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<https://ejournal.upi.edu/index.php/penjas/article/view/37215>DOI: <https://doi.org/10.17509/jpjo.v6i2.37215>**Batting Performance Analisis of West Java Athletes****Agus Gumilar\*<sup>1</sup>, Jajat Darajat<sup>1</sup>, Amung Ma'mun<sup>1</sup>, Nuryadi<sup>1</sup>, Mudjihartono<sup>1</sup>, Dadan Mulyana<sup>2</sup>, Burhan Hambali<sup>1</sup>**<sup>1</sup>Department of Sports Education, Universitas Pendidikan Indonesia, Indonesia<sup>2</sup>Sports Coaching Education Study Program, Universitas Pendidikan Indonesia, Indonesia**Article Info***Article History :**Received July 2021**Revised July 2021**Accepted August 2021**Available online September 2021**Keywords :**Batting, Softball, Speed bat, Time to impact, Zeep swing analysis***Abstract**

This research aimed to analyze the batting skill performance on softball using an application of technology. The assessment results can help the coaching process by providing empirical data and become material for evaluation and recommendations for trainers and coaches in the following coaching process. The method used in this research was a descriptive analysis survey. The samples were 21 West Java female softball athletes who were doing training concentration. The measurement of the speed impact parameter was obtained ( $79.94 \pm 7.73$ ) to achieve the 25.06% target achievement. The results of the parameter test on the target obtained a p-value ( $0.0001$ )  $< 0.05$ . This means that the percentage of the results on this parameter had not significantly met the target. The impact time parameter obtained an average percentage of the results of ( $83.06 \pm 8.47$ ). The percentage of the target was 16.94%. The Tukey statistical follow-up test results showed that the impact time parameter had not shown a significant achievement with a p-value ( $0.0001$ )  $< 0.05$ . It concludes that the batting performance of West Java female softball athletes had not reached the stated target. Therefore, it is recommended that the training increase based on the portion and exercise items according to the predetermined parameters.

## INTRODUCTION

Today, humans cannot be separated from the digital world, where increasingly sophisticated technology has changed the pattern of human life (Prensky, 2009). The impact of this technological development is the reduction of physical activity performed by humans because every human need can be obtained by simply pressing a button on a cell phone. Therefore, the role of sports activities is needed to prevent people from sedentary diseases. Sport is a syllable that cannot be separated from our lives, and this word tends to be inherent in the life of Indonesian society. A sports actor is any person or group of people directly involved in sports activities, including its management, sports coaches, and sports personnel (UU No 3 Tahun 2005, 2005). In the community's implementation of sports, there are many purposes of sports, including sports for achievement, sports for health, and sports for recreation or pleasure. When children and teens are involved in sports, it is believed that they will benefit from their experiences. Parents, coaches, and school administrators often assume that children and young people will acquire essential life skills (Gould & Voelker, 2010).

A hitting move, such as a tennis forehand, a ping pong hit, or a baseball bat, depends on predicting where the ball can be hit correctly and returned to the opponent (Kober et al., 2010). For example, baseball players manipulate the bat with both hands exerting force and moment on the handle grips of the bat to hit a ball thrown in various directions. However, due to the kinetic reduction in a system consisting of the bat and the upper hand, it is essentially impossible to know how each hand exerts force and moment on the bat. This is known as the closed-loop problem (Kazumichi Ae and Sekiya Koike, 2011). As a result, there is a reduction in the kinetic system when hitting, causing the energy released when hitting cannot be investigated with certainty.

