THE EFFECT OF WARM-UP SESSIONS WITH KNOB-LOADED, CENTER-LOADED, AND BARREL-LOADED BASEBALL BATS ON BAT SPEED IN COLLEGIATE BASEBALL PLAYERS

by

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ABSTRACT

The purpose of this study was to examine the effect of warm-up with a knob-loaded, center-loaded, and barrel-loaded baseball bat on swinging velocity when compared to a normal baseball bat in Division I collegiate baseball hitters. Middle Tennessee State University Baseball hitters (N=9) participated in the study. The velocity was the highest in warm-up with a normal baseball bat. There was no significant difference in swing velocity between a game bat, knob-loaded, center-loaded, and barrel-loaded bat warm-ups. While no significant effect was found, the changing of the location of weight on baseball bat can alter bat speed when switched to a normal baseball bat in game situation.

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CHAPTER I: INTRODUCTION

Hitting a baseball requires high levels of motor skills in order to make good contact on a pitched baseball. Baseball hitters have to make a decision whether to swing at a pitch or not in a split-second, especially when trying to hit 90 miles per hour (mph) fastball (Koike & Miura, 2016). As a hitter, consistently making good contact and driving the baseball are keys to succeed in the game. Bat speed is important factor for every hitter since higher bat speed translates to hitting the baseball a greater distance.

When a pitcher throws a baseball from the mound and a hitter's bat makes contact, the baseball receives greater counter force back towards the field. The baseball will speed up even quicker than when it was pitched once it makes contact with a baseball bat since the bat is heavier than a pitched baseball (Sawicki & Hubbard, 2003). Faster bat speed results in the baseball traveling further and faster after making contact to a baseball. If the batted-baseball is traveling in high velocity, it would give fielders less time to react to the batted-baseball, which allows the batter to collect more base hits. One of the most common warm-ups for hitting is using weighted baseball bat. During a game, hitters have time to practice swinging their bats as they are waiting to face the pitcher. Many players put a weighted donut or ring on the barrel of their bats and practice swing. Some prefer using just the standard bat to get ready to hit but warm-up with barrel-loaded baseball bats is one the most common types of warm-up in hitting. It has psychological effect to baseball hitters as well. Players believe that the bat speed will increase after warming up with a heavy bat. It feels lighter when they switch to the regular bat and feel like they can swing faster and harder (Kim, 2013). According to

research, however, swinging a heavy bat will decrease bat speed when hitters switch to their normal bat (Montoya, Brown, Coburn & Zinder, 2009).

Many researchers have used warm-up sessions with barrel-loaded bats to see if that would affect bat speed (Reyes & Dolny, 2009; Southard & Groomer, 2003; Montoya, Brown, Coburn & Zinder, 2009; Szymanski, Beiser, Bassett, Till, Medlin & DeRenne, 2011), but have not compared normal, center-loaded, and knob-loaded bats to find the optimal way to increase bat speed. Biomechanical factors such as moment of inertia affects bat speed and a smaller moment of inertia creates more rotational speed (Smith, Broker, & Nathan, 2003). Barrel-loaded bat increases moment of inertia because the mass is away from the axis of rotation. Mass is the closest to the axis of rotation with knob-loaded bat. Maximal swing is determined depending on the distribution of mass in baseball bat, the distance of the weight to the knob of the bat (Cross & Nathan, 2009).

In summary, while it has been shown that warm-up with a barrel-loaded baseball bat will decrease the bat speed, there is limited research on warm-up with normal, knob-loaded, and center-loaded bats. More research is needs to be done since knob-loaded and center-loaded bats are becoming more popular among baseball players at competitive levels and they may affect bat speeds. Therefore, the purpose of this study is to determine the effect of warm-up with normal, knob-loaded, center-loaded, barrel-loaded bats on normal baseball bat velocity in collegiate baseball players.

Purpose of Study

The purpose of this study was to examine the effect of warm-up with a knob-loaded, center-loaded, and barrel-loaded baseball bat on bat swinging velocity when compared to a normal baseball bat in Division I collegiate baseball hitters.

Hypotheses

1. Bat swing speed will increase after warming up with a knob-loaded bat.
2. Bat swing speed will decrease or stay the same after warming up with a center-loaded bat.
3. Bat swing speed will decrease after warming up with a barrel-loaded bat.

Delimitations

1. Participants had no orthopedic injuries in the past 3 months.
2. Only true baseball hitters were used, in other words, a player did not participate in this study if he pitches and plays positions.

Limitations

1. The bat speed was not measured by the gold standard device.
2. Normal baseball bat weight and length were different on each players.
3. Limited sample size

Basic Assumptions

1. The validity of the measuring device was high.
2. Each player gave maximum effort on the test.

Significance of Study

This study provided effects on baseball bat swing speed after warming up with three different types of weighted bats.

CHAPTER II: LITERATURE REVIEW

In this chapter, biomechanics of baseball bat swing and impact of warm-up sessions on batting performance will be examined. A successful baseball hitter has higher bat speed and constantly makes good contact on a pitched baseball to drive the baseball farther. The physics and forces of the hitter will be studied to determine how the weight distribution of the baseball bat affect baseball bat swing. This chapter closes with an overall summary and review of the purpose of this study.

