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Armwrestling Hook Techniques in POGTI Athletes in Semarang City

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ABSTRACT

This study aims to analyze the hook technique in arm wrestling by athletes from the Indonesian Arm Wrestling Association (POGTI) in Semarang based on a biomechanical review. The study uses a quantitative approach with a descriptive method. The research subjects consisted of 10 POGTI athletes in Semarang who were selected using purposive sampling. Data were collected by recording videos of the hook technique, which were then analyzed using Kinovea version 0.9.5. The variables analyzed included the angles of the wrist, elbow, and shoulder, foot position, shoulder distance, and movement characteristics in the preparation, execution, and completion phases, both in attacking and defending conditions. The results showed that an effective hook technique was characterized by progressive wrist flexion, an optimal elbow angle to generate maximum torque, and a more compact body posture in the final phase. Effectiveness in attacking was influenced by wrist flexion speed and elbow stability, while in defending it was determined by the ability to maintain joint angles and postural stability.

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AUTHORS' CONTRIBUTION

A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
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INTRODUCTION

Sports are structured and planned physical activities carried out with the aim of maintaining and improving physical and mental health and fitness (Gulatowski, 2020). The concept of sports extends beyond mere competition to become a basic necessity in a healthy lifestyle. In general, sports are various body movements that are arranged in a regular and planned manner, with the main objective of maintaining and improving health (Pane, 2015). Regular exercise can reduce stress and anxiety levels, improve concentration and creativity, and help improve brain function (Maharani et al., 2024). Appropriate exercise is a natural way to maintain health and prevent various disorders, both physical and mental (Nor Adnan et al., 2018).

Although sports in general have been proven to be important in improving quality of life, fitness, and preventing chronic diseases, their scope is not limited to activities oriented towards competition or achievement (Gomes, 2019). This study will focus on

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sports that are done in leisure time with the main objectives of recreation, enjoyment, and recovery from daily routines. This dimension is known as recreational sports. Unlike competitive sports, which demand discipline and maximum achievement, recreational sports are voluntary and flexible, making them an effective means of relieving stress, building social relationships, and preserving local culture through traditional games (Kemenpora, 2022). Therefore, understanding the definition, characteristics, and implementation of recreational sports is crucial in the context of modern lifestyles.

Recreational sports in Indonesia are physical activities aimed at improving physical fitness, mental health, and strengthening social relationships within the community. One of the main institutions overseeing these activities is the Indonesian Community Recreational Sports Committee (KORMI) (KORMI, 2023). KORMI plays an important role in promoting recreational sports culture through various activities such as the National Community Recreational Sports Festival (FORNAS), which brings together thousands of sports enthusiasts from all over Indonesia to showcase traditional and modern sports, including new sports such as arm wrestling, which is now rapidly growing as a community-based strength sport (Hidayat & Rahma, 2023).

Arm wrestling, known in Indonesian as panco, is a sport that has existed since ancient times (Purnomo & Rahmawati, 2021). The earliest evidence of arm wrestling can be found in wall paintings in the tomb of Beni Hasan in Egypt, dating back to around 2000 BC. These paintings depict two individuals engaged in a physical battle similar to arm wrestling. Since then, arm wrestling has continued to evolve and become part of various ancient cultures, including Greece and Rome, where physical strength was often tested in various forms of competition (Arm Wrestling World, 2023).

Arm wrestling techniques, as defined by the World Armwrestling Federation (WAF), are a series of strategic movements used by athletes to defeat their opponents by pressing their opponents' backs of their hands onto the table surface (Hirai et al., 2021). These techniques involve the use of strength, leverage, and proper body positioning to gain an advantage in the match. Examples of commonly used techniques include hooks and toprolls, each focusing on different aspects of strength and technique (Mausehund & Krosshaug, 2023). The toproll technique is a technique in hand wrestling that relies on controlling the opponent's wrist by turning the palm downward (pronation), thereby reducing their strength and making it easier to defeat the opponent (Grinder Gym, 2025).

