and require surgery.

The analysis of movement allows the coach or teacher to investigate the biomechanical nature of volleyball movements, including spiking, serving, and blocking. Analysis of movements helps in ascertaining certain faulty techniques that would possibly result in an injury. For instance, poor skills of landing after a jump may lead to knee injuries, and faulty arm mechanics at the time of spiking can cause injuries to the shoulder. Analysis of movement helps in the early detection of such flaws, enabling necessary corrections before injuries occur.

Application of motion analysis in volleyball learning environments presents real-time opportunities for players to correct their technique errors. Coaches use visual feedback, guiding students toward safer and more productive movement patterns. This is in line with the feedback loop that helps establish proper techniques, greatly reducing risks associated with injury, thereby enhancing performance. This can be achieved through proper training of the athletes to land with bent knees instead of straight rigid legs to reduce the impact forces transmitted to joints by a great margin to avoid such injuries as ACL tears.

Furthermore, motion analysis supports the personalization of training programs based on the needs and abilities of players. Different physical attributes and ways of moving bring out uniformity in training as being presumably very inefficient. Analysis of individual motion data by a coach allows the stipulation of specific training regimens necessary for rectifying certain weaknesses or imbalances in the biomechanics of a player. This personal approach will prevent injuries and optimize the player's development.

Moreover, introducing motion analysis into volleyball learning brings minimal risk of immediate injury and contributes to the long-term development of an athlete. By learning how to move in a much safer and more efficient manner, a base for further advanced techniques and competitive play becomes stronger. Besides, preventing injuries with good technique and training reduces downtime due to injury, thus allowing more consistent practice over a longer period of time.

Generally speaking, motion analysis is indispensable during the learning process for volleyball games and closely related to the efficient prevention of injury. Consequently, it enhances safety and effectiveness in volleyball training through the detailed delivery of biomechanical insight, real-time technique correction, and customized training programs. Therefore, students will be able to develop their skills with minimal risks of injury, thereby contributing toward better performance and a positive experience when it comes to long-term learning.

5. CONCLUSION

Based on the results of data collection then processed and analyzed, the following conclusions were obtained conclusion that:

1. The level of reduction in the risk of injury in learning volleyball games through motion analysis of 0.02.
2. Volleyball skills have an effect on Injury risk.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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