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Jacob Hausch

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ACCURACY OF SELF-REPORTED HEIGHT AND WEIGHT IN COLLEGIATE ATHLETES

By

Jacob Hausch

A Senior Thesis Submitted to the

Eastern Michigan University

Honors College

in Partial Fulfillment of the Requirements for Graduation

with Honors in Exercise Science

Approved at Ypsilanti, Michigan, on April 17, 2020

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Dedication

I would like to dedicate this to my mother and father, who believed in me and supported me for as long as I can remember. I'd also like to dedicate this to my fiancé Emilie, for providing encouragement throughout this entire process. Without the support of these three people, I would not be where I am today.

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Abstract

The purpose of this study was to determine whether or not athletes are able to self-report accurate, unbiased height and weight. Fifty-seven Eastern Michigan University athletes and forty EMU non-athlete students volunteered for this study. After completing an informed consent, the participants filled out an online questionnaire in which they self-reported their heights and weights. Then, a member of the research team measured the participants' heights and weights in a private room. Paired samples t-tests were used to compare the self-reported heights and weights to the measured values. Results were categorized by sport, gender and body size of the participants. This study provides evidence that competitive athletes are capable of self-reporting accurate heights and weights. However, the athletes in this sample consistently reported being taller and lighter than they actually were. There was not a significant difference between the self-reporting bias of athletes and non-athletes for height, weight, or BMI.

Structured Abstract

ACCURACY OF SELF-REPORTED HEIGHT AND WEIGHT OF COLLEGIATE ATHLETES

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Performance data is used to answer questions about sport and human performance. The value of this data is increased when it is paired with anthropometric data. However, researchers may be unable to collect anthropometric measurements in person due to geographical or time constraints. This can be resolved by allowing the athlete to self-report their height and weight in an online survey. **PURPOSE:** To determine whether or not collegiate athletes self-report accurate, unbiased heights and weights. **METHODS:** Competitive athletes (n=57) were met at one of the Eastern Michigan University (EMU) practice facilities and non-athlete students (n=40) were met at the EMU Running Laboratory. After completing an informed consent, the participants filled out an online questionnaire in which they self-reported their heights and weights. Then, a member of the research team measured the participants' heights and weights in a private room. The self-reported and measured values were completed on the same day. Paired samples t-tests were used to compare the self-reported heights and weights to the measured values. Independent sample t-tests were used to compare the reporting errors between the athlete and non-athlete group. **RESULTS:** The athletes had a mean percent error of 1.0% (s = 0.7%) for self-reported height, 1.8% (s = 1.5%) for self-reported weight, and 3.0% (*s* = 2.3%) for self-reported Body Mass Index. Self-reported height (174.6 ± 9.50 cm) was significantly greater than measured height (173.7 ± 9.26 cm) (t=3.44, p=0.007). Self-reported weight (72.7 ± 14.13 kg) was significantly less than measured weight (71.9 ± 13.66 kg) (t=3.40, p=0.0001). Self-reported BMI (23.7 ± 3.4 kg/m^2) was significantly less than measured BMI (24.2 ± 3.5 kg/m^2) (t=5.32, p=0.0001). **CONCLUSIONS:** This study provides evidence that competitive athletes are capable of self-reporting accurate heights and weights via the relatively low percent errors. However, the athletes in this sample consistently reported being taller and lighter than they actually were. The combination of these self-reporting errors led to a greater self-reporting error for BMI. There was no significant difference in reporting error between the total sample of athletes and non-athletes.

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction and Background

Many sport governing bodies collect and store performance data from competitions taking place within their jurisdiction. The data can then be used by researchers to answer questions about sport and human performance. Such performance data sets are valuable in and of themselves. However, their value can be increased if basic anthropometric data – e.g., height, weight, and body mass index (BMI) – can be combined with the performance data. Unfortunately, it is not always an option for researchers to take such measurements because the athletes live throughout the country, or even the world. One way around this obstacle would be to have the athletes report their own heights and weights in an online survey. There are many sources of error that can potentially impact the way an athlete self-reports their height and weight, such as daily weight changes due to exercise and eating habits or lapse in memory of current weight or height. Before online surveying can be deemed a valid method of collecting anthropometric data, there needs to be evidence that athletes are able to accurately self-report height and weight.

An example of performance researchers using online competition data is Cornett, Duski, Wagner, Wright, and Stager (2017). This group of researchers studied the relationship between maturational timing and swim performance in collegiate female swimmers. They did this by retrieving performance data from USA Swimming, a national database containing performances of many collegiate swimmers. They also retrieved self-reported height, mass, and other values via email survey. These self-reported heights and weights are valuable to the interpretation of the performance data. However, the validity of these self-reported values is questionable and should be verified.

Previous studies have aimed to demonstrate that the average person or group of people can accurately self-report their height and weight. This was typically done by having subjects answer a survey that reported their height and weight, then have their height and weight physically measured by a researcher. These values would be compared and discrepancies in self-reported height/weight and measured height/weight would often be found. Studies were done that specifically investigated different populations. For example, Gunnare, Silliman, and Morris (2013) focused on college students; Spencer, Appleby, Davey and Key (2001) studied middle-aged English citizens; and Knechtle, Rüst, Rosemann, Knechtle, and Bescos (2012) looked at endurance athletes. There are many more examples of the diversity of the literature regarding this subject. Regardless of the population studied, the general trend was that people overreported height and underreported weight. In other words, they reported being taller than they actually were and weighing less than they actually did. Most studies did not distinctly determine if their results showed validity of self-reported values. Rather, they provided mean differences of the entire group.

Athletes may not follow the same trends as the general population. It is possible that they are more subject to daily weight fluctuations because of their exercise regime and daily caloric intake. The NCAA allows athletes to practice up to 20 hours per week (*NCAA Bylaws 17.1.7.1*, 1991). Members of the general population can be sedentary or active. That is, non-athletes can exercise zero hours per week or more. Therefore, it is not great to compare trends from a population with varying physical activity/exercise levels to athletes that regularly exercise 20 hours a week. Diet is another difference between athletes and the general population. Members of the general population typically eat 1800-2000 calories per day. Athletes are recommended to eat 2-3 times that number because of the energy requirements of exercise (Benson, 2013). Of course, these values are variable depending on the size/goals of the individuals. Regardless, athletes exercise more frequently and eat much more than members of the general population. Since diet and exercise can possibly lead to weight gain or weight loss, there could be some uncertainty when reporting weight that members of the general population may not have to consider.

Knechtle et al. (2012) has been the only study to investigate if an athlete can accurately report height and weight. They studied 1,618 endurance athletes (swimming, cycling, running, triathlon, and inline skating) immediately before a competition. The results showed that athletes actually follow the same self-reporting bias pattern that members of the general population did. They were found to have lower self-reported weight than measured weight. They also tended to have greater self-reported height than measured height. Both of these findings are consistent with trends from the general population. However, Knecthle et at. (2012) found that female athletes were more accurate than the general population when reporting weight, and men were more inaccurate than the general population when reporting weight. Knechtle et al. (2012) found that both athletic men and women are significantly more accurate when reporting their height compared to the general population. Knecthle et al. (2012) identified the accuracy of self-reported height and weight in endurance athletes. However, more work needs to be done on endurance athletes, and there is still a gap in the literature for members of non-endurance sports.

This study plans to address the accuracy of online self-reporting of anthropometric data. The evolution of technology has changed and improved many facets of life. Specifically, long distance communication has been made much easier and cheaper. Academia and researchers have directly benefited from this technology. Participants that were asked to complete surveys or quizzes can now complete these in an online fashion. Previously, surveys would have to be completed in person or via mail. The new methodology of survey completion saves time/money and allows researchers to test participants that are across the country! It also allows numerous participant surveys to be completed and filed in an efficient way. However, increased efficiency and ability to study non-local participants should not be substituted for accuracy because survey participants may be purposely or accidentally untruthful when completing a survey online.

There were multiple reviewed studies that investigated the accuracy of self-reported height and weight via an online survey. They found that participants will tend to overreport their height and underreport their weight when answering a survey online (Vartarian & Germeroth, 2011; Bonn, Lagerros, & Bälter, 2013; Pursey, Burrows, Stanwell, & Collins, 2014). This was identical to the trend witnessed in the general population. However, there was only one study of the aforementioned three that investigated the accuracy of self-reported height. Pursey et al. (2014) found that online participants tended to overreport their height to a greater extent than people completing surveys in person. The three studies did not have any conclusive results regarding the accuracy of online self-reported weight compared to in person self-reported weight. One study found that online self-reported weight was more accurate than in person self-reported weight. Another study found that online self-reported weight had approximately the same mean difference in underreported weight as previous studies. And the third study found that people tended to underreport their weight to a greater extent when reporting online. Online reporting of height and weight has been inconclusive, and more work needs to be done to better understand the accuracy of self-reported height and weight reported through online questionnaires.