In this context, arm wrestling, also known as Panco, is interesting to study because it represents a transition from informal displays of strength during leisure time to a sport that requires biomechanics, focused strength training, and mitigation of serious injury risks. Arm wrestling is a competitive sport that requires a combination of physical strength, technique, and high-level strategy (Frankowska-Rutkowska et al., 2021). Although arm wrestling appears simple, its performance analysis involves complex interactions between the muscles of the forearm, shoulder, and wrist (Ignited Minds Journals, 2023). In the context of arm wrestling, biomechanics serves as a lens for analyzing internal forces (generated by muscles and joints) and external forces (pushing forces from opponents) acting on the athlete's body during a match. The goal is to understand the basic scientific concepts

applied in human movement so that athletes' techniques, strength, and safety can be developed properly and (Daharis et al., 2022). By applying the principles of kinematics and kinetics, biomechanical analysis can identify which muscles are limiting factors for success and how shoulder rotation affects leverage, which is crucial for success in arm wrestling competitions (Ignited Minds Journals, 2023).

To perform quantitative biomechanical analysis of arm wrestling movements, this study utilized the open source software Kinovea version 0.9.5. This software is an important tool in sports science due to its ability to perform slow motion video analysis, annotation, and accurate kinematic measurements (Prasetyowibowo et al., 2022). Kinovea 0.9.5 allows researchers to measure important variables such as joint angles (arm flexion/extension) and angular velocity (Finahari & Rubiono, 2018). The results of Kinovea's analysis then form the basis for evaluating whether the techniques used by arm wrestling athletes are efficient or pose a high risk of injury (Tomik et al., 2022).

Initial observations conducted at the Indonesian Arm Wrestling Association (POGTI) in Semarang showed that the arm wrestling community in that location was active, with a total of 30 registered athletes. In terms of technique, it was found that around 33% of athletes predominantly applied the hook technique, which involves twisting the wrist inward to gain leverage. Given that the hook technique produces significant torsional stress on the humerus, there are concerns about the high risk of injury associated with this technique (Rusmana et al., 2025). Therefore, an in-depth biomechanical analysis of the hook technique applied by POGTI athletes is needed to identify the effectiveness of the hook technique in attacking and defending.

Research conducted by Marotta et al. (2025), entitled "Analysis of Kinematic and Muscular Activities in Arm Wrestling," has provided an important basis for understanding this sport. The study specifically analyzed the kinematic and muscular activities involved during arm wrestling matches, showing how the complexity of the movements requires high muscle coordination, especially in the forearms and shoulders. These findings emphasize the need for further biomechanical analysis to optimize technique and reduce the risk of injury.

Considering the complexity of biomechanics in arm wrestling Marotta et al. (2025), the high risk of injury caused by torsional forces in the hook technique (Kridasuwarso, 2016), and the prevalence of this technique among POGTI Semarang athletes, this research is crucial. Therefore, this study aims to conduct a quantitative biomechanical analysis using Kinovea 0.9.5 software to identify in detail the kinematic parameters of the hook technique in arm wrestling athletes, so that more efficient and safer technical recommendations can be formulated to minimize the risk of injury.

METHODS

This study uses a descriptive analysis approach to describe and analyze the characteristics of the hook technique as performed by athletes in the field without intending to generalize the research results (Sugiyono, 2019). Quantitative data were obtained from video recordings of hook techniques in arm wrestling, which were then

analyzed using Kinovea software version 0.9.5. This analysis aimed to obtain an overview of the effectiveness of hook techniques based on the phases of movement observed through video recordings.

The population of this study was POGTI athletes in Semarang City. Sampling was conducted using purposive sampling, which resulted in 10 athletes. The inclusion criteria for sampling were athletes aged 18-42 years, with preference given to those who used the hook technique (in panco). In addition, athletes had to have been members of a team for at least 1 year.

The research variables to be observed and analyzed include independent variables and dependent variables. The independent variable in this study is the analysis of hook techniques in arm wrestling. The dependent variable in this study is the effectiveness of hook techniques in POGTI Semarang City arm wrestling athletes.

