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Application of Biomechanical Analysis of Pencak Silat Techniques

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Abstract. Pencak silat is a self-defense method with distinctive movements that utilize every part of the human body as a sport. These movements are organized into a set of fundamental techniques, including as blocks, punches, kicks, kicks, punches, drops, and slams, and are known as moves. Based on the foregoing, the researchers' plan for this study is to do biomechanical analyses of the Pencak Silat technique. The method used in this research is scientific journals are reviewed quantitatively in order to provide an overview of the journals' quality, maturity, productivity, and other factors. Journals or scientific publications published between 2019 and 2023 that were retrieved from the Scopus and Sinta databases served as the research data for this study. Using "pencak silat biomechanics analysis" as a keyword in Google Scholar, search for published articles using that phrase. When a research paper meets the criteria, it is gathered, and a summary of the journal is created including the author's name, the year, the topic, the sample, the methodology, and a description of the results or findings. The results of an application of biomechanical analysis of pencak silat techniques by searching literature related to the analysis of pencak silat biomechanics, it can be concluded that the biomechanical analysis that can be applied to pencak silat techniques is time, angles, direction, flexion, extension, rotation, adduction, visual focus, force, moment of inertia, rotational kinetic energy, effort.

Keywords: Biomechanical Analysis; Pencak Silat

INTRODUCTION

Pencak silat is a practical subject with distinctive movements that use every part of the human body (Ediyono & Widodo, 2019). These actions are part of a series of fundamental techniques known as moves, which include blocks, punches, kicks, catches, falls, and slams. It takes good and correct basic mastery of both stance methods, punches, kicks, blocks, catches, drops, and slams, among other things, to be proficient in the usage of pencak silat techniques, which are split into defense and attack techniques (Harahap, Adek Arifin; Sinulingga, 2021). For the Phycical Education Studi Program University in North Sumatra, Pencak Silat is a required subject with a course load of 2 credits. Lecturers must be experts in the subject matter if they are to impart knowledge effectively. Therefore, it is highly anticipated that lecturers would be able to thoroughly master the material of pencak silat motions throughout the teaching of pencak silat. If students already possess the knowledge and abilities necessary to master the subject, they are prepared to teach pencak silat to their students in a physical education setting (Muzakki et al., 2023; Sasmitha et al., 2020).

As a sport, pencak silat is a self-defense system that has unique movements that involve all components of the human body (Kusuma & Sudarsono, 2022). These movements are arranged in a systematic movement, called moves, which are in the form of a series of basic techniques in the form of blocks, punches, kicks, punches, drops and slams (Lubis et al., 2022). Martial arts sport requires an element of agility, agility is a person's ability to change the direction of the body's position in a state of movement with high speed and accuracy without losing balance (Herdiman et al., 2022). There are numerous terminologies and movement patterns that make up the learning features of pencak silat. In order to avoid misconceptions throughout the practical learning process, lecturer must be able to demonstrate the abilities they have acquired in front of the students. Old age and illness are barriers to the lecturer-centered learning process, hence in this situation a replacement for the lecturer's role in providing movement examples is required.

Based on the results of observations and interviews with researchers with lecturers and students, the learning process is in the nature of memorizing the moves without knowing the biomechanical analysis of each movement material in pencak silat which can be seen through lecturer practice in learning activities.

Biomechanics is a scientific discipline that

studies the forms and types of motion based on mechanical principles and analyzes motion. The discipline of biomechanics does not stand alone, but is supported by other disciplines, such as anatomy, physiology and physics, then the basics or principles of the three fields of science become the basis of a scientific discipline called biomechanics. In addition, basically the main emphasis in biomechanics is all mechanical concepts, but the human body is a much more complex system than most objects encountered in mechanical concepts. Biomechanics is the study of the forms and types of human movement in sports on the basis of mechanical principles and analyzes the movements of these sports to understand them. The material studied in this course is focused on anatomical principles related to body movements.

Biomechanical analysis and motion stages are closely related to sports science (Yan et al., 2022) and have an important function for physical education lecturers and sports trainers. Physical education in the psychomotor field is inseparable from biomechanics. Understanding the factors that control human movement is very important for physical education lecturers. It is very important to pay attention to the role of each muscle that contributes to continuing to be trained so that motion automation goes well according to the amount of energy impulse expenditure (Bustomi et al., 2020; Trasolini et al., 2022).