The analysis of hitting the ball was carried out for three category levels: the professional league, university league, and high school league. Average, slugging, and contact rates were calculated at the end of the pre-intervention, intervention, and intervention seasons (DeRenne & Morgan, 2013). This study analyzes the time taken for the step/stride hitting at three different championship levels (Takamido et al., 2019). The research was related to the contribution of joint torque to

strike speed in baseball games. This research measured all joint movements that work when a baseball player makes a swing. The results showed that the joint moments, the motion-dependent term, and the gravity term gave the most significant contribution to the swing speed in baseball (Koike & Mimura, 2016). The speed of strokes in softball is applied in the field. This study used a video camera to see the speed of a player's stroke with various ball speeds. However, this study still used a video camera as an instrument to analyze the biomechanical motion of the stroke results (Smith et al., 2012).

However, not many local trainers apply the data from the biomechanical analysis results in the softball hitting practice process, even though this is very important as material for evaluation and implementation of the following program. Negligence in evaluating and only focusing on game techniques and tactics will result in players having weak strengths to worsen their sports performance. (Nurul et al., 2019; Sugimoto et al., 2017). Mechanics is a branch of science from physics that studies the motion and changes in the shape of a material caused by mechanical disturbances called forces (Hendrayana et al., 2019). Mechanics is the oldest of all branches of physics. Biomechanics is defined as applying mechanics to biological systems (Hendrayana et al., 2019; Hidayat, 1998). Biomechanics is a combination of the disciplines of applied mechanics and the sciences of biology and physiology. Biomechanics concerns the human body and almost all bodies of living things. In biomechanics, the principles of mechanics are used in the drafting, analysis, design, and development of equipment and systems in biology and medicine (Hidayat, 1998). The importance of the role of science, as well as the application of science and technology in the coaching process in the development of youth movement skills, becomes one aspect that the writers concerned to conduct science-based research and the application of science and technology for the needs of learning development and to participate in coaching achievement sports in Indonesia. Therefore, the authors intended to research and analyze the muscle performance and movement skills of hitting softball athletes.

**METHODS**

The research method used in this research was descriptive research with a survey research approach. The purpose of descriptive research is to make descriptions systematically, factually, and accurately regarding the facts of the characteristics and relationships between the phenomena being investigated (Muhammad Nazir, 2004). Survey research is collecting information from several groups of people in order to describe some aspects or characteristics that can use questions in data collection, while information can be obtained from a sample of the population (Fraenkel JR, Wallen NE, 1993).

**Participants**

Participants in this study were West Java female softball athletes conducting training to face the national multi-event championship. In addition, participants do an exercise program five times a week. The number of participants involved in this study was all athletes, involving 21 people. The sampling technique of this study was a saturated sampling method, where the entire population became the samples of the study. This was because the total number of athletes who were members of the training camp team was 21 people.

**Instrument and Procedure**

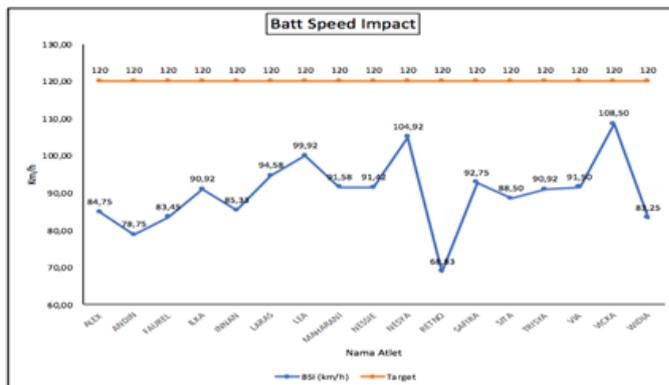
The instrument used in this research was the Zeep Swing Analysis Sensor, a sensor developed to measure hitting skills. The sample hit the ball with the ball served by the pitcher ten times. The speed and time to impact data were obtained in real-time. ZEEP (Zone Based Energy Efficient Routing Protocol). The ZEEP protocol is designed for stationary and mobile nodes to transmit data (Vidyapeetham et al., 2013). The mechanism is when the batter batting, the sensor installed on the knob of the bat, the sensor is directly connected to the IOS device in which there is already a database of batter. The output generated from this sensor is data related to speed bat, impact, as well as a picture of swing in the biomechanics of motion.

