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Fatigue Impact to Mechanical Movement and Ball Velocity Pitcher Baseball

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***Abstract*—Fatigue factor can restrict and interfere with the decision-making cognition players and also hamper the players during the game. It was found that fatigue can reduce the speed of the ball on the performance of throws, fatigue is a key component of the risk of injury because it can cause loss of proper mechanics, while others find a different ball exit speed which has not changed significantly. while playing in a game simulation. The purpose of this study was to determine the level of fatigue more comprehensive by tossing a change of pace and movement mechanisms that occur at the baseball pitcher. The method used in this research is quantitative descriptive. These samples included 6 beginner baseball player pitcher university education in Indonesia. The independent variables consist of fatigue index levels (normal and maximum). Meanwhile, the dependent variable is the speed of the ball. The results showed that there was a significant difference in the speed of the ball between normal and fatigue conditions. Furthermore, the results of Ground Reaction Force (GRF) and impulse showed significant differences.**

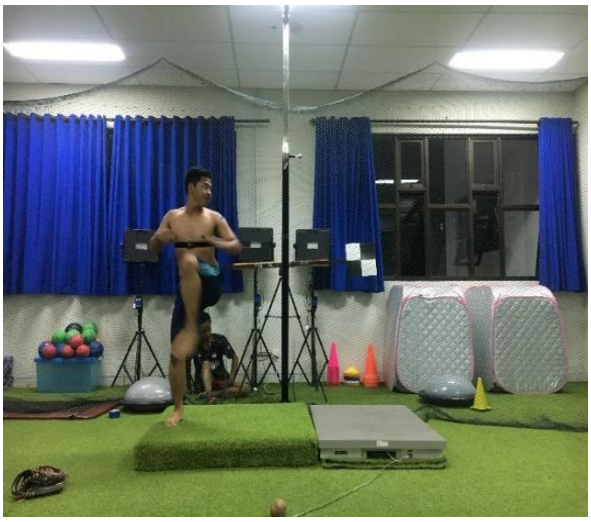
Keywords— Fatigue, baseball pitcher, Biomechanics

I. INTRODUCTION

Pitching motion in baseball games or involve the coordinated movements of the upper and lower muscle groups, to push the ball at speed, can result in muscle fatigue which damage the performance and may increase susceptibility to injury. According to [1], throwing speed is one of the very valuable characteristic of competitive baseball pitcher, for each additional 1-mph in ball speed reduces time to react. According to [2]pitcher maximum speed is an indication of kinematics, kinetics, and the relative time of segmental interaction that causes the effective transfer of momentum for baseball. According to [3] During the baseball pitching believed to be associated with the most common injuries in the shoulder, Fatigue can be a key component of the risk of injury because it can cause loss of proper movement mechanics [4], This is determined by the capacity of hand muscle strength and range of motion is perfectly phase mechanism on a pitcher, there are six phases in which baseball pitching wind-up, stride arm cocking, arm acceleration, and deceleration arm follow-through [5].

Fatigue is a crucial problem that has long emerged from several scientific studies at the baseball game. According to [6] Fatigue factor can restrict and disrupt decision-making cognition players and also hamper the players during the game. According to [7] Fatigue is an important factor to consider when assessing the risk of injury. According to [8], Muscle fatigue is generally a result of vigorous exercise, muscle fatigue effect is that we are not able to maintain the level of exercise or activity. From other experts also argue that fatigue is a major factor affecting the quality of pitching in a pitcher's mechanics, when a pitcher maximum muscle fatigue, a pitcher throwing mechanics is difficult to maintain ideal [9], These negative effects can be seen from the decline in motion seoang athletes that have an impact at the time of maximum performance during the game. Factors cause of these problems often arise because the body's physiological systems in abnormal circumstances, thereby affectingmechanical quality throw on a baseball pitcher.

Results of research conducted [4] show that the kinematics of the pitcher very significant change in the internal rotation of the dominant upper limb showed that the internal rotation that is experiencing high demand for pitching performance. Meanwhile, according to [10] The results showed that the speed of the ball was significantly lower in the last inning compared to the first inning, the kinematics of the pitcher greatly changed from the first to the last inning pitching simulation game. Research result [11] indicates that the final parameters decreased significantly during the play is the speed of the ball. On average, the pitcher at 40 m / s (90 mph) in the early innings, and decreased on average in the last inning 2 m / s (5 mph) during the game.according to [5] That explains the results of a study simulating the effects of the game, compared with the end of the second inning, and two innings end, as a pitcher approach muscle fatigue there is a significant reduction in the speed of the ball. But there is no other significant differences in the kinematics or kinetics variables. Although the effects of fatigue connected with the study of biomechanics and physiology in the ability to throw, the fact that this issue is still unclear. From several studies related to fatigue by throwing performance mentioned earlier, there are different implementations in conditions of normal players and one after maximum fatigue.