Batting Motion

Baseball bat swing and pitching require tremendous amounts of rotational force created by each segment of body. While pitching a baseball is very dynamic activity, baseball bat swing is also very dynamic. One study gives detailed description of pitching phases; windup, stride, arm cocking, arm acceleration, arm deceleration, and follow through (Tullos & King, 1973). As the pitchers have distinct throwing phases, baseball bat swing motion is separated into different phases. The motion is broken down to six phases; preparation phases, stance phase, stride phase, drive phase, bat acceleration phase, and follow-through phase (Fleisig, Hsu, Fortenbaugh, Cordover, & Press, 2013). In a similar study, baseball swing phases were separated into preparation phase, initiation phase, loading phase, shift and transfer phase, and contact phase (Russo & Landolphi, 1998).

The first phase is preparation phase, which is individualized by each player. This phase consists of getting into the hitting stance. Each player has their own routine before each at bat in order for them to get their mindsets ready to face a pitcher and have successful outcome. This pre-performance routine is defined as plan, procedure, or ritual

that facilitates performance. It also allows players to control their motor, emotional, and cognitive behavior during their performance (Lidor & Singer, 2000). The primary purpose of routine is to put oneself in an optimally aroused, confident, and focused state immediately before the performance begins. Having a specific plan, whether that's hitting a specific pitch or pitch location, can make a huge difference compared to just taking swings on random pitches without any competition plan. Pre-performance routine can be used for cognitive and motivational purpose to boost the performance (Munroe-Chandler, Hall, & Fishburne, 2008). Developing and implementing personalized pre-performance during preparation phase is a key to succeed in competitive level of sports. Stepping into a batter's box in a certain way or taking a deep breath before get into the stance phase are some examples of routine. Overall goal of preparation phase is simply to prepare their mindset before facing an opposing pitcher.

The next phase is the stance phase, which consists of how a hitter stands in the batter's box (Chang, Bishop, Baker, & West, 2016). During the stance phase, some hitters have wider stance while others have narrower stance in the box. Depending on where to put the front leg, there are closed stance, open stance, and square stance (LaBranche, 1994). For a closed stance, the hitter's front foot is closer to the home plate than the back foot. The closed stance has been described as requiring a longer swing time and producing higher bat speed. The open stance is when front foot is farther from home plate than the back foot, which produces faster swing time. Finally the square stance is when both feet are equal distant from home plate, allowing hitters to produce combination of short swing time and high bat speed. Once the front foot is lifted off the

ground, the stance phase ends and goes into the next phase (Fleisig, Hsu, Fortenbaugh, Cordover, & Press, 2013).

The stride phase begins once the player lifts his front foot off the ground and begins the swing. The hitter will start eccentrically stretching agonist muscles and rotates the body away from the pitched baseball. The elastic energy stored during this period is released when the hitter concentrically contracts each muscle to produce maximal swing speed (Chang, Bishop, Baker, & West, 2016). The stride phase ends when the hitter's front foot comes into contact with the ground.

The drive phase begins as the player starts to rotate his torso and swing at a pitched baseball. The front foot comes into contact with the ground and it produces the peak ground reaction force (Laughlin, Fleisig, Aune, & Diffendaffer, 2016). The back elbow should be down, both upper extremities should be positioned close to the hitter's body, and all the proximal interphalangeal joints of the hands should align on the handle of the bat (Chang, Bishop, Baker, & West, 2016). Rotation of the torso begins as soon as front foot strikes the ground and the bat acceleration begins immediately after that.

During the bat acceleration phase, baseball bat eventually comes into contact with a baseball. A player has to use both upper and lower extremity muscles to transfer all the energy to the baseball. The hip will turn first, followed by trunk, and gradually gaining angular velocity (Welch, Banks, & Cook, 1995). During this phase, a hitter's upper body starts to open up and face the pitcher, then the baseball bat comes around the body as the hitter swings the bat. The bat acceleration phase consists of the point of maximal bat loading until the bat actually makes contact with a baseball (Monti, 2015). At the contact, elbow has to be extended and make contact to a baseball out in front of the body to

transfer all the energy to the baseball. Rotation of torso continues even after bat to ball contact and goes into follow-through phase.

The final phase in baseball swing is follow-through phase, which is completion of full rotation of body. During the follow-through phase, axial rotation of torso is increased to the maximum level and the axial acceleration is also peaked (Fleisig, Hsu, Fortenbaugh, Cordover, & Press, 2013).

Moment of Inertia

One of the most important physical properties in swinging motion in sports is moment of inertia. Heavy baseball bats cannot be swung as fast as lighter baseball bats since rotating heavier objects requires more power to manipulate. People tend to focus too much on total amount of mass of the object rather than distribution of the mass. Distribution of mass on an object is very important on changing baseball bat speed.