Data retrieval is done by measuring hitting skills by hitting the pitcher's ball at the Lodaya Bandung softball field. Before taking measurements, the researcher took data on weight, height, and data related to the habits of each beater; then, the sample was tested ten times in turns, using a beater equipped with a Zeep sensor. The data generated from measurements using the zeep

swing analysis of this sensor are bat speed impact, time to impact, vertical angel, max hand speed, and attack angle. However, for the needs of this study, the researcher only took two parameters of the data from the analysis, namely bat speed impact and time to impact.

**RESULT**

After the performance data from hitting skills were obtained, the next step was to carry out statistical tests to measure the achievement of the batting performance with the predetermined achievement targets. For this reason, the data was tested with a one-way statistical test and then strengthened by a further posthoc test (Tukey's method). Based on the one-way ANOVA test, the result obtained a p-value (0.0001) <0.05, which means a significant difference in the achievement of the results against the target. Thus, the two parameters had not reached the target perfectly. The mean and standard deviation of the percentage of the results of the bat speed impact parameter measurement was obtained (79.94 ± 7.73) to achieve the target achievement of 25.06%. The results of the parameter test against the target obtained p-value (0.0001) <0, 05. This means that the percentage of output achievement significance on this parameter had not met the target. Therefore, it needs action and application of technical exercises explicitly tailored.



**Figure 1.** Bat speed impact measurement

The time to impact parameter obtained an average percentage of achievement of (83.06 ± 8.47). The percentage of the target was 16.94%. The results of Tukey's statistical follow-up test show that the time-to-impact parameters had not shown significant achieve-

ments. In other words, the achievement of the target was 16.94% that required rigorous training to achieve these targets. The p-value (0.0001) <0.05. The percentage result of each athlete is shown in Figure 2.

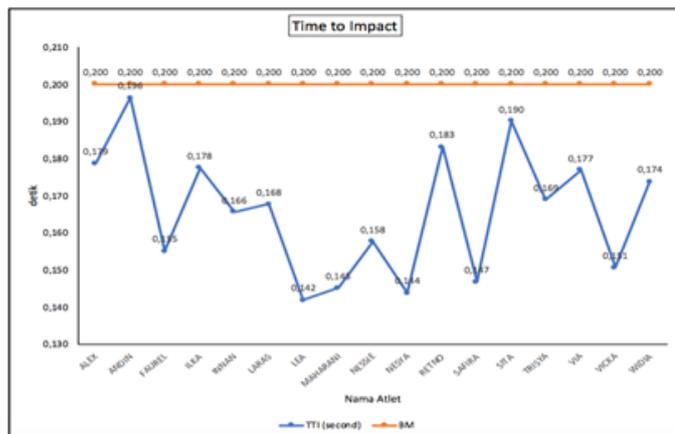


Figure 2. Time to impact measurement

DISCUSSION

Hitting is undoubtedly a complex skill, as pitchers can reach speeds of  $\geq 120$  km / h, and the ball can be released from as close as 12m from home plate (Flyger et al., 2006). There are many ways to improve hitting performance in softball games, such as applying training using a heavy bat drill and reaction time as an exercise to increase bat speed (Zawrotny, 2005). Transfer weight, ground reaction force, the center of pressure, stride, flexion and extension, segment rotation, bat movement, batting event, etc., can affect the speed of the bat and the momentum when it will hit the ball (Ae et al., 2018; Welch et al., 1995). Parameters for bat position and rotation axes, the force acting on the bat, torque acting on the bat, angular displacement and body segments, force exerted by each arm, and bat swing model are parameters for hitting motion to detect errors that occur when hitting (Cross, 2009).