Picture 1. Movement pitcher in baseball

Therefore, the problem of fatigue against throwing velocity and mechanics of motion in a baseball pitcher's performance should be followed by a more comprehensive research and actual. This research theme related to the throwing motion mechanisms associated with fatigue level consisting of normal, maximum and sub-maximum of the change in the heart rate monitor.

Picture 2. Vertical ground reaction force in the legs during throwing

Samples from this study is the sixth player in the club's male student in the department of exercise science that has the ability to throw a ball baseball pitcher. The method can be used in this research is quantitative descriptive.

The instrument used in this study is the polar beat to measure fatigue levels of players with an indicator monitors the pulse.

II. METHOD

Samples from this study is the sixth player in the club's male student in the department of exercise science that has the ability to throw a ball baseball pitcher. The method can be used in this research is quantitative descriptive.

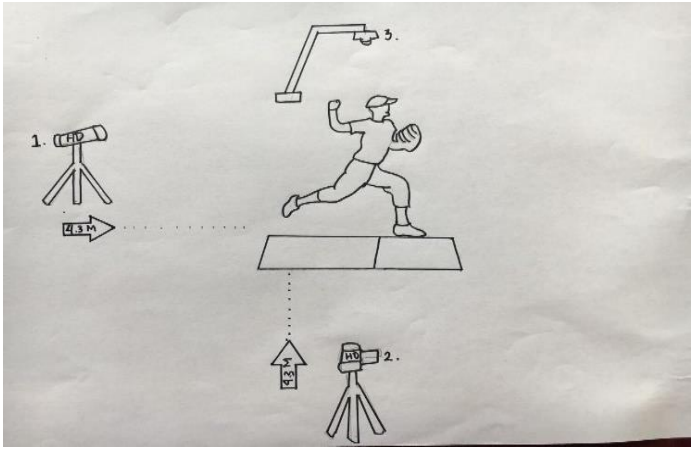
The instrument used in this study is the polar beat to measure fatigue levels of players with an indicator monitors the pulse.

TABLE I. FATIGUE ZONE BASED ON THE MONITOR PULSE

Zone	Types of Intensity	Pulse
1	Low	120-150
2	Moderate	150-170
3	High	170-185
4	Maximum	<185

a.

Meanwhile, using the Bushnell Speed Radar Gun for measuring the speed of the ball. Then, to throw a kinematic analysis using two cameras (Panasonic; 4K Ultra HD Camcorder with Wi-Fi, built-in multi-scene twin cameras and an electronic viewfinder for semi-professional recording experience HCWXF991K). Then, using a go-pro.



Picture 3. Image capture scheme

III. RESULT

There is a result of the speed of the ball If a player under fatigue and normal conditions. Follows below:

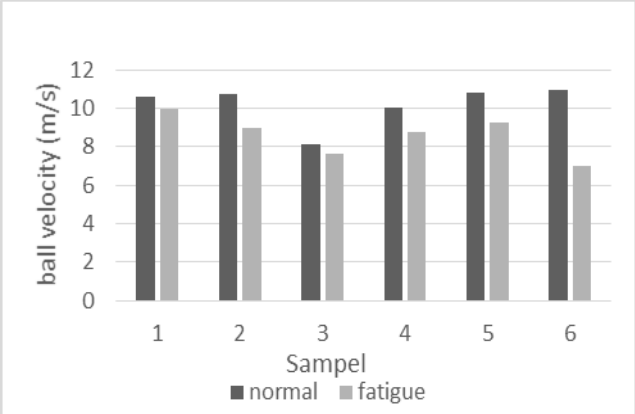


Figure 1. Data speed of the ball under fatigue and abnormal conditions

The results showed that the speed of the ball from each player during normal conditions (10,22 m / s) and fatigue (8.47 m / S) there is a significant difference.