Moment of inertia is measured by an object's resistance to angular acceleration about a given axis (Schorah, Choppin, & James, 2015). In other words, rotational speed will increase if a mass is closer to the axis of rotation rather than further away from the axis, which will require more power to rotate the object. Baseball bat speed can be easily altered by simply increasing the total amount of the bat, changing length of the bat, or changing distribution of the weight (Cross & Nathan, 2009). Moreover, research by Smith et al. shows that increasing baseball bat speed heavily depends on moment of inertia not the total mass (Smith, Broker, & Nathan, 2003). Participants in the study (N=20) compared ten bats of constant mass and different values of moment of inertia versus the other ten bats consisting of constant moment of inertia and different mass. The study showed that swing speed highly depends on moment of inertia but little dependence

on bat weight. Knob-loaded baseball bat; locating mass close to the body, produced higher bat speed than barrel-loaded baseball bat; locating weight away from the axis of rotation.

The energy of baseball bat will transferred to the baseball when a player swings the baseball bat and make contact with a pitched baseball. With higher moment of inertia, outbound ball speed is higher (Bahill, 2014), which contributes to transferring more power to a baseball when the bat comes into contact with the ball. However, higher moment of inertia decreases baseball bat velocity, which makes it difficult to hypothesize that barrel-loaded bat will help a player increase a bat speed when he switches to a game bat. Driving a baseball farther and consistently making good contact heavily rely on the bat speed.

Moving weight closer to the axis of rotation decreases the bat's moment of inertia, which increases the angular velocity (Southard & Groomer, 2003). On the other hand, swinging an over-weighted bat alters motor pattern of the swing, which means altering swing mechanics. Therefore, lower moment of inertia helps each player swing their bat at their maximum swing speed.

Warm-Up

Baseball players typically use weighted bats, placing a weighted ring on the bat or use a weighted baseball bat. They use those devices as they are waiting for their turn to hit. In professional and amateur level, players commonly use 16 oz. weighted ring or 24 oz. wrap added to their game bats (Szymanski, Beiser, Bassett, Till, Medlin & DeRenne, 2011). Some players prefer using a weighted baseball bat for routine warm-up swing, while others do not use those devices at all and just use their game bats for warm-up.

Weighed bat device can be used to strengthen upper body muscles for swinging a bat harder (Reyes & Dolny, 2009). Increasing the bat's moment of inertia by adding weights on the barrel of bat is beneficial for strengthening musculature for swinging baseball bats.

Each player uses warm-up devices, which is weighted ring or wrap in order to optimize their swing speed. However, most players use these weighed bats to increase velocity of baseball bat swing but research report that warm-up with heavier bats actually decrease bat velocity (DeRenne, Buxton, Hetzler, & Ho, 1995). Researchers says that use of heavy bats creates inefficient swing motor pattern, resulting in decreased bat speed (Southard & Groomer, 2003). The other research shows that warm-up with lighter bat will actually increase bat speed in a game situation compared to warm-up with heavy baseball bat (Montoya, Brown, Coburn & Zinder, 2009). The "kinesthetic illusion", a feeling of faster bat speed immediately after warming up with a weighted bat, was responsible for the common mistakes of using a weighed ring at the on-deck circle (Nakamoto, Ishii, Ikudome, & Ohta, 2012). Previous research by DeRenne et al. shows that warm-up with implements weighting between 27 and 34 oz. produced the greatest improvement on bat speed, whereas anything above or below those number produced adverse effects on bat speed (DeRenne, Buxton, Hetzler, & Ho, 1995).

Research by Southard et al. shows that having over weighted bat with a moment of inertia similar to a game bat may allow for a desired training effect without any disruptions in the swing motor patterns of hitters (Southard & Groomer, 2003). All of these weights were attached at the top-end of the bat while there have been very limited research for center-loaded and knob-loaded baseball bat.

Bat Speed

A successful hitter is considered to be someone whose batting average is above or at least close to .300 and there are so many ways to reach that number, one of them is increasing bat speed (Breen, 1967). Higher bat velocity allows each hitter to perform well by increasing batting average, home runs, and slugging percentage. The swing speed needs to be fast enough to overcome the force of the pitched baseball because the baseball is coming at a hitter at very fast velocity. The energy is transferred from a baseball bat to a pitched baseball as the bat makes contact to the pitched baseball. For that reason, being successful player also means being able to produce high bat swing velocity.

Increasing bat speed can be achieved by overloading principles, resistive training, and other weight trainings (DeRenne, Buxton, Hetzler, & Ho, 1995). Those training can be resistance training for overall strength or plyometric exercises for power. Resistance training allows athletes to increase their power, speed, and strength that are required for increasing bat speed. Since the baseball bat swing motion is very dynamic, strengthening both upper and lower extremity musculatures are very important for every player.

Three direct benefits of increasing bat speed are increased decision time, decreased swing time, and increased batted baseball velocity (Szymanski, Beiser, Till, Medlin, & DeRenne, 2011). At college baseball level, the average pitcher throws with a velocity between 74-86 mph (Werner, Suri, Guido, et al., 2016). Hitters have to determine where the pitch location will be, what type of pitch is going to be thrown, and velocity of the pitch. They have to process all of these information and decide whether they swing a bat or not. Spending more time to see the ball before swing on a pitch

allows a hitter to swing only at a ball in the strike zone, which is very important goal in hitting (DeRenne, 2007).