The data obtained from video recordings and grip strength measurements were then transferred to a laptop for analysis. Motion analysis was performed using Kinovea software version 0.9.5 to measure joint angles, motion trajectories, and the time required to perform the hook technique. The quantitative data obtained was analyzed descriptively by calculating the average value of each experiment to obtain representative data and minimize individual variation between athletes (Winter, 2009).

RESULTS AND DISCUSSION

Result

This chapter presents the main findings obtained through the field data collection process, which includes documentation results and motion analysis using Kinovea 0.9.5 to measure joint angles, motion trajectories, and the time required to perform the hook technique. The quantitative data obtained were analyzed descriptively by calculating the average value of each trial to obtain representative data and minimize individual variation between athletes (Sugiyono, 2022).

Table 1.
The result of Antropometri

Category	Mean ± SD	Min	Max
Body Weight (kg)	81,6 ± 15	61	110
Body Height (m)	1,75 ± 0,66	1,65	1,85
Age (years)	27 ± 9,3	16	42
Load Record (kg)	43 ± 14,3	25	65
BMI	26,4 ± 3,15	22,41	32,49
Grip Strength (kg)	58,9 ± 8	45	70

Based on Table 1. the anthropometric results of the sample, which included data on body weight, height, age, weightlifting records, grip strength, and BMI (Body Mass Index), showed that POGTI athletes in Semarang City had an average sample weight of 81.6 (kg) with a maximum weight of 110 (kg) and a minimum weight of 61 (kg), which had a standard deviation of ± 15 (kg). The sample height has an average of 1.75 (m) with the largest height being 1.85 (m) and the smallest height being 1.65 (m) with a standard deviation of ± 0.66 (m).

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Analysis of the Ideal Hand Hook Technique in POGTI Athletes in Semarang City

Technical analysis of the hook technique in POGTI athletes in Semarang was conducted in three phases of movement, namely the preparation phase, execution phase, and finishing phase. Kinematic data in each phase showed changes in joint angles and body posture that supported the effectiveness of the hook technique execution. In the preparation phase, the right wrist flexion angle was almost straight (173.12° ± 4.54°), indicating that the wrist was still stable at the start. The relatively large elbow and shoulder angles reflected the open arm position used to build initial support. In addition, the leg angle and wide shoulder distance indicated a balanced body posture before receiving pressure from the opponent.

Entering the execution phase, the wrist flexion angle decreased to 124.38° ± 12.33°, indicating the start of the flexion process as the main characteristic of the hook technique. The decrease in the elbow and shoulder angles showed an effort to shorten the moment arm to increase force efficiency. In this phase, there was also considerable variation in wrist flexion time (2.35 s ± 1.96 s), reflecting differences in speed and strategy between athletes. In the final phase (finishing), the wrist flexion angle reached its lowest value (91.4° ± 27°) as a form of maximum flexion. The smallest and most consistent shoulder distance (24.45 cm ± 1.40 cm) indicates that body stability is at an optimal condition. This emphasizes the importance of locking the body position in the final stage to maintain control over the opponent.

Analysis of the effectiveness of hand wrestling hook techniques when attacking POGTI athletes in Semarang City

In the hand wrestling hook technique, the preparation phase is characterized by a high right wrist flexion angle (169.84° ± 5.21), a moderate right elbow angle, and large right and left leg angles, indicating a stable body position with a wide stance as an effort to accumulate force and prepare for power transfer. Entering the execution stage, there is a decrease in the wrist flexion angle (118.67° ± 13.91), elbow angle, and right shoulder angle, which indicates the active involvement of the arm and shoulder muscles in generating pulling force, accompanied by a shift in the foot's center of gravity and a relatively fast wrist flexion duration. In the final stage, the wrist flexion angle reached its smallest value (88.26° ± 24.73) and the elbow angle increased again, indicating a locking and stabilization phase, where the body was at the closest shoulder distance to the opponent to maintain control and balance after the attack was made.