As a prospective physical education lecturer, you can apply biomechanics to help the physical education learning process efficiently and effectively (Ramadhan & Irawan, 2022). Lecturers should help students learn basic motor skills, such as jumping, throwing and running, or games that provide a foundation for learning more advanced sports skills. In general, the benefits of studying biomechanics in sports lie in improving performance and preventing injuries (Wardati & Kusuma, 2020).

With the correct movement technique through the mechanics aspect minimize the occurrence of errors and to correct movements that are deemed inappropriate in carrying out the phases of pencak silat techniques so that periodically fix the movement to be more correct mechanically with more effective and efficient and can minimize errors in motion . The most important benefit of studying biomechanics is increased mobility, almost every physical activity has a risk of injury (Ardiyanto & Widiyanto, 2019). Today's physical education lecturers must have a thorough understanding of biomechanics in order to analyze and improve techniques effectively.

Based on the above, the researchers have the purpose of this research is to Application of Biomechanical Analysis of Pencak Silat Techniques. The results of this study are expected to provide suggestions for the analysis of the biomechanics of pencak silat technique, so that researchers have a foundation in analyzing technique in pencak silat.

METHODS

This study uses a quantitative descriptive method to review scientific journals, an overview of the journal will be obtained such as journal quality, journal maturity, journal productivity and so on. The data used in this study is secondary data obtained from the results of research that has been conducted by previous researchers. The secondary data source in question is in the form of primary scientific reports contained in related articles or journals. The research data used in this study are journals or scientific articles spanning 2019-2023 sourced from the Scopus and Sinta databases. The strategy for searching published articles using keywords at Google Scholar with the keyword “pencak silat biomechanics analysis”. Research articles that match the criteria are then collected and a summary of the journal is made including author, year, topic, sample, method and a summary of the results or findings. The summary of the journal is then carried out by analyzing the contents contained in the research objectives and research results.

RESULTS AND DISCUSSION

Result

This literary study was conducted to determine what kind of biomechanical analysis can be observed in pencak silat technique. The collected literature is analyzed using critical evaluation tables to achieve the measurement objectives and compared with the results of simple measurements. There are literature on Biomechanical Analysis, all of these journals are national journals that are searched for on the Google Scholar portal by entering the keyword "biomechanical analysis", which is then analyzed by critical appraisal analysis to analyze the core. Research journal results so you know the similarities and differences between the journals. The following is a critical analysis table of 10 journals:

Tabel 1. Literature Review

No	Author/Year and Topic	Sample	Method	Result
1	(Harun et al., 2020) Side Kick Speed Analysis	Fighter athletes	Survei	Time
2	(Hariono et al., 2021) Motion Analyis Of The Front Kick	Fighter athletes	Descriptive exploratory	Angles
3	(Subekti et al., 2021) Pencak silat combat time motion analysis	Fighter athletes	Experimental approach to the problem	Time
4	(Irawan et al., 2021) Pencak Silat Side Kick	Fighter athletes	Quantitative research	Direction, flexion, extension, rotation, adduction, visual focus.
5	(Risa Billah & Awang Irawan, 2022) Biomechanical Analysis of Horse Kick Athletes Single Art Category Pencak Silat	Athletes single art	Quantitative research	Angles of flexion and extension
6	(Lubis et al., 2022) Biomechanical analysis enhance the learning outcomes of Pencak Silat	Undergraduate students	Descriptive quantitative	Angles
7	(Doewes et al., 2022) Biomechanics analysis on Jejag kick	Fighter athletes	Laboratory biomechanical analysis	The magnitude of the moment of force, moment of inertia, rotational kinetic energy, effort, and power
8	(Bakhtiar & Irawan, 2023) Movement Compatibility Analysis Of Sicket Kick	Fighter athletes	Quantitative explanation	Time and angle
9	(Sonia and Bhanu Pratap, 2023) Analysis Of Round House Kick	Fighter athletes	Quantitative	Angles
10	(Suryo Putro et al., 2023) Biomechanical Analysis of Martial Arts Fore Kick	Fighter athletes	Qualitative	Time, speed, flexion angle and extension angle

Based on the table above, the literature above shows that biomechanical analysis that can be used in pencak silat techniques is time, angles, direction, flexion, extension, rotation, adduction, visual focus, force, moment of inertia, rotational kinetic energy, effort.