The swing time stands for the time needed to physically adjust the swing of the bat to hit a pitched baseball. The less time it takes to swing the bat, the longer the hitter's decision time will be. According to a research by Breen et al., major league baseball hitters have swing time of 0.19-0.28 seconds (Breen, 1967). If a hitter can decrease the swing time, it allows the hitter to select more pitches in the batter's box.

The batted baseball velocity will be greater if the ball was hit with higher bat velocity. The ball will travel farther, and be hit harder if the bat velocity is high because of the larger transfer of force is applied to the ball. According to a research by Crisco et al., aluminum bats produce higher batted baseball velocity since it is lighter than wooden bats and produce higher bat speed (Crisco, Greenwald, Blume, & Penna, 2002). Thus aluminum bats produce higher batted baseball velocity and a hitter will able to drive the ball farther than wooden bats. Wooden bats have also higher moment of inertia, which decreases bat speed compared to aluminum bats with weights distributed closer to the axis of rotation and lower moment of inertia.

Overall Summary

Baseball bat swing motion is very dynamic and somewhat similar to pitching motion. Each phases of swing motion plays very important roles in producing higher bat speed. The stance phase is individualized by each player before getting into the stride phase, where a hitter lift off the front foot to load all the forces (Monti, 2015). During the drive phase, rotation of torso is initiated as soon as the front foot comes into contact with

ground. The bat acceleration phase is when the bat strikes a baseball from the maximal loading, then follow through, completion of swing.

It is important to understand the principle of moment of inertia, which is basically distribution of mass of a baseball bat. Altering moment of inertia affect bat speed a lot rather than just over- or under-loading mass on a bat. By changing distribution of mass closer to the axis of rotation, a hitter can produce higher bat speed and force transferred to a baseball. Increasing bat speed enhances the hitter's performance by increasing decision time, decreasing swing time, and increasing batted baseball velocity (Szymanski, Beiser, Till, Medlin, & DeRenne, 2011).

CHAPTER III: METHODS

Participants

Participants for this research were Division I collegiate baseball hitters (N=9) with minimum five years of hitting experience. Both right-handed, left-handed hitters, and list hitting as their primary position were evaluated. All hitters were, medically cleared by their team physician to participate team activity. Participants with past history of orthopedic and muscular injuries within past 4 weeks were excluded in this study.

Instrumentation

Non-weighted bat. A game bat without additional weight attached to it.

Knob-loaded bat. 5 oz. weight was attached to the bottom end of bat that each player uses during a game.

Center-loaded bat. 5oz. weight ring was attached to the center of a normal bat that each player uses during a game.

Barrel-loaded bat. 5oz. weight ring was attached to the barrel of a normal bat that each player uses during a game.

Pitching machine. Pitching machine was set at 85 mph fastball. All the pitch locations can be adjusted where each participant wants.

Bat speed. Speed at which the bat moves toward the incoming pitch was measured with Blast Baseball swing analyzer, a device that can be attached at the bottom end of a bat to measure bat velocity.

Procedures

Informed consent was obtained from the Institutional Review Board (IRB) at Middle Tennessee State University. In this experimental research, baseball hitters from Middle Tennessee State University participated in this study. Testing procedures and participants guidelines were explained to each player. All the players signed consent form before they got tested and their coaches approved to conduct this study on each player. All testing took place in the batting cage at Middle Tennessee State University baseball indoor facility. Each participant completed testing within a week during their season.

Prior to testing, participants were told not to take any swing with any type of bat in the last 30 minutes. Each player did not lift 24 hours prior to prevent muscular soreness that may alter the swing speed. Each participant warmed up their body with an arm bike for 10 minutes while maintaining 70% of their maximum heart rate. A pitching machine was set at 85 mph fastball in an indoor cage. Each participant took five warm-up dry swings with 5 oz. weight attached to their game bat as if they were preparing to hit in a game. These warm-up swings were performed at maximum intensity. Each player then took the weight off their game bat and a bat speed measuring device, Blast Baseball swing analyzer, was attached to their bats.

Once hitters were ready, they were allowed to stand anywhere in the batter's box and took a couple pitches to adjust the location, but no warm-up swing with a normal bat was allowed. The machine was set at 60 feet away from the home plate, which was the same distance from the mound to the home plate. Once the machine was ready, participants took five swings against the pitching machine. The swings were performed at maximum effort while making contact with the pitched baseball. Participants were

allowed to choose types of weight on the bat whether that was knob-loaded, center-loaded, or barrel-loaded. But non-weighted baseball bat was always tested last. A 10 minute rest was given between each trial.

Data Analysis

Descriptive statistics were calculated for each player's body-weight, height, age, and bat speed with or without a 5 oz. weight. Bat speed with a game bat, was compared between three different conditions (knob-loaded weight, center-loaded weight, and barrel-loaded weight). Data was analyzed by the Statistical Package for Social Sciences (SPSS).