In producing an increased stroke speed, of course, many aspects are needed; other studies conclude that the speed of the stroke is also influenced by the pattern of the exercise performed (Dabbs et al., 2010). Of course, the heating pattern must be appropriately chosen; experiments were carried out to increase the speed of the stroke by placing a load on the tip of the bat when the warm-up turned out to have a negative effect on increasing the speed of the stroke on players at the college level (Koenig et al., 2004). This is also support-

ed by other research conducted on baseball players that giving a ballast at the end of the bat makes the swing pattern lower, resulting in a lower hitting speed (Kim & Hinrichs, 2003).

The motion of hitting a softball is a highly coordinated three-dimensional motion, as depicted in the figure. 3 (Milanovich & Nesbit, 2014)(Milanovich & Nesbit, 2014). Figure 1 shows a free-body diagram of this model. The local and global coordinate systems are defined as shown in figure 1. The local bat coordinate system (XYZ) is aligned with the three markers attached to the bat. The Z-axis is aligned with the long axis of the bat, the Y-axis is perpendicular to the plane formed by these markers, and the X-axis completes the three markers of the right hand. The global coordinate system (XYZ) is fixed to the ground with the Z-axis in the vertical position. Two other local coordinate systems were defined to facilitate kinematic and resolution of the kinetic components and their descriptions. The grip coordinate systems are attached to point A and are parallel to the tangential, normal, and bi-normal directions relative to the path of the grip points. A tangential-normal (swing pitch-roll) coordinate system is also attached to point A and is parallel to the long axis of the bat, the relative normal direction to the swing plane (defined by the bat position), and the bi-normal coordinates in these two directions.

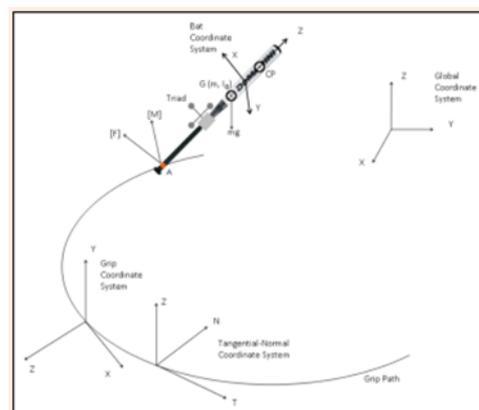


Figure 3. Free body diagram bat (Milanovich & Nesbit, 2014)

Understanding the mechanics of batting moves at various levels of competition can help players and coaches identify the key kinematics essential to being a successful batter. (Dowling & Fleisig, 2016). The analysis results, of course, become a reference for the coach

to make an exercise program. The mechanics of motion can be seen through the three-dimensional softball bat model, which was developed to study the hitting motion, the interaction between the subject (batter), and energy transfer; it turns out that the shift in body weight does not affect the speed of the ball, players are given the freedom to use whichever model feels most comfortable for them. (Jensen, 2016). To increase the speed bat, you can perform an interval-based hitting program designed to gradually return the athlete's performance to competition (Chang et al., 2016).

In addition, the experience of competing is one of the important things, while training with the stimulation of situations and conditions will affect the increase in overall batting performance (Gray & Beilock, 2011). Batters with high skill and experience have better hitting speed than beginner batters (Dowling & Fleisig, 2016). Through the analysis carried out by applying the zEEP swing sensor analysis, it is hoped that the coaches of the West Java softball team can analyze and provide training programs that can increase the speed bat and time to impact of the West Java female softball players so that they can improve their best performance.

## CONCLUSION

Based on the analysis and discussion results, the researchers can conclude that the performance of the bat speed was 25.06%, and the time to impact was 16.94%. Therefore, it shows that female softball athletes' batting performance had not yet reached the target performance set. Therefore they need action and application of technical exercises tailored to the periodization of specific exercises. In this case, the results of this batting analysis will be a recommendation for the trainer to create an exercise program so that the batting performance can be improved.

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## CONFLICT OF INTEREST

The authors declared no conflict of interest.

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