Statement of the Problem

Researchers analyze performance data in order to better understand the factors that affect athletic performances. The data from these performances is often paired with height, weight, and BMI. Development in technology has led to a more efficient pathway for researchers to retrieve this information. Email and online surveys are commonly used as an alternative to in-person communication. Being able to distantly retrieve basic anthropometric information can allow researchers to 1) communicate with athletes and analyze performances from a distant location and 2) analyze local athletes more efficiently by reducing face-to-face time and improving filing speed. However, athletes self-reporting their height and weight must be validated. If athletes are not found to accurately report their anthropometric data, the data from self-reports cannot be used.

Justification and Significance

Research is necessary to validate the accuracy of self-reported height and weight in athletes. This study attempts to discover if athletes report accurate height and weight values. This research is significant because studies that use online surveys to retrieve information rely on the fact that athletes can accurately report anthropometric data. Evidence that athletes can accurately report their height and weight in an online survey would allow for a wider range of athletes to be tested and also allow for a more efficient research protocol.

Purpose of the Study

The purpose of this study is to examine the accuracy of self-reported height and weights of NCAA Division I athletes. This data was obtained by comparing self-reported data from an online survey and physically measured height and weight recorded by a research team member.

Research Hypotheses

Based on previous literature regarding the accuracy of self-reported height and weight, the researchers hypothesized that:

1. Similar to the general population, athletes will tend to overreport height, underreport weight, and underreport BMI.
2. Athletes will be able to accurately report their height, weight, and BMI.

Definition of Terms

1. Anthropometric Data: the size and proportion of a person. For this study, height, weight, and BMI are the specific anthropometric values referred to.

Limitations

1. There was a small sample size for the athlete sample of this study. Fifty-seven Division I athletes from Eastern Michigan University were studied. This is a smaller percentage of the total athlete population than what was hoped for. Athletes and coaches have very busy schedules and the focus of the methodology

was on accommodating them. However, many coaches and athletes chose not to participate in the study.

2. The aim of this study was to simulate an experience where the participants answered a questionnaire "online" via their phone, although they would answer it while in the same area as the research team. Deception was attempted to prevent participants from knowing they would be immediately measured after. However, some participants inferred that they would get their physical measurements completed immediately after the survey. This may or may not have had an effect on the possible estimation bias.
3. Due to the timing of the study, athletes were studied during many points of the season: pre-season, off-season, and competition season. Researchers likely only use data from the competition season.

Chapter 2

Review of Related Literature

Many previous studies have tested the validity of survey reported height and weight with many different populations. The overall goals of the twenty-eight reviewed articles or webpages were to evaluate any potential discrepancies in self-reported height and weight values or to provide additional background information about the national surveys. This review of literature will be divided into the following sections: (1) Methodological Considerations, (2) General Trends of Self-Reported Height and Weight, (3) Gender Bias of Self-Reported Height and Weight, (4) Estimation Bias Based on Body Size, (5) Physically Active Self-Reporting Accuracy, and finally, (6) Summary.

Methodological Considerations

The method that data was collected varied between studies. The general methodology was asking participants to report their height and weight in a questionnaire. Following the questionnaire, the researchers would physically measure their height and weight. After data collection, the self-reported values were compared to the measured values and discrepancies were noted.

Ten studies specifically looked at the potential self-reporting error when the participant completed the survey in person. Seven of the studies that were reviewed used a previously completed national survey and in-person collected data. Four studies examined the potential estimation bias when the survey was done online or by another distant method.

Another factor that was specifically assessed during the literature review was how long the physical measurements came after completion of the survey. This is important to be aware of because weight can fluctuate on a day-to-day basis. If the survey was reported on a different day or time from the physical measurements, there may be incidental discrepancies between the self-reported weight versus the measured weight. Of the studies reviewed, nine research articles had the survey and physical measurements completed on the same day. An additional two studies had the physical measurements taken less than one week from the survey date. Three papers had the height and weight measured over one week, but no more than one month after the survey date. Two papers had the measurements completed between one-two months after the survey. The Adventist Health Survey-2 completed physical measurements over two months, but less than a year, after the initial survey was completed. Two papers did not mention the time frame between survey completion and physical height and weight measurements. In addition to the above summary, Gunnare, Silliman, & Morris (2013) looked at three Australian national surveys in their paper. For one national survey, there were two-three weeks in between the survey and the physical measurements. The other two surveys had physical measurements completed on the same day. Despite the variability between studies of physical measurement timing, no one has discussed its potential impact on the accuracy of self-reported height and weight.

Six studies specifically mentioned that they used deception in order to assure the participants were not aware that their height and weight were going to be verified following the survey. The remaining studies did not mention if their participants were made aware or not aware of the imminent physical measurements. There have not been any studies to determine whether or not deception affects the accuracy of reporting.

The reviewed literature used many statistical tests to analyze the accuracy of self-reported height and weight. The most common statistic was mean difference. T-tests were used to test for significance between self-reported height and weight and measured height and weight. Percent difference and absolute difference were also descriptive statistics that were used, but not as commonly as mean difference. Percent height/weight difference was found by taking the difference in self-reporting and measured data, then dividing it by the measured data. This statistic considers the size of the subject. Absolute difference was used to compare overreporting values and underreporting values. The aforementioned tests were often used with Spearman correlation coefficients, Pearson correlation coefficients, and Bland-Altman plots to analyze the agreement or disagreement between the two variables. These statistical tests were used within different classifications of participants. For example, participants were frequently classified into the following BMI groups: underweight (BMI < 20 kg/m^2), normal weight (BMI between 20-24.9 kg/m^2), overweight (BMI between 25-29.9 kg/m^2), and obese (BMI > 30 kg/m^2). Some studies also classified subjects into groups of physical activity levels, race, frequency of weight, and socioeconomic status, along with many more groups. The mean difference, percent difference, and absolute difference were often done within every classification. Multivariate linear regression was also commonly used in order to see which variables were a greater predictor of discrepancies between reported and measured data.

Overall, the previous literature regarding the accuracy of self-reported height and weight has great diversity in its methodology. There have been studies that specifically looked at different ages, regions of the world, past medical history, and many other characteristics. However, there have been few studies that have analyzed this relationship with athletes or with people that are physically active. Information about athlete self-reporting validity is important for sport governing bodies that collect data distantly.

General Trends of Self-Reported Height and Weight

Bes-Rastrollo, Sabaté, Jaceldo-Siegl, and Fraser (2011) analyzed the validity of self-reported height and weight data from the Adventist Health Study 2 (AHS-2). The primary objective of the AHS-2 study was to assess the role of diet to the risk of cancer. The population of this survey is Seventh-Day Adventist Church members that are above the age of 30. This includes people that are in all 50 states and Canada. The questionnaire contains information about diet and physical activity. Following the survey, 950 of the survey participants took part in an in-person calibration study to validate the self-reported data. This visit included physical measurements and occurred over two months after the completion of the survey (Butler et al., 2008). Bes-Rastrollo et al. (2011) selected 911 participants from the calibration study. For the general population, they found that people tended to overestimate height. In short, people reported they were taller on the survey than they were actually measured to be. They also found that people will generally underreport their weight on the survey. The mean difference in self-reported height and measured height was 1.66 cm. This value was adjusted for time-lag between the survey and physical measurements, race, sex, and age. The mean difference in self-reported weight and measured weight was -0.31 kg in the general population, adjusted for time-lag, race, sex, and age. Body mass and Body Mass Index (BMI) are directly proportional. While height and BMI are indirectly proportional. The underestimation of weight and overestimation of height lead to an overall underestimation of BMI, which was found to be -0.64 kg/m^2. The authors of this paper believe that these estimation biases are minimal, and that their results show that the self-reported anthropometric values are valid (Bes-Rastrollo et al., 2011).