CHAPTER IV: RESULTS

The current study included 9 male Division I collegiate baseball hitters (right handed $n = 6$; left handed $n = 3$) from Middle Tennessee State University that volunteered to take part in the study. All participants in the study were listed as primary position players on the roster. Descriptive characteristics of the participants are shown in Table 1. The means and standard deviations for velocity the four conditions are provided in Table 2.

The one-way repeated measure ANOVA revealed no significant difference between non-weight, knob, center, and top loaded bat warm ups. *Wilks' Lambda*, = .517, F (3, 6) = 1.87, p = 0.24.

Table 1

Characteristics of the Sample ($N = 9$)

	M	*SD*
Height (cm)	182.2	5.7
Weight (kg)	87.8	13.5
Age (y)	20.7	1.1

Table 2

Comparison of Bat Speed for Non-Weighted Bat and Three Weighted Bats (mph)

	M	*SD*
Non-Weight (mph)	74.4	3.7
Knob (mph)	72.6	4.0
Center (mph)	73.3	3.5
Top (mph)	73.2	3.9

CHAPTER V: DISCUSSION

The purpose of this study was to examine the effect of warm-up with a knob-loaded, center-loaded, and barrel-loaded baseball bat on bat swinging velocity when compared to a normal baseball bat in Division I collegiate baseball hitters. This study is unique because the study focuses on warm-up swings in game situations. There were no significant differences in bat speed among the four warm-up situations. The results did not support the hypothesis that the hitters' bat speed would increase after warming up with a knob-loaded bat. Also, the hypothesis that bat swing speed would decrease or stay the same after warming up with a center-loaded bat was not supported. Furthermore, the findings of the study did not support the hypothesis that bat swing speed would decrease after warming up with a barrel-loaded bat. Lastly, while not significant, the results showed that warm-up with a game bat without additional weight had the largest increase in bat speed.

The one-way repeated measures ANOVA showed no significant difference in bat speed, regardless of where each hitter located the weight on their baseball bats ($p = 0.24$). However, based on the results, warm-up with a game bat without additional weight appeared to increase the bat swing speed the most when hitting against the machine. This suggests that warm-up with any type of weighted bat would actually decrease bat swing speed at the plate, which potentially decrease hitting performance in a game. Warm-up with knob-loaded bat decreased bat speed almost 2 mph compared to warm-up with a game bat. A 2 mph drop in bat swing speed may dramatically impact hitting performance by changing exit velocity, distance, trajectory, and spin of the batted baseball.

Based on the current knowledge on this topic, shifting moment of inertia close to the axis of rotation would increase rotational speed (Smith, Broker, & Nathan, 2003). However, warm-up with knob-loaded baseball bat showed the slowest bat swing speed among all four conditions. In this study, changing moment of inertia did not alter bat swing speed. Warm-up with a game bat showed the highest bat swing speed. There might be psychological factors contributing to the results. It is likely that players feel the most comfortable with their game bats because they use it in a game and practice, which allows players to feel more confident and comfortable.

One study examined acute effects of different types of pre-exercise protocols on performance. In this study, researchers measured the acute effects of four warm-up protocols with and without weighted vests on anaerobic performance in high school athletes. Subjects performed four randomly ordered warm-up protocols: five static stretches, nine moderate-intensity to high-intensity dynamic exercises, the same nine dynamic exercises performed with a vest weighted with 2% of body mass, and the same nine exercises performed with a vest weighted with 6% of body mass (Faigenbaum, McFarland, Schwerdtman, Ratamess, Kang, & Hoffman, 2006). Long jump performance was significantly greater after warming up with a vest weighted with 2% of body mass. However, our data, while not significant, suggests that warming up with weighted protocols would decrease the performance. One of the reasons for the different findings between the two studies is that our study examine the upper body and they examined the lower body. The upper body has less mass and is more prone to neuromuscular fatigue than the lower body. Therefore, the contrasting findings between our study and

Faigenbaum et al. may be due the increased susceptibility of the upper body to neuromuscular fatigue.

One of the strengths of this study was that the participants were in peak condition at the end of the season. Another strength of the study is that the bat swing speed was collected during real batting situation using a pitching machine. The machine was set at 85 mph fastball, which is the average fastball velocity for college baseball pitchers. This allowed us to get the bat swing speed in real situation. A major limitation of this study was the sample size. There were some obvious differences in bat swing speeds and due to the low sample size it is likely that error was not controlled. Also, in our study, warm-up with a game bat was always last while hitters randomly selected order of three weighted bats. Setting specific warm-up protocol order may affect the bat speed in a game situation.

In summary, bat swing speed is critical to hitting success in a baseball game. Altering moment of inertia during the warm-up by changing distribution of the weight on baseball bats may have detrimental effects on bat swing speed in game situations, which may increase or decrease exit velocity, distance, trajectory, and spin of batted baseball. Future study should use larger sample sizes to support this. The result from the study would help players decide whether they use weighted baseball bat or not in order to increase their batting performance.