Analysis of the effectiveness of the armwresling hook technique when defending against POGTI athletes in Semarang City

Based on the kinematic data of the hook defense technique in POGTI Semarang City armwrestling athletes, there was a clear change in the angle of motion from the preparation phase to the final phase. In the preparation phase, the right wrist flexion angle was 96.38° ± 22.14°, the elbow angle was 101.27° ± 8.95°, and the shoulder angle is 49.86° ± 6.32°, indicating that the arm is still open, with a relatively wide shoulder distance (26.84 ± 1.58 cm) as a form of defensive readiness. In the execution phase, the wrist flexion angle increased to 105.76° ± 20.63°, accompanied by a decrease in the elbow

angle (97.83° ± 7.94°) and shoulder angle (45.12° ± 5.87°), which indicated the beginning of hook locking and an increase in resistance force efficiency. In the final phase (finishing), the wrist flexion angle reached its highest value of 112.34° ± 18.97°, while the elbow angle (94.82° ± 7.63°) and shoulder angle (42.18° ± 5.36°) were at their lowest values. The shoulder distance becomes the smallest (24.63 ± 1.39 cm), indicating optimal body posture stability in maintaining position.

Discussion

Analysis of the Ideal Armwresling Hook Technique in POGTI Athletes in Semarang City

The ideal hook technique preparation phase is characterized by relatively open joint positions, stable body posture, and biomechanical readiness prior to the production of the main force. The execution phase of maximum force production is characterized by optimal coordination between wrist, elbow, and shoulder flexion and body stability. In the final phase (finishing), the wrist flexion angle reaches a range of 85°–100°, indicating maximum flexion, while the elbow angle is relatively stable in the range of 90°–105°. In addition, the athlete's shoulder distance becomes smaller and more consistent, reflecting a more compact body posture. According to Savitsky (2020), locking the body posture in the final phase is a key factor in maintaining control over the opponent and preventing loss of momentum. Thus, the ideal hook technique in POGTI athletes in Semarang City is characterized by optimal coordination between the wrist, elbow, shoulder, and overall body posture stability.

Effectiveness of the Armwresling Hook Technique When Attacking in the Preparation Stage (Hook Attack Technique)

The preparation phase is characterized by relatively large joint angles, stable body posture, and focus on movement readiness before the production of the main force. The execution phase is the phase of maximum force production, characterized by a decrease in the main joint angles and efficient movement coordination between the arms, shoulders, and body. In the final stage, the right wrist flexion angle reaches its lowest value with a mean of 88.26° ± 24.73, indicating maximum flexion as a form of technique locking. This condition is important for maintaining grip control and ensuring dominance over the opponent.

Effectiveness of Armwrestling Hook Techniques While Defending

The preparation stage is characterized by biomechanical readiness, postural stability, and relatively flexible joint positions. The execution phase is a transition phase from readiness to force production, characterized by changes in joint angles and more active body coordination. In the final phase, the right wrist flexion angle increased to 112.34° ± 18.97, reflecting a more locked wrist position to maintain control over the opponent. The elbow angle (94.82° ± 7.63) and shoulder angle (42.18° ± 5.36) indicate joint stabilization, signifying the achievement of a mechanically advantageous position in the finishing phase.

CONCLUSION

Based on the research questions and objectives, as well as the results and discussion of the study, the following conclusions can be drawn: (1) The ideal hand hook

technique for POGTI athletes in Semarang City consists of three main phases of movement, namely the preparation phase, the execution phase, and the finishing phase, which are characterized by structured and continuous kinematic changes. (2) The hand hook wrestling technique in POGTI athletes in Semarang City is effective when attacking if supported by the correct joint angle, speed of execution, and optimal body movement coordination. (3) The hand hook wrestling technique in POGTI athletes in Semarang City is effective when defending if the athlete is able to maintain joint angle stability, body posture, and wrist control when receiving pressure from the opponent.

These findings emphasize the effectiveness of the hook technique in POGTI arm wrestling athletes in Semarang City. The characteristics of the hook technique can be more comprehensively understood by adding other variables, such as specific muscle strength, reaction time, or electromyography (EMG) activity, and identifying the biomechanical advantages of each technique in the context of competition.

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