Gunnare, Silliman, and Morris (2013) was another group of researchers that studied the accuracy of self-reported height and weight. The survey provided contained questions about height, weight, demographic information, frequency of weighing, physical activity, and body dissatisfaction. This study contained 323 participants, all of which were college students. Gunnare et al. (2013) found that the participants generally overestimated their height and underestimated their weight. Specifically, the general population was found to overreport their height by a mean difference 1.28 cm, while weight was underreported by a mean difference of -1.6 kg. These discrepancies lead to an overall underreporting of BMI that is -0.9 kg/m^2. Gunnare et al. (2013) also calculated the percent weight difference to account for different sized people. The mean percent weight difference was -1.9% for the entire study population. Mean percent height difference was not calculated.

Overall studies of large populations with diversity across body sizes and gender find that people will generally self-report a greater height than what they are actually measured. People will also tend to have a lower self-reported weight than measured weight (Bes-Rastrollo et al., 2013; Gunnare et al., 2013). Both of these biases lead to an underestimation of BMI. Trends found in a general population are helpful but taking a closer look at individual groups of people also helps identify potential self-reporting errors.

Gender Bias of Self-Reported Height and Weight

The Civilian American and European Surface Anthropometric Report (CAESAR) project was analyzed by Krul, Daanen, and Choi (2010). This project surveyed 4,459 people from the United States, Netherlands, and Italy in the early 2000s. The participants first completed a survey about gender, age, stature, and weight. In the same day, the participants wore special clothing and had their height and weight measured (Robinette et al., 2002; Krul, Daanen, & Choi, 2010). Krul et al. (2010) found that men had a greater overreporting of height compared to women. Men overreported their height by a mean difference of 1.7 cm, while women overreported their height by a mean difference of 1.2 cm. However, the 0.5 cm difference in overreporting of height could be due to men being naturally taller than women, as a result, there is more room for error. Krul et al. (2010) also found that women underestimated their weight more than men did. Women underreported their weight by a mean difference of -1.05 kg and men by -0.41 kg. The combination of men overestimating their height and women underestimating their weight lead to a nearly identical underestimation of BMI, -0.61 kg/m^2 for men and -0.71 kg/m^2 for women (Krul et al., 2010). While both men and women followed the same trends in self-reporting bias, they were at different gravities.

Merrill and Richardson (2009) studied the validity of self-reported height and weight by analyzing data from National Health and Nutrition Survey (NHANES) 2001-2006. The NHANES is used to assess health and nutritional status of people in the United States. This survey contains a diverse sample across all of the United States. All participants are above the age of 16 (Curtin et al., 2012). The NHANES contains questions regarding demographic, socioeconomic, dietary, health-related information, and anthropometric data. The physical examination contains medical, dental, and physiological measures (Centers for Disease Control and Prevention, 2017). The survey and physical measurements were completed on the same day (Curtin et al., 2012). Merrill and Richardson (2009) analyzed a sample of 8,208 men and 8,606 women. They found that both men and women significantly overestimated their height. Men overestimated their height by a mean difference of 1.22 cm, while women overreported their height by a mean difference of 0.68 cm. However, men and women tended to have different results when self-reporting their weight. Women were found to underreport their weight by -1.39 kg. Interestingly, against previously discovered trends, men were found to overreport their weight by a mean difference of 0.30 kilograms (Merrill & Richardson, 2009). The results from this study somewhat contradict the results of the Krul et al. (2010) study that was associated with underreported weight among men.

Larson (2000) studied the effect of social desirability on self-reported height and weight. They did so by screening 56 volunteers over the phone about their current height and weight. Within one week, the participants would be met in person for physical measurements and additional surveys regarding social desirability. This study found that women underreported their weight. This was found by regression with actual weight of the participant, $r = 0.66$. There was no statistical significance with self-reported weight of men, $r = 0.03$. On the other hand, there was no statistical significance with overreporting of height by either gender (Larson, 2000). The results of this study differed from both of the previously mentioned studies that specifically looked at gender.

Overall, the main trend when studying the effect of gender bias is that women had a greater underreporting of their weight. This was seen in the three aforementioned studies (Merrill & Richardson, 2009; Krul et al., 2010; Larson, 2000). However, there were diverse results when investigating the accuracy of men self-reporting weight. Krul et al. (2010) found that men underestimate their weight, but still to a lesser extent than women. Merrill and Richardson (2009) found that a large population of men overreport their weight on average. And finally, Larson (2000) found that there was no statistical significance in self-reported weight of men, overreport or underreport. Both Merrill and Richardson (2009) and Krul et al. (2010) found that both men and women overestimated their height, with men being to a greater extent. However, Larson (2000) found no relation with gender and overreporting of height.

Estimation Bias Based on Body Size

Hayes, Clarke, and Yung (2011) examined self-reported height and weight estimation bias by analyzing data from the National Nutrition Survey (NNS) in 1995 and data from the National Health Survey (NHS) in both 1995 and 2008. Both surveys contained a population of Australian adults over 20 years old. Similar to the previous national surveys, the goals of both of these surveys were to assess demographic, lifestyle factors, and socioeconomic factors on health risks (Australian Bureau of Statistics, 2011). Physical measurements from the 1995 NNS and 2007-2008 NHS were taken within 24 hours of the initial survey. The physical measurements from the 1995 NHS were taken 2-3 weeks following the survey (Hayes, Clarke, & Lung, 2011). Previously discussed literature found that there are general trends of underreporting weight and overreporting height. Hayes et al. (2011) found that in both 1995 and 2008, the underreporting error of weight was directly proportional to the subject's body size. As body mass increased, there was greater underreporting of weight. Participants that were underweight, a BMI of less than 18.4 kg/m^2, had the most accurate weight self-report. This was significant for both men and women. For height, all individuals tended to overreport their height. Shorter men had the greatest error in self-reporting height. The men in the tallest group had the most accurate self-reported height. Shorter women were also more inaccurate than taller women, but this relationship was not as extreme as it was for males (Hayes et al., 2011). Another interesting note is that Hayes et al. (2011) stated the accuracy of self-reporting height and weight has improved from 1995 to 2008.

Spencer, Appleby, Davey and Key (2001) investigated the validity of self-reported height and weight in middle aged men and women in England. The total population of this study was 5,140. Surveys that contained questions regarding current height, weight, diet, and lifestyle factors were distributed to participants. Then, physical measurements were then taken 2-3 weeks following completion of the survey (Spencer et al., 2001). The results of this study also show a self-reporting trend towards the lightest weight and tallest height. This bias is greater in individuals that are the heaviest or shortest. For example, men that were in the lightest weight quartile underreported their weight by a mean difference of -0.86 kg. The next heaviest quartile underreported their weight by a mean difference of -1.69 kg. The second heaviest quartile of men underreported their weight by a mean difference of -2.06 kg. Finally, the heaviest quartile of men underreported their weight by a mean difference of -2.86 kg (Spencer et al., 2001). There was a similar trend witnessed for women. The lightest quartile of women underreported their weight by a mean difference -0.66 kg. The next quartile underreported their weight by a mean difference of -1.19. Following up, the next heaviest quartile underreported their weight by a mean difference of -1.61 kg. Finally, the heaviest quartile of women underreported their weight by a mean difference of -2.23 (Spencer et al., 2001). So, there was a notable trend of increased underreporting weight error as the participants got larger. With increased weight, there is more room for error, which could be the cause of the greater underreporting as individual weight increases. There was not a definitive bias trend seen with self-reported height and measured height in this study. The shortest quartile of men overreported their height by a mean difference of 1.82 cm, which was the greatest of all quartiles. However, the next two quartiles do not follow a pattern of decreased overestimation. The mean differences were 1.05 cm overestimation for the second shortest quartile and 1.25 overestimation for the second tallest quartile. The fourth and tallest quartile overreported their height by a mean difference of 0.53 cm. So, the tallest quartile of men was the most accurate, but they still overreported their height. For women, the shortest quartile overreported their height by a mean difference of 0.82 cm. This was the greatest overreporting of all quartiles, but only by 0.2 cm over the most accurate quartile. Thus, there were no significant patterns in regard to overreporting of height in women (Spencer et al., 2001). For both genders, the shortest quartile tended to have the most inaccurate self-reported height. This could be due to desirability to be taller. Also, the average height individuals do not follow a distinguishable trend in self-reported height.