Discussion

Pencak silat techniques include varied and differentiated pencak silat techniques along with their unique characteristics, functions and performance as well as theories and strategies for their performance which are categorized into four components namely postures, movements, attacks and defenses. The main objective of teaching pencak silat is to form martial arts practitioners who have insight into the structure of pencak silat techniques and processes (management) as well as tips on how to perform them practically, pragmatically, effectively, efficiently, creatively, tactically and productively, all of which can create competitive advantage. against opponents.

Pencak silat techniques generally use punches, kicks, locks, blocks, and evasion. Each technique is still broken down again, for example punches are divided into palm punches, backhand punches, scratches, plugs, and so on. In addition, in pencak silat, traditional weapons such as swords, machetes, sticks, spears, celurit, knives, tridents, kerambit (a type of knife), keris, and others are taught.

Biomechanics is a scientific discipline that integrates factors that affect human movement, drawn from basic knowledge such as physics, mathematics, chemistry, physiology, anatomy and engineering concepts to analyze the forces that occur in the body. forces and moments imposed on workers so that work accidents do not occur. Biomechanics is part of a scientific

discipline that borrows basic mechanical principles to explain performance systems in the human body (living things) (Mouromadhoni & Kuswanto, 2019).

Biomechanics is a science which is a combination of physics (especially mechanics) and engineering, based on biology as well as knowledge of the work environment. General biomechanics is that part of biomechanics that deals with the basic laws that affect the organic human body both in rest and in motion. Biomechanics is a study that specializes in analyzing segments of human body motion, one of which is quantitative data on angles in degrees (Suhartoyo et al., 2022).

Basically understanding and applying biomechanics is the basis of good technique in all sports. By learning how the human body naturally wants to move, we can lighten and relieve bones, joints, muscles and ligaments. The study of motion biomechanics is the analysis of the magnitude of physical activity on body structure. Biomechanics helps athletes, coaches and motion analysts achieve maximum performance with minimal risk of injury. Both of these substantial knowledge of sports biomechanics are deemed necessary by trainers and motion analysts to help their athletes achieve the best performance (Ardiyanto & Widiyanto, 2019)

Studying the effects of these forces has two main advantages. First, it allows training to improve technique and avoid injury. This research also helps improve performance and improve physical fitness in terms of strength, cardiovascular fitness and flexibility. Through biomechanical analysis there are many benefits that can be drawn, because biomechanics provides a lot of information for various kinds of human movement analysis, especially to improve athlete performance (increasing performance) and to reduce the risk of injury (Knudson, 2021).

Pencak Silat in the psychomotor domain is inseparable from biomechanics, understanding the factors that govern human movement is very important for technique (Ramadhan & Irawan, 2022). Harnessing biomechanics for training enables intelligent training planning so you can get the most out of it in the shortest time and in the safest way.

Studying exercise biomechanics allows the user to understand how the body responds to different types of exercise intensity, angle and position. In other words, studying the biomechanics of exercise makes these effects more pronounced, enabling athletes to choose the right sport. When form and technique are poor, biomechanical analysis can shed light on the facts and help determine what forces poor technique is exerting on joints and surrounding tissues. Whether to relieve pain or improve performance, athletes of all ages and abilities can benefit from biomechanical analysis. Here are some of the biomechanical benefits in brief, including: Increasing movement speed, increasing strength, helping to eliminate muscle imbalances. reduced wear and tear on joints and ligaments, better sport-specific form and technique.

Biomechanical analysis is an addition to any material on pencak silat technique. Biomechanical analysis and motion stages are closely related to sports science and have an important function for physical education teachers and sports trainers. Physical education in the psychomotor field is inseparable from biomechanics. Understanding the factors that control human movement is very important for physical education teachers. It is very important to pay attention to the role of each muscle that contributes to continuing to be trained so that motion automation goes well according to the amount of energy impulse expenditure (Bustomi et al., 2020)

CONCLUSION

Based on the outcomes of using techniques for biomechanical analysis of pencak silat by searching literature related to the analysis of pencak silat biomechanics, it can be concluded that the biomechanical analysis that can be applied to pencak silat techniques is time, angles, direction, flexion, extension, rotation, adduction, visual focus, force, moment of inertia, rotational kinetic energy, effort.

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