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APPENDICES

APPENDIX A

Informed Consent Form

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

IRBF016: INFORMED CONSENT
(Use this consent template when recruiting adult participants not considered as "vulnerable")
IRBF016 – Participant Informed Consent
A. INFORMATION AND DISCLOSURE SECTION
(Participant Copy)

Primary Investigator(s)	Keita Isaji	**Student ☒**
Contact information	Box 96, 615-494-7973; keitaisaji@gmail.com	
Department Institution	Middle Tennessee State University	
Faculty Advisor	John M. Coons Department HHP	
Study Title	The effect os warm-up sessions with knob-loaded, center-loaded, and barrel-loaded baseball bats on bat speed in collegiate baseball players	
IRB ID	**19-2183 Expiration: 04/30/2022**	**Approval: 04/26/2019**

The following information is provided to inform you about the research project and your participation in it. Please read this disclosure carefully and feel free to ask any questions you may have about this study and the information given below. You must be given an opportunity to ask questions, and your questions must be answered. Also, you must receive a signed copy of this disclosure.

Your participation in this research study is voluntary. You are also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

For additional information about giving consent or your rights as a participant in this study, please feel free to contact the Middle Tennessee State University (MTSU) Office of Compliance (Tel 615-494-8918 or send your emails to irb_information@mtsu.edu. Please visit www.mtsu.edu/irb for general information on MTSU's research participant protection policies.

Please read this section and sign Section B if you wish to enroll in this study. The researcher will provide you with a copy of this disclosure form for you to keep for your future reference.

1. **Purpose of the study:** You are being asked to participate in this research study because The purpose of this study is to exmine the effect of knob-loaded, center-loaded, and barrel-loaded warm-ups on swinging perfromance in collegiate baseball players

2. **Classification of procedures to be followed and approximate duration of the study:**
   - ☐ 2.1 ***Educational Tests*** – dy involves either standard or novel education practices which consists educational testing and such studies expose the participants to lower than minimal risk
   - ☐ 2.2 ***Behavioral Evaluation*** – Although the study may or may not involve educational tests, the specific aim is to understand behavioral characteristics. .

   The following classifications indicate that the participant will be asked to perform or part-take in physical activities or procedures. Examples of such studies simple physical exercises, medical or clinical intervention, pharmaceutical testing and etc. Due to the nature of these studies, you may be exposed risky situations thay may exceed normal day-to-day scenarios.
   - ☐ 2.3 ***Psychological intervention or procedures***
   - ☒ 2.4 ***Physical Evaluation or Procedures***
   - ☐ 2.5 ***Medical Evaluation or Clinical Research***
   - ☐ 2.6 ***OTHER***

3. **What are procedures we intend on doing in this study?**
Participants for this research will be Division I collegiate baseball hitters (N=16) with minimum 5 years of hitting experience (permission to conduct study has been granted by coach, see attached) that volunteer to be part of the study. Both right-handed, left-handed hitters, and list hitting as their primary position will be evaluated. All hitters will be, medically cleared by their team physician to participate team activity. Participants with past history of orthopedic and muscular injuries within past 4 weeks will be excluded in this study.
Instrumentation
Knob-loaded bat. 5 ounces (oz.) weight will be attached to the bottom end of bat that each player uses during a game. Center-loaded bat. 5oz. weight ring will be attached to the middle part of a normal bat that each player uses during a game. Barrel-loaded bat. 5oz. weight ring will be attached to the barrel of a normal bat that each player uses during a game. The participatns will also perform a session with no weight. This will serve as a control measure. The pitching machine will be set at 85 mph fastball. All the pitch locations can be adjusted where each participant wants. Bat speed at which the bat moves toward the incoming pitch will be measured with Zepp 3D, a device that can be attached at the bottom end of a bat to measure bat velocity.
In this experimental research, baseball positioning players from Middle Tennessee State University will participate in this study. Testing procedures and participants guidelines will be explained to each player. All the players will read and sign an informed consent form (see attached) before they get tested and their coaches have approved to conduct this study on each player. All testing will take place in the batting cage at Middle Tennessee State University baseball indoor facility. Each participant will complete testing within a week during their pre-season.
Prior to testing, participants will be told not to take any swing with any type of bat in the last 30 minutes. Each player also should not be lifting past 24 hours to prevent muscular soreness that may alter the swing speed. Each participants warms-up their body with an arm bike for 10 minutes while they are maintaining maximum heart rate within 70%. A pitching machine will be set at 85 mph fastball in an indoor cage. Each participant will take five warm-up dry swings with a knob-loaded bat as if they are preparing to hit in a game. Those warm-up swings can be at moderate to maximum intensity. Then each player takes a weight off from their bat that they use during a game and a bat speed measuring device, Zepp 3D, is attached at the end of their bats. Once hitters are ready, they will be allowed to stand anywhere they want in the batter's box and take a couple pitches to adjust the pitched baseball location to where they want, but no warm-up swing with a normal bat is allowed. The machine will be set at 60 feet away from the home plate, which is the same distance from the mound to the home plate. Once the machine is ready, participants will takes five swings against the pitching machine. Each hitter will take those swings with maximum effort while making a contact to a pitched baseball. Participants are allowed to randomly choose the order on types of a bat weight. 10 minute rest will be given in between each trial.