Research by Stommel and Schoenborn (2009) also evaluated the accuracy of self-reported BMI values. Along with Merrill and Richardson (2009), they used the NHANES data from 2001-2006. The methods and purpose for NHANES was discussed above. To review, the NHANES contains questions regarding demographic, socioeconomic, dietary, health-related information, and anthropometric data (Centers for Disease Control and Prevention, 2017). The survey and physical measurements were completed on the same day (Curtin et al., 2012). Stommel and Schoenborn (2009) also found the previously identified trends of overreporting of height and underreporting of weight. Stommel and Schoenborn (2009) found that non-average subjects tended to report their weight towards the average persons. Individuals who were under 25 kg/m^2 overreported their weight, and individuals who were above 25 kg/m^2 underreported their weight. More specifically, participants who are underweight (below 18.5 kg/m^2) overreported their weight by 2.14 kg. Participants who are considered normal weight (18.5 kg/m^2-24.9 kg/m^2) overreported their weight by 0.53 kg. On the other hand, individuals who are considered overweight (25 kg/m^2-29.9 kg/m^2) happened to underreport their weight by -0.60 kg. Obese individuals (30 kg/m^2-34.9 kg/m^2) underreported their weight by a greater margin, -2.02 kg. Finally, extremely obese individuals (over 35 kg/m^2) had the greatest underreporting of weight, -4.31 kg (Stommel and Schoenborn, 2009). To summarize, the individuals that were considered underweight or obese happened to self-report weight that regressed towards the average person's weight. This was most significant the further someone was away from average. In addition, Stommel and Schoenborn (2009) did not have any significant findings regarding the self-reported height and its relationship with individual height.

The aforementioned studies all found data that showed people will tend to underreport their weight and overreport their height. The extent of the self-reporting error was different between height and weight classifications. Hayes et al. (2011), Spencer et al. (2001), and Stommel and Schoenborn (2009) all found that overweight or obese individuals will often underreport their weight more drastically than the general population. This underreporting of weight was proved to be more significant as actual weight increased (Spencer et al., 2001; Stommel & Schoenborn, 2009). However, there were contradictions when studying individuals that were underweight. Spencer et al. (2001) found that lighter participants still underreported their weight, but not to the degree of heavier individuals. On the other hand, Stommel and Schoenborn (2009) found that underweight participants actually overreport their weight. In regard to height, Hayes et al. (2011) and Spencer et al. (2001) found that taller males were more accurate in reporting height than shorter males. There were no other relationships found with accuracy of self-reported height.

Physically Active Self-Reporting Accuracy

To this point, there have been few studies that look at the potential estimation bias that athletes or physically active individuals may have when they complete a self-reported height and weight survey. Knecthle et al. (2012) researched this potential estimation bias in 1,618 endurance athletes that competed in swimming, cycling, running, triathlon, and inline skating. On competition day, participants completed a questionnaire about their estimated height and weight. This was immediately followed by physical measurements. The study does not mention if participants were made aware of their height and weight being measured following the survey. Similar to the aforementioned studies, Knechtle et al. (2012) found overreporting of height and underreporting of weight. For body mass, both athletic men and women were found to underreport their weight by a mean difference of -0.9 kg. The previously discussed studies said that women underreported their weight by a mean difference of -1.39 kg and -1.05 kg (Merrill & Richardson, 2009; Krul et al., 2010), respectively. Therefore, Knecthle et al. (2012) found that athletic women were found to have a more accurate reporting of weight when compared to Merrill and Richardson (2009), which was statistically significant by a two-sample t-test. But when compared to the results from Krul et al. (2010), athletic women were not statistically more accurate in reporting weight than the general population. As for men, Merrill and Richardson (2009) found a mean difference overreporting of 0.3 kg and Krul et al. (2010) found that men underreport their weight by a mean difference -0.41 kg. Knechtle et al. (2012) found men underreported their weight by a mean difference of -0.9 kg. Therefore, athletic men were actually more inaccurate in reporting weight than men in a general population. This was statistically significant for both studies by a two-sample t-test. Knechtle et al. (2012) also found that height was overreported by a mean difference of 0.3 cm for men and 0.5 cm for women. Merrill and Richardson (2009) found that men overreported their height by a mean difference of 1.22 cm and women by a mean difference of 0.68 cm. Krul et al. (2010) discovered men overreported their height by a mean difference of 1.7 cm and women overreported their height by a mean difference of 1.2 cm. Therefore, Knechtle et al. (2012) found that both athletic men and women are significantly more accurate when reporting their height compared to the general population, which was proved statistically with two-sample t-tests. Overall, women athletes were slightly more accurate in reporting their weight on a survey. On the other hand, men were less accurate in self-reporting their weight. Both genders of athletes were more accurate at reporting their height on a survey.

Gunnare et al. (2013) specifically questioned the relationship between amount of physical activity and accuracy of self-reported height and weight. This study was previously mentioned above. To review, the survey contained questions about height, weight, demographic information, frequency of weighing, and physical activity. Specifically, the survey questioned how frequently the subjects completed a 30-minute session of physical activity or exercise per week. Gunnare et al. (2013) analyzed regression and predictor variables that lead to inaccurate self-reported BMI. More frequent physical activity was associated with a greater underreporting of weight. This was significant for mean difference, percent weight difference, and absolute weight difference (Gunnare et al., 2013).

Villanueva (2001) was another study that specifically looked at the effects of physical activity on the accuracy of self-reported height and weight. This was done by retrieving data from NHANES. To review, the NHANES contains questions regarding demographic, socioeconomic, dietary, health-related information, and anthropometric data. The survey and physical measurements were completed on the same day (Curtin et al., 2012). Villanueva (2001) used logistical regression to evaluate for the common causes of misreported height and weight. Villanueva (2001) found that women who were physically active were more likely to overreport their weight than less physically active women. This relationship was not evaluated for men. The findings from Villanueva (2001) contrast the results from the aforementioned study Gunnare et al. (2013), where physical activity was associated with underreporting error.

Additional studies have investigated the effect of physical activity on the accuracy of self-reported height and weight. Bes-Rastrollo et al. (2011) was discussed above in the section regarding trends in the general population. To review, the Adventist Health Study 2 (AHS-2) was used in this study. This survey had a calibration study that took physical measurements over two months after the initial survey was dispersed. One section of the national survey AHS-2 contained questions regarding volume of physical activity. Participants would either be classified as low, medium, or high-volume physical activity. The low physical activity classification was used as a reference. Bes-Rastrollo et al. (2011) found that participants with medium or high physical activity levels did not significantly underreport or overreport their weight compared to the low physical activity classification. So, Bes-Rastrolla et al. (2011) did not have any significant findings regarding the relationship of physical activity to the accuracy of self-reported height and weight.

The primary goal of this paper is to investigate the accuracy of self-reported height and weight of athletes and physically active people. Knechtle et al. (2012) previously investigated the accuracy of self-reported height and weight of endurance athletes. Overall, they found that athletes are more accurate than the general population when reporting height. Athletic women were also more accurate in reporting weight, but athletic men were actually more inaccurate in reporting weight when compared to the general population (Knechtle et al., 2012). There were multiple studies that investigated the relationship between physical activity and the accuracy of self-reported weight. Gunnare et al. (2013) found that more physical activity actually leads to greater underreporting of weight in both genders. Villanueva (2001) discovered physically active women were more likely to overreport their weight than non-active individuals. And finally, Bes-Rastrollo (2011) did not find any significant relationship between physical activity and accuracy of self-reported weight. In conclusion, increased physical activity has multiple contrasting findings, and a definitive relationship cannot be determined.

Summary

The accuracy of self-reported height and weight has been thoroughly researched for multiple diverse groups of people with a variety of different methods. Regardless of the population studied or method of survey delivery, many of the papers had similar trends. The widespread finding was that a sample of people were more likely to underreport weight and overreport their height. Women were found to be more likely to underreport their weight or more drastically underreport their weight than men. Heavier individuals were found to have the greatest weight underestimation bias of all sizes. Shorter individuals tended to overestimate their height more drastically than average or tall individuals. Finally, athletic and physically active individuals were found to report their height more accurately than the general population, but the accuracy of self-reported weight was largely inconclusive.

This study will aim to conclude if Division I athletes can accurately report their height and weight. It will also aim to find a more conclusive relationship between physical activity in non-athletes and accuracy of self-reported height and weight. No previous studies have investigated how non-endurance athletes reported their height and weight. There were also few previous studies that asked participants to report their height and weight remotely, whether that is over the phone or via the Internet. These issues will be addressed in this paper.