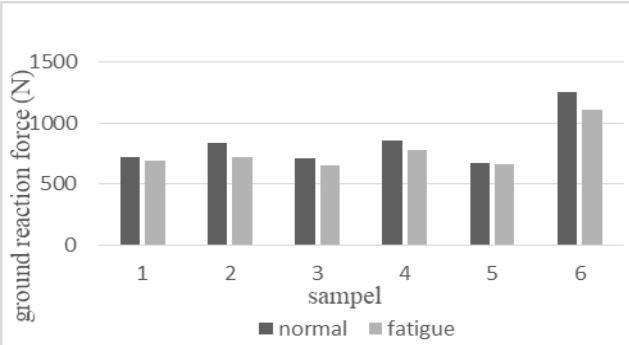


Figure 2. Data ground reaction force under fatigue and abnormal conditions

The results showed that the ground reaction force of each player during normal conditions (986.25 N) and fatigue (896.625 N) there are significant differences.

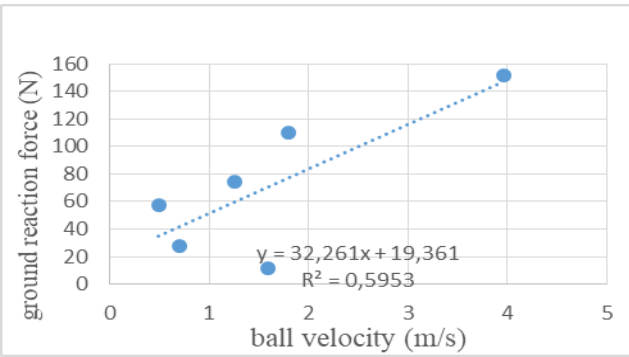


Figure 3. The relationship between the speed of the ball and the ground reaction force

The relationship between the speed of the ball and the ground reaction force, results showed that there was a positive and significant correlation between the ground reaction force and speed of the ball. This suggests that the greater the repulsion of the legs and then generate a greater ball speed.

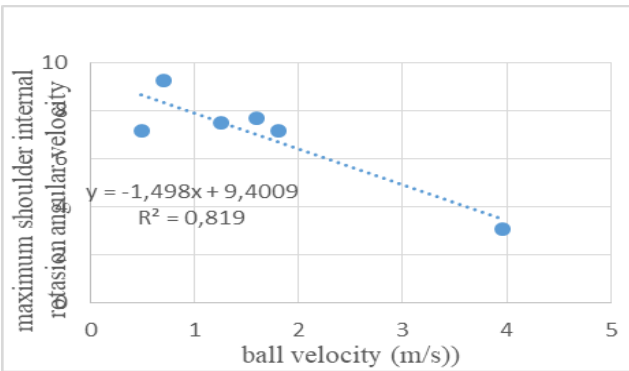


Figure 4. Relations ball speed and maximum internal shoulder angular velocity rotasion

The results showed that there was a positive and significant correlation between rotasion maximum internal shoulder angular velocity at the speed of the ball, This suggests that the greater the repulsion of the legs and then generate a greater ball speed.

IV. Discussion

There are significant differences ball speed normal conditions (10,22 m / s) and fatigue (8.47 m/ S). While addressing the results of ground reaction was no significant difference normal conditions (986.25 N) and fatigue (896.625 N). In a previous study[10], Ball speed is significantly lower [p = 0.02] in the last inning [21.7 ± 2.2m / s; 48.5 ± 5.0mph] compared to the first inning [22.0 ± 2.3m / s 49.2 ± 5.1mph]. In another study, compared with the beginning of second half, as a pitcher approach muscle fatigue during the final 2, there was a significant decrease in the speed of the ball, and the trunk is significantly closer to the vertical position [5].

Research result [12] results compared to the first inning, decreased significantly until the 7th inning. a significant decrease in speed, increase the vertical movement, and a decrease in height of the release emerged later than the fifth inning, and the biggest difference in all the variables are generally recorded between 1 and a half innings the final (7-9). The most effective pitcher during the second inning and was significantly worse in round 4 and 6. In another study, no differences were found in the rotation of the arm or arm speed as the game progresses. However, the arm slot was found to decrease with each successive innings (0.731 degrees perinning reduction; p <0.001) [13].

V. Conclusion

The average velocity of the ball when the players do not experience the fatigue condition, which means that the (normal) is a 10:22 m / s. While the condition of the players experience fatigue makimal ball speed is 8.47 m / s. The maximum speed of the ball is determined bymaximum internal shoulder angular velocity rotasion, Leg strength and arm strength.

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