4. **What will you be asked to do in this study?**
You will be asked to perform a batting warmup with no weight added and with a 5 oz weight that will be loaded at different positions (knob-loaded, center-loaded, and barrel-loaded) on the bat. After the warm-up, you will be asked to step in a batting practice session. The batting practice session will involve you swinging at a 85 mph fastball that will be preset to a location that you desire. You will be asked to take 5 practice swings for each warmup session. A device that assesses batting performance will be attached to the end of your practice bat. Thirty minutes prior to the warm-up sessions, you will be asked not to swing any type of bat.

5. **What are we planning to do with the data collected using your participation?**
   All data from this study will be used to complete a masters thesis and possibly be used to write a manuscript for a journal. All data will be stored in a locked secured location to ensure confidentiality and privacy.

6. **What are your expected costs to you, your effort and your time commitment?**
   Your participation will involve minimal effort and time commitment. There will be no expected costs to you.

7. **What are the potential discomforts, inconveniences, and/or possible risks that can be reasonably expected as a result of participation in this study?**
   Risk of injury and discomfort is minimal.

8. **How will you be compensated for your participation?**
   No compensation for participation will be given.

9. **What are the anticipated benefits from this study?**
   Information from this study may enhance batting performance in baseball.

10. **Are there any alternatives to this study such that you could receive the same benefits?**
    No alternatives to this study are known.

11. **Will you be compensated for any study-related injuries?**
    No compensation is available.

12. **Circumstances under which the researcher may withdraw you from this study:**
    Not participating in one of the sessions

13. **What happens if you choose to withdraw your participation?**
    Participation in this study is strictly voluntary, If you decide to participate in the study and then for some reason decide to withdraw, you may withdraw from the study without penalty.

14. **Can you stop the participation any time after initially agreeing to give consent/assent?**
    After initially agreeing to give consent participation can be stopped any time.

15. **Contact Information.** If you should have any questions about this research study or possibly injury, please feel free to contact Keita Isaji by telephone 562-234-9693 or by email ki2k@mtmail.mtsu.edu OR my faculty advisor, Dr. John Coons, at john.coons@mtsu.edu; 615-494-7973. Contact MTSU Office of Compliance (compliance@mtsu.edu or 615 494 8918) to report abuse, misconduct or an adverse event.

16. **Confidentiality.** All efforts, within reason, will be made to keep the personal information in your child's research record private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, *if* you or someone else is in danger or if we are required to do so by law.

You do not have to do anything if you decide not to participate. If you wish to enroll, then follow the direction next to the checked box below:

☒ Enter your name and age in the attached Section B document and sign in the space provided.
☐ Anonymous: Just your age and give consent by signing in the bottom of the space provided.
☐ Verbal Consent: Give consent verbally; this is done to protect your identity.

Consent obtained by:

Researcher's Signature	Name and Title	Date

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010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

B. Signature Section
(Researchers' Copy)

Primary Investigator(s)	Keita Isaji	**Student ☒**
Contact information	Box 96, 615-494-7973; keitaisaji@gmail.com	
Department Institution	Middle Tennessee State University	
Faculty Advisor	John M. Coons Department HHP	
Study Title	The effect os warm-up sessions with knob-loaded, center-loaded, and barrel-loaded baseball bats on bat speed in collegiate baseball players	
IRB ID	**19-2183** **Expiration: 04/30/2022**	**Approval: 04/26/2019**

PARTICIPANT SECTION
(To be filled by the participant and return to the researcher)

Participant Name or ID	(print)	Age:

☐No ☐Yes I have read this informed consent document pertaining to the above identified research
☐No ☐Yes The research procedures to be conducted have been explained to me verbally
☐No ☐Yes I understand each part of the interventions and all my questions have been answered
☐No ☐Yes I am aware of the potential risks of the study

By signing below, I affirm that I freely and voluntarily choose to participate in this study. I understand I can withdraw from this study at any time without facing any consequences.

Follow the signage instruction next to the box checked below:
☒ Enter your name and age above and sign below to enroll in the study
☐ Anonymous: Just enter your age above and sign below; DO NOT ENTER YOUR NAME
☐ Verbal Consent: The participant will give consent verbally to protect the participant's identity.