Chapter 3

Research Design and Methodology

Participants

Ninety-seven participants were included in this study. It was composed of individuals from Eastern Michigan University's (EMU) Division I athletic teams and non-athlete students. The participant characteristics can be found in Table 1 below. The researchers coordinated meetings with athletes through coaches and athletic trainers of the teams. The athletes were notified that participation was completely optional and they would not be punished for not participating in our study. In addition, non-athletes were recruited to the Eastern Michigan University Running Laboratory through EMU faculty. Immediately before the survey, participants would read and sign an informed consent. This study was approved by EMU's Institutional Review Board.

Table 1: Characteristics of study participants. Note: some participants are counted multiple times (i.e., a male sprinter is included in the "Men's Sprint/Jump/Hurdle", "Men's Track and Field Total", and "Men's and Women's S/J/H" groups).

Sport	n
Rowing	19
Men's Sprint/Jump/Hurdle	9
Men's Cross Country	8
Men's Throws	2
Men's Track and Field Total	17
Women's Sprint/Jump/Hurdle	8
Women's Cross Country	8
Women's Track and Field Total	16
Men's and Women's S/J/H	17
Men's and Women's Cross Country	16
Volleyball	3
Non-athlete Female	20
Non-athlete Male	20

Procedures

All athletes were met during one of their practice sessions. Non-athletes were met at the EMU Running Laboratory at a scheduled time. Prior to data collection, the participants were debriefed of the general study protocol. If they chose to participate in the study, they were provided a QR code that would allow them to take a survey on their phone. The first page of the survey contained an informed consent page that was required to sign before proceeding. The survey consisted of questions regarding current height, weight, frequency of measurements, and current physical activity levels. Following completion of the survey, participants were asked if their height and weight could be physically measured. Subjects were not made aware that they were going to get physically measured following the survey. For both measurements, participants were in light sportswear without shoes. Height was measured in centimeters using a Shorrboard® Adult and Pediatric Measuring Board. Weight was measured in kilograms using a Tanita BWB-800 scale. Height was measured twice to the nearest 0.1 cm, and if values were not within 0.5 cm, a third height measurement was completed. The average of the 2-3 values would be used for data analysis. Weight was measured twice to the nearest 0.1 kg for all participants. The average was used for data analysis. The visit was complete after both height and weight measurements were taken. Total time for the participant to complete this study was approximately 10 minutes.

Survey

The survey used in this study contained 12 questions, but some questions were not answered depending on the participant's athlete status. Every participant reported their current weight and the last time they had their weight measured. This was followed up by identical questions regarding height. After this, participants were separated into two groups: athletes and non-athletes. Athletes reported the sport they participate in and the number of years they have participated in the sport. That concluded the athlete portion of the survey. Non-athletes reported the total number of days they exercise, followed by the average length of an exercise session.

Validity Trial

There were three researchers that took physical measurements of the participants. It was necessary to verify that these three researchers were able to produce similar values when measuring height. In order to assess this reliability between the researchers, a small sample of 10 participants from a single exercise physiology class volunteered to participate in an objectivity trial. Participants were assigned to a participant number and completed an informed consent form. The three members of the research team measured the height of all 10 participants. The height data collected from each researcher were compared to one another to assure reporting validity and establish objectivity. Pearson correlations were found to be 0.935 or above between all researchers.

Statistical Analysis

Descriptive statistics of self-reported height and weight, and measured height and weight of participants were determined as mean and standard deviation. The self-reported and measured values were used to calculate self-reported BMI and measured BMI values. BMI is the subject's weight in kilograms divided by the square of the subject's height in meters. Paired sample t-tests were used to determine differences between the self-reported and measured height, weight, and BMI values. Percent error was also calculated to account for different body sizes. Consistent with much of the research conducted on this topic, Spearman's Correlation coefficients were used to evaluate the relationship between self-reported and measured values for all height, weight, and BMI. An alpha level of 0.05 was used to determine significance for all statistical tests.

Z-scores were calculated for the difference between self-reported and measured values. The z-score is the number of standard deviations a score is away from the mean [z=(x - mean)/SD]. Z-scores less than -3 or greater than 3 were considered outliers for this study. The data from two participants in the athlete group were excluded from the data set on the basis of the outlier criteria. Two participants were also excluded from the non-athlete group.

The statistical tests were run multiple times for both athletes and non-athletes. The athlete group was divided by gender, body size, and the sport team the participant was a part of. In addition, the Men and Women Cross Country runners, and the Men and Women Sprinters/Jumpers/Hurdlers were combined for their own respective groups. The non-athlete group was divided by gender, body size, and physical activity. Body size was based on the measured BMI. The categories were as followed: Underweight (<18.5 kg/m^2), Normal (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2), and Obese (>30.0 kg/m^2) (Riebe, Ehrman, Liguori, & Magal, 2018). The physical activity variable was based on the ACSM-AHA Primary Physical Activity Recommendations. Adults should participate in moderate-vigorous physical activity for 150 minutes per week (Riebe et al., 2018). Therefore, the groups were classified as "Active" if they exercised for 150 minutes or more, “Somewhat Active” if they exercised between 60 and 150 minutes, and “Sedentary” if they exercised for less than 60 minutes per week.

Chapter 4

Results

The descriptive statistics for height, weight, and Body Mass Index (BMI) self-reported by athletes and measured by researchers are shown in Tables 2, 3, and 4. There were 57 total athlete participants before outliers were excluded. The mean percent error for the entire athlete group was 1.0% (*s*=0.6%) for self-reported height, 2.0% (*s*=1.8%) for self-reported weight, and 3.0% (*s*=2.3%) for self-reported BMI. Self-reported height (174.7 ± 9.7 cm) was significantly greater than measured height (173.6 ± 9.5 cm) (t=4.564, p=0.0010). Self-reported weight (73.1 ± 14.2 kg) was significantly less than measured weight (73.8 ± 13.9 kg) (t=2.82, p=0.0070). Self-reported BMI (23.7 ± 3.4 kg/m^2) was significantly less than measured BMI (24.2 ± 3.54 kg/m^2) (t=5.32, p<0.0001). Spearman's correlation coefficients were also calculated for height, weight, and Body Mass Index, and are shown in Figures 1, 2, and 3.

Table 2**:** Height comparison between data reported by different sports and data measured by researchers. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Sport	n	Self-Reported Height (cm)	Measured Height (cm)	Difference (cm)	Percent Error	p
Total Athletes	56	174.7 ± 9.7	173.6 ± 9.5	1.1 ± 1.7	1.0% ± 0.6%	<0.0001
Rowing	18	173.6 ± 8.3	172.5 ± 7.6	1.1 ± 2.2	1.2% ± 0.7%	0.0542
Men's Track and Field	19	182.7 ± 5.3	181.8 ± 5.5	0.9 ± 1.4	0.7% ± 0.5%	0.0126
Women's Track and Field	16	165.6 ± 7.0	164.6 ± 6.9	1.0 ± 1.7	0.6% ± 1.0%	0.0247
Sprint/Jumps/Hurdles (M/W)	17	174.3 ± 10.8	173.3 ± 10.8	1.0 ± 1.5	0.9% ± 0.5%	0.0242
Distance (M/W)	16	173.7 ± 9.8	172.8 ± 10.0	0.9 ± 1.4	0.5% ± 0.8%	0.0273

Table 3**:** Weight comparison between data reported by different sports and data measured by researchers. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Sport	n	Self-Reported Weight (kg)	Measured Weight (kg)	Difference (kg)	Percent Error	p
Total Athletes	56	73.1 ± 14.2	73.8 ± 13.9	-0.7 ± 1.7	2.0% ± 1.8%	0.0066
Rowing	18	78.8 ± 11.6	78.7 ± 11.2	0.1 ± 1.7	1.7% ± 1.5%	0.8093
Men's Track and Field	19	78.2 ± 14.3	78.9 ± 14.1	-0.7 ± 1.4	1.6% ± 1.0%	0.0385
Women's Track and Field	16	59.8 ± 8.1	61.1 ± 8.9	-1.3 ± 2.0	2.8% ± 2.5%	0.0142
Sprint/Jumps/Hurdles (M/W)	17	70.8 ± 11.2	71.9 ± 11.1	-1.1 ± 1.7	2.2% ± 1.9%	0.0140
Distance (M/W)	16	63.4 ± 9.5	64.4 ± 10.4	-1.0 ± 1.6	2.1% ± 1.8%	0.0231

Table 4**:** BMI comparison between data reported by different sports and data measured by researchers. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Sport	n	Self-Reported BMI (kg/m^2)	Measured BMI (kg/m^2)	Difference (kg/m^2)	Percent Error	p
Total Athletes	55	23.7 ± 3.4	24.2 ± 3.5	-0.5 ± 0.8	3.0% ± 2.3%	<0.0001
Rowing	17	25.7 ± 3.4	26.0 ± 3.6	-0.3 ± 0.8	2.8% ± 1.7%	0.1153
Men's Track and Field	19	23.4 ± 3.6	23.8 ± 3.6	-0.4 ± 0.5	2.1% ± 1.7%	0.0008
Women's Track and Field	16	21.8 ± 2.4	22.6 ± 2.9	-0.8 ± 0.9	4.2% ± 3.1%	0.0038
Sprint/Jumps/Hurdles (M/W)	17	22.9 ± 1.9	23.6 ± 1.8	-0.7 ± 0.7	3.0% ± 2.6%	0.0005
Distance (M/W)	16	21.0 ± 2.2	21.6 ± 2.7	-0.6 ± 0.8	3.4% ± 2.6%	0.0098

Figure 1**:** Scatterplot showing the correlation between self-reported height (y-axis) and measured (x-axis) height (cm). The Spearman's correlation coefficient was 0.979 ($p<0.0001$). Each data point represents one subject (n=56).

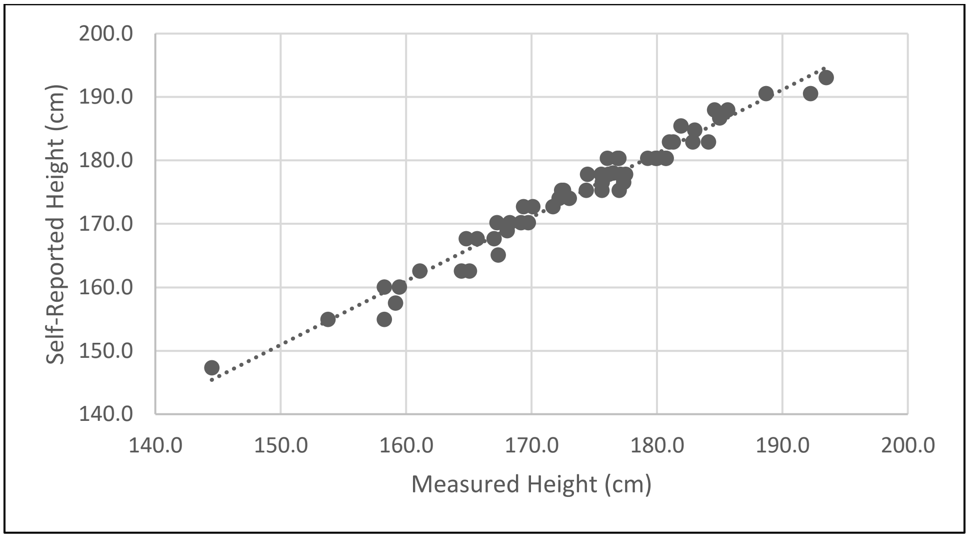


Figure 2**:** Scatterplot showing the correlation between self-reported weight (y-axis) and measured (x-axis) weight (kg). The Spearman's correlation coefficient was 0.989 ($p<0.0001$). Each data point represents one subject (n=56).

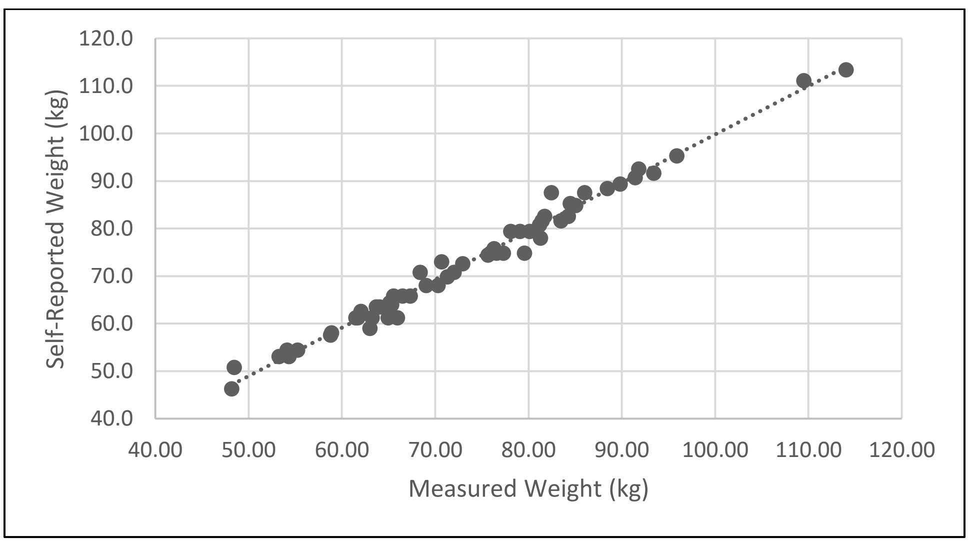
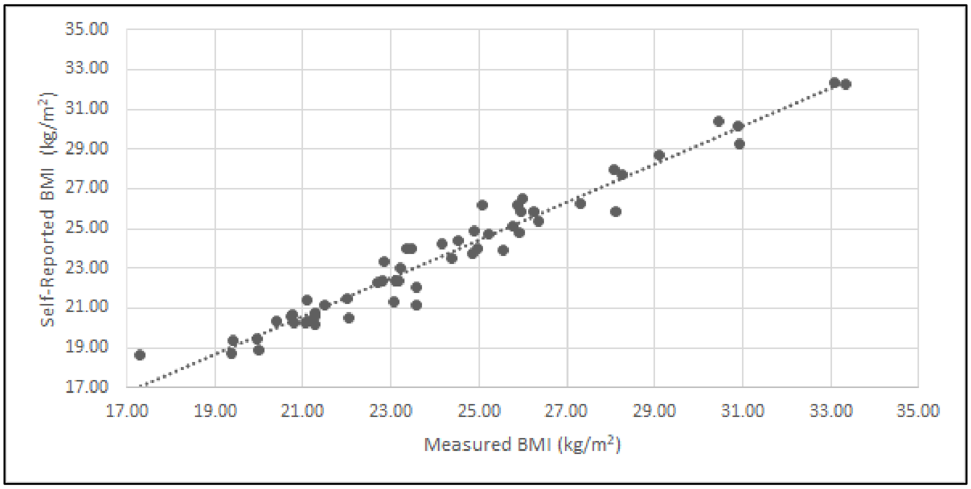


Figure 3**:** Scatterplot showing the correlation between self-reported BMI (y-axis) and measured (x-axis) BMI (kg/m^2). The Spearman's correlation coefficient was 0.965 (p<0.0001). Each data point represents one subject (n=55).



Gender Differences for Athletes

Gender was explored as a variable for self-reporting estimation bias. Male athletes were found to have a smaller mean difference between self-reported height and measured height than female athletes, although both genders overreported height significantly. The mean self-reported height for males was 182.7 ± 5.3 cm with an average measured height of 181.8 ± 5.5 cm. This led to a mean difference of 0.9 ± 1.4 cm (n=19, p=0.0126). Females had a mean self-reported height of 170.6 ± 9.0 cm and a measured height of 169.4 ± 8.4. This brought about a mean difference of 1.2 cm ± 1.9 (n=37, p=0.0008). The mean percent error for male athletes was 0.7% (*s*=0.5%), while female athletes had a mean percent error of 1.1% (*s*=0.6%).

Both genders were found to underreport their weight on the survey, but only the men's difference was statistically significant. Men had an average self-reported weight of 78.2 ± 14.3 kg and a mean measured weight of 78.9 ± 14.1 kg. This produced a -0.7 ± 1.4

kg mean difference (n=19, p=0.0385). Women athletes had a mean self-reported weight of 70.5 ± 13.6 kg and a measured weight of 71.1 ± 13.2 kg. This led to a mean difference of -0.6 ± 1.9 kg, which was not statistically significant (n=37, p=0.0518). The mean height percent error for male athletes was 1.6% (*s*=1.0%), while female athletes had a mean percent error of 2.1% (*s*=2.0%).