Date Signature of the Participant

RESEARCHER SECTION
(To be filled by the researchers)

Informed Consent obtained by:

Date Signature Print Name & Title

Faculty Verification if the PI is a student:

Date Faculty Signature Print Name & Title

APPENDIX B

University Institutional Review Board Approval

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN001 - EXPEDITED PROTOCOL APPROVAL NOTICE

Friday, April 26, 2019

Principal Investigator	**Keilta Isaji** (Student)
Faculty Advisor	John Coons
Co-Investigators	Vaughn Barry
Investigator Email(s)	ki2k@mtmail.mtsu.edu; john.coons@mtsu.edu
Department	Exercise Science, Health and Human Performance
Protocol Title	***The effect of warm-up sessions with knob-loaded, center-loaded, and barrel-loaded baseball bats on bat speed in collegiate baseball players***
Protocol ID	**19-2183**

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXPEDITED** mechanism under 45 CFR 46.110 and 21 CFR 56.110 within the category *(4) Collection of data through noninvasive procedures*. A summary of the IRB action and other particulars in regard to this protocol application is tabulated below:

IRB Action	**APPROVED for ONE YEAR**		
Date of Expiration	**4/30/2022**	Date of Approval	4/26/19
Sample Size	100 (ONE HUNDRED)		
Participant Pool	Primary Classification: **Healthy Adults (18 years or older)** Specific Classification: **Collegiate baseball players**		
Exceptions	NONE		
Restrictions	**1. Mandatory signed informed consent; the participants must have access to an official copy of the informed consent document signed by the PI.** **2. Data must be deidentified once processed.** **3. Identifiable data must be destroyed as described in the protocol.** **4. Any identifiable data/artifacts that include auido/video data, photographs and handwriting samples must be used only for research purpose and must be destroyed after data processing.** **5. Research site restriction applies (site information on file)**		
Comments	NONE		

This protocol can be continued for up to THREE years (**4/30/2022**) by obtaining a continuation approval prior to **4/30/2020**. Refer to the following schedule to plan your annual project reports and be aware that you may not receive a separate reminder to complete your continuing reviews. Failure in obtaining an approval for continuation will automatically result in cancellation of this protocol. Moreover, the completion of this study MUST be notified to the Office of Compliance by filing a final report in order to close-out the protocol.

Post-approval Actions

The investigator(s) indicated in this notification should read and abide by all of the post-approval conditions imposed with this approval. Refer to the post-approval guidelines posted in the MTSU IRB's website. Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 within 48 hours of the incident. Amendments to this protocol must be approved by the IRB. Inclusion of new researchers must also be approved by the Office of Compliance before they begin to work on the project.

Continuing Review **(Follow the Schedule Below:)**

Submit an annual report to request continuing review by the deadline indicated below and please be aware that **REMINDERS WILL NOT BE SENT.**

Reporting Period	Requisition Deadline	IRB Comments
First year report	3/31/2020	This protocol will automatically close on the date mentioned in page 1.
Second year report	3/31/2021	NOT COMPLETED
Final report	3/31/2022	NOT COMPLETED

Post-approval Protocol Amendments:

Only two procedural amendment requests will be entertained per year. *In addition, the researchers can request amendments during continuing review. This amendment restriction does not apply to minor changes such as language usage and addition/removal of research personnel. .*

Date	Amendment(s)	IRB Comments
NONE	NONE.	NONE

Other Post-approval Actions:

Date	IRB Action(s)	IRB Comments
NONE	NONE.	NONE

Mandatory Data Storage Requirement: All of the research-related records, which include signed consent forms, investigator information and other documents related to the study, must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data storage must be maintained for at least three (3) years after study has been closed. Subsequent to closing the protocol, the researcher may destroy the data in a manner that maintains confidentiality and anonymity.

IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

Click here for a detailed list of the post-approval responsibilities.
More information on expedited procedures can be found here.

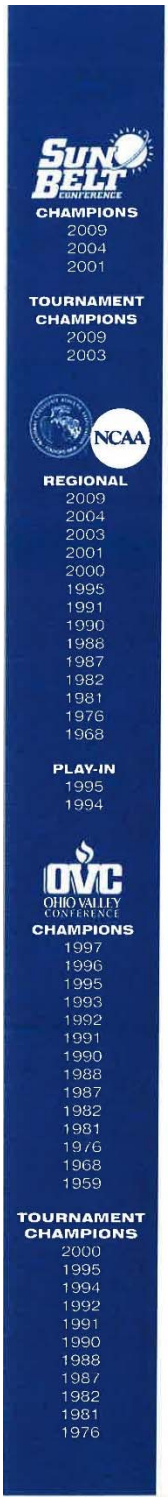
APPENDIX C

Data Collection Form

Name:					
Body Mass	Height	R/L	Order:		
Knob-Loaded			**Center-Loaded**		
MPH	Top	Avg	MPH	Top	Avg
Top-Loaded			**Non-Weighted**		
MPH	Top	Avg	MPH	Top	Avg

APPENDIX D

Coach's Approval Letter



MT BASEBALL

1/12/19

To Whom It May Concern:

Keita Isaji has been approved to use our baseball hitters for his thesis project. Our coaching staff, myself, and players will be happy to support him while he is collecting data and completing his study.

Sincerely,

Jim Toman

Head Baseball Coach

MIDDLE TENNESSEE STATE UNIVERSITY ◆ BASEBALL OFFICE ◆ MTSU BOX 90
MURFREESBORO, TN 37132 ◆ PH. 615-898-2450 ◆ FAX 615-904-8285