The overreporting of height and underreporting of weight lead to a greater underestimation of BMI for both genders. The underreporting of BMI was significant for both genders, but greater in females. Males had a self-reported BMI of 23.4 ± 3.6 kg/m^2 and a measured BMI of 23.8 ± 3.6 kg/m^2. This led to a mean difference of -0.4 ± 0.5 kg/m^2 (n=19, p=0.0008). Females had a self-reported BMI of 23.8 ± 3.4 kg/m^2 and a measured BMI of 24.4 ± 3.5 kg/m^2. This led to a mean difference of -0.6 ± 0.9 kg/m^2 (n=36, p=0.0002). The percent error for the BMI misreporting was also greater in females, at 3.5 ± 2.5%, with males being at 2.1 ± 1.7%.

Effect of Body Size on Athlete Reporting Error

Body size was also investigated as a variable of estimation bias. As mentioned above, the categories were based on measured BMI rather than self-reported BMI. The lightest category, under 18.5 kg/m^2, only had one participant. Therefore, this category was not investigated due to the small sample size. The remaining groups were Normal (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2), and Obese (over 30.0 kg/m^2).

All three groups significantly overreported their height. Athletes in the Normal category had a self-reported height of 173.6 ± 10.3 cm and a measured height of 172.7 ± 10.1 cm. This produced a mean difference of 0.9 ± 1.8 cm and a percent error of 1.0 ±

0.6% (n=34, p=0.0078). The Overweight category of athletes had a mean self-reported height of 177.2 ± 6.3 cm and a measured height of 175.9 ± 6.5 cm. This led to a mean difference of 1.3 ± 1.3 cm and a percent error of 0.8 ± 0.7% (n=15, p=0.0026). Finally, the Obese group had a self-reported height of 176.1 ± 13.5 and a measured height of 173.9 ± 13.6. This brought about a mean difference of 2.2 ± 1.7 cm and a percent error of 1.4 ± 0.8% (n=6, p=0.0260).

Only one of the three BMI classes significantly underreported weight. The Normal group had a mean self-reported weight of 65.6 ± 8.6 kg and a mean measured weight of 66.6 ± 8.6 kg. This led to a significant mean difference of -1.0 ± 1.4 kg, along with a percent error of 2.0 ± 1.6% (n=34, p=0.0003). The Overweight group was found to underreport their weight, but it was not statistically significant. That group's average self-reported weight was 81.9 ± 7.3 kg and the average measured weight was 82.2 ± 6.4. This produced a mean difference of -0.3 ± 2.2 kg and percent error of 2.0 ± 2.1% (n=16, p=0.5613). The Obese group was found to overreport their weight by a small margin of 0.1 ± 1.1 kg along with a percent error of 0.9 ± 0.4% (n=5, p=0.8837). This was statistically insignificant. The mean self-reported weight was 100.6 ± 10.8 kg and the mean measured weight was 100.5 ± 10.5 kg for this group.

All three BMI classifications significantly underreported their BMI. First off, the Normal BMI group had a calculated mean self-reported BMI of 21.7 ± 1.7 kg/m^2 in conjunction with a mean measured BMI of 22.3 ± 1.6 g/m^2. The mean difference was calculated to be -0.6 ± 0.7 kg/m^2 and the mean percent error was 3.0 ± 2.4% (n=34, $p<0.0001$). The Overweight BMI class had a mean underreporting of -0.5 ± 0.8 kg/m^2 with a mean percent error of 3.0 ± 2.1% (n=15, p=0.0289). The mean self-reported BMI for this group was 26.1 ± 1.3 kg/m^2 while the mean measured BMI was 26.6 ± 1.3 kg/m^2. Finally, the Obese BMI class significant had a mean calculated self-reported BMI of 30.9 ± 1.4 kg/m^2, along with a mean measured BMI of 31.7 ± 1.4 kg/m^2. Overall, this led to an underreporting mean of -0.9 ± 0.6 kg/m^2 and a mean percent error of 2.7 ± 1.9% (n=5, p=0.0311).

Non-Athlete Sample and the Comparison to Athletes

There were 40 participants in the non-athlete sample. The data from this sample was arranged by multiple variables, including gender, body size, and physical activity. The descriptive statistics by variable are shown in Tables 5, 6, and 7. The mean percent error for the entire non-athlete group was 0.9% (*s*=0.7%) for self-reported height, 1.9% (*s*=2.1%) for self-reported weight, and 2.6% (*s*=2.2%) for self-reported BMI. Self-reported height (173.3 ± 10.1 cm) was significantly greater than measured height (172.6 ± 9.3 cm) (t=2.21, p=0.0331). Self-reported weight (76.0 ± 21.0 kg) was not significantly different than measured weight (76.3 ± 20.7 kg) (t=0.93, p=0.3581). Self-reported BMI (25.2 ± 5.7 kg/m^2) was significantly less than measured BMI (25.5 ± 5.7 kg/m^2) (t=2.40, p=0.0215). Mean differences were compared between the total athlete sample and total non-athlete sample using independent sample t-tests. There were no significant differences between the athlete and non-athlete groups for height (t=1.01, p=0.3150), weight (t=-0.88, p=0.3832), and BMI (t=-1.41, p=0.1634).

Table 5: Height comparison between data reported by non-athletes and data measured by researchers. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Variable	n	Self-Reported Height (cm)	Measured Height (cm)	Difference (cm)	Percent Error	p
Total Non-athlete	39	173.3 ± 10.1	172.6 ± 9.3	0.7 ± 1.9	0.9 ± 0.7%	0.0331
Female	20	166.1 ± 5.4	166.3 ± 5.3	-0.2 ± 1.9	0.9 ± 0.7%	0.6729
Male	19	180.8 ± 8.1	179.2 ± 8.0	1.6 ± 1.5	0.9 ± 0.8%	0.0002
Normal	22	169.6 ± 9.4	169.5 ± 8.6	0.1 ± 2.1	0.9 ± 0.8%	0.9206
Overweight	11	179.8 ± 8.9	178.3 ± 8.8	1.5 ± 1.2	0.9 ± 0.7%	0.0030
Obese	5	176.5 ± 9.4	175.3 ± 8.9	1.2 ± 0.9	0.7 ± 0.5%	0.0425
Sedentary	8	167.2 ± 5.0	167.5 ± 4.4	-0.3 ± 1.7	0.8 ± 0.7%	0.5938
Somewhat Active	11	169.1 ± 11.4	168.6 ± 10.2	0.5 ± 1.8	0.8 ± 0.7%	0.3640
Active	19	178.6 ± 8.6	177.5 ± 8.3	1.1 ± 1.9	0.9 ± 0.8%	0.0260

Table 6: Weight comparison between data reported by non-athletes and data measured by researchers. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Variable	n	Self-Reported Weight (kg)	Measured Weight (kg)	Difference (kg)	Percent Error	p
Total Non-athlete	39	76.0 ± 21.0	76.3 ± 20.7	-0.3 ± 2.0	1.9 ± 2.1%	0.3581
Female	19	64.8 ± 9.6	65.4 ± 10.1	-0.6 ± 2.0	1.9 ± 2.4%	0.2105
Male	20	86.7 ± 23.4	86.7 ± 22.9	0.0 ± 1.5	1.9 ± 1.8%	0.9372
Normal	22	63.5 ± 6.8	63.9 ± 6.9	-0.4 ± 1.8	1.8 ± 2.2%	0.2692
Overweight	11	84.0 ± 10.3	84.3 ± 9.3	-0.3 ± 2.7	2.5 ± 2.3%	0.7290
Obese	5	116.0 ± 24.2	116.1± 23.3	-0.1 ± 1.9	1.3 ± 1.1%	0.9429
Sedentary	8	64.6 ± 6.1	64.5 ± 6.8	0.1 ± 1.3	1.5 ± 1.1%	0.7575
Somewhat Active	11	74.5 ± 24.4	75.1 ± 23.8	-0.6 ± 2.8	2.7 ± 2.9%	0.5129
Active	19	82.3 ± 21.8	82.7 ± 21.3	-0.4 ± 1.9	1.7 ± 1.8%	0.4038

Table 7: Body Mass Index comparison between data reported by non-athletes and data measured by researchers. The BMI values were calculated using the self-reported and measured values. The results of the paired sample t-tests are displayed by the p-value column. A p value less than 0.05 conveys statistical significance.

Variable	n	Self-Reported BMI (kg/m^2)	Measured BMI (kg/m^2)	Difference (kg/m^2)	Percent Error	p
Total Non-athlete	38	25.2 ± 5.7	25.5 ± 5.7	-0.3 ± 0.8	2.6 ± 2.2%	0.0215
Female	19	23.5 ± 3.6	23.6 ± 3.9	-0.1 ± 0.9	2.9 ± 2.3%	0.5385
Male	19	26.8 ± 6.9	27.3 ± 6.8	-0.5 ± 0.7	2.4 ± 2.1%	0.0043
Normal	22	22.1 ± 1.7	22.2 ± 1.4	-0.1 ± 0.8	2.8 ± 2.2%	0.4402
Overweight	11	25.9 ± 1.1	26.5 ± 1.1	-0.6 ± 0.8	2.8 ± 2.4%	0.5056
Obese	5	37.2 ± 6.7	37.7 ± 6.5	-0.5 ± 0.6	1.6 ± 1.4%	0.1060
Sedentary	8	23.2 ± 2.1	23.0 ± 2.3	0.2 ± 0.8	2.4 ± 2.1%	0.5876
Somewhat Active	11	25.8 ± 7.3	26.2 ± 7.4	-0.4 ± 0.9	2.8 ± 2.8%	0.1702
Active	19	25.6 ± 5.7	26.1 ± 5.7	-0.5 ± 0.7	2.7 ± 1.9%	0.0126

Male non-athletes were found to significantly overreport their height. This group had a self-reported height of 180.8 ± 8.1 cm and a measured height of 179.2 ± 8.0 cm. This led to a mean difference of 1.6 ± 1.5 cm and mean percent error of 0.9 ± 0.8% (n=19, p=0.0002). In the female non-athlete group, there was no significant difference between self-reported height (166.1 ± 5.4 cm) and measured height (166.3 ± 5.3 cm). This produced a mean difference of -0.2 ± 1.9 cm and mean percent error of 0.9 ± 0.7% (n=20, p=0.6729. There was not a significant difference between the height reporting errors of male athletes and male non-athletes (t=-1.56, p=0.1286). There was a significant difference between the height reporting error of female athletes and non-athletes (t=2.53, p=0.0143).

There was no significant difference between self-reported weight and measured weight for male or female non-athletes. Male non-athletes had a self-reported weight of 86.7 ± 23.4 kg and a measured weight of 65.4 ± 10.1 kg, which led to a mean difference of 0.0 ± 1.5 kg and a mean percent error of 1.9 ± 1.8% (n=20, p=0.9372). Female non-athletes had a self-reported weight of 64.8 ± 9.6 kg and measured weight of 65.4 ± 10.1 kg. This resulted in a mean difference of -0.6 ± 2.0 kg and mean percent error of 1.9 ± 2.4% (n=19, p=0.2105). There was not a significant difference in weight reporting error between male athletes and non-athletes (t=-1.13, p=0.2666) or female athletes and non-athletes (t=-0.07, p=0.9420).

Male non-athletes significantly underreported Body Mass Index. There was no significant difference between self-reported and measured BMI of female non-athletes. Male non-athletes had a self-reported BMI of 26.8 ± 6.9 kg/m^2 and a measured BMI of 27.3 ± 6.8 kg/m^2. This brought about a mean difference of -0.5 ± 0.7 kg/m^2 and a mean percent error of 2.4 ± 2.1% (n=19, p=0.0043). The female non-athletes had a self-reported BMI of 23.5 ± 3.6 kg/m^2 and a measured BMI of 23.6 ± 3.9 kg/m^2, which led to a mean difference of -0.1 ± kg/m^2 and mean percent error of 2.9 ± 2.3% (n=19, p=0.5385). There was not a significant difference in BMI reporting error between male athletes and non-athletes (t=0.28, t=0.7826) and female athletes and non-athletes (t=-1.9, p=0.0682).

Body size was also investigated for the non-athlete group. To review, the categories were based on measured BMI. The three groups for non-athletes were Normal (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2), and Obese (over 30.0 kg/m^2). The Normal group did not have a significant reporting error, while the Overweight and Obese groups both significantly overreported height. The Normal BMI group had a self-reported height of 169.6 ± 9.4 cm and measured height of 169.5 ± 2.1 cm, which led to a mean difference of 0.1 ± 2.1 cm and mean percent error of 0.9 ± 0.8% (n=22, p=0.9206). The

Overweight BMI group had a self-reported height of 179.8 ± 8.9 cm and a measured height of 178.3 ± 8.8 cm. This led to a significant mean difference of 1.5 ± 1.2 cm and mean percent error of 0.9 ± 0.7% (n=11, p=0.0030). Finally, the Obese BMI group had a self-reported height of 176.5 ± 9.4 cm and a measured height of 175.3 ± 8.9 cm. This led to a significant mean difference of 1.2 ± 0.9 cm and mean percent error of 0.7 ± 0.5% (n=5, p=0.0425). There was no significant difference in height reporting error between Normal (t=1.16, p=0.1261), Overweight (t=0.48, p=0.6329), or Obese (t=1.18, p=0.2665) athletes and non-athletes.

None of the three BMI groups had a significant difference between self-reported weight and measured weight. The Normal BMI group had a mean self-reported weight of 63.5 ± 6.8 kg and a mean measured weight of 63.9 ± 6.9 kg. This group had a mean difference of -0.1 ± 0.8 and mean percent error of 1.8 ± 2.2% (n=22, p=0.2692). The Overweight BMI group had a self-reported weight of 84.0 ± 10.3 kg and a measured weight of 84.3 ± 9.3 kg, which led to a mean difference of -0.6 ± 0.8 kg and mean percent error of 2.5 ± 2.3% (n=11, p=0.7290). Finally, the Obese BMI group had a self-reported weight of 116.0 ± 24.2 kg and a measured weight of 116.1 ± 23.3 kg. This group had a mean difference of -0.5 ± 0.6 kg and mean percent error of 1.3 ± 1.1% (n=5, p=0.9429). There was no significant difference in weight reporting error between Normal (t=-1.31 p=0.1951), Overweight (t=-0.08, p=0.9376), or Obese (t=-0.56, p=0.5748) athletes and non-athletes.

There were no significant differences in BMI reporting for any of the three BMI groups. The Normal BMI group had a mean self-reported BMI of 22.1 ± 1.7 kg/m^2 and a mean measured BMI of 22.2 ± 1.4 kg/m^2. This led to a mean difference of -0.1 ± 0.8

kg/m^2 and mean percent error of 2.8 ± 2.2 % (n=22, p=0.4402). The Overweight BMI group had a mean self-reported BMI of 25.9 ± 1.1 kg/m^2 and a mean measured BMI of 26.5 ± 1.1 kg/m^2, which resulted in a mean difference of -0.6 ± 0.8 kg/m^2 and mean percent error of 2.8 ± 2.4% (n=11, p=0.5056). The Obese BMI group had a mean self-reported BMI of 37.2 ± 6.7 kg/m^2 and a mean measured BMI of 37.7 ± 6.5 kg/m^2. This BMI group had a mean difference of -0.5 ± 0.6 kg/m^2 and mean percent error of 1.6 ± 1.4% (n=5, p=0.1060). There was a significant difference in BMI reporting error between the Normal BMI athletes and non-athletes (t=-2.10, p=0.0407). There was no significant difference in BMI reporting error between Overweight (t=0.89, p=0.9299) and Obese (t= -0.85, p=0.4205) athletes and non-athletes.

Physical activity was explored as a variable for self-reporting estimation bias for non-athletes. To review, the groups were classified as "Active" if they exercised for 150 minutes or more, "Somewhat Active" if they exercised between 60 and 150 minutes, and "Sedentary" if they exercised for less than 60 minutes per week. The Active group significantly overreported their height, while neither the Sedentary nor the Somewhat Active group had a significant difference between self-reported height and measured height. The Sedentary group had a mean self-reported height of 167.2 ± 5.0 cm and a mean measured height of 167.5 ± 4.4 cm. This group had a mean difference of -0.3 ± 1.7 cm and mean percent error of 0.8 ± 0.7% (n=8, p=0.5938). The Somewhat Active group had a mean self-reported height of 169.1 ± 11.4 cm and a mean measured height o 168.6 ± 10.2 cm. This brought about a mean difference of 0.5 ± 1.8 and mean percent error of 0.8 ± 0.7% (n=11, p=0.3640). Finally, the Active group had a mean self-reported height of 178.6 ± 8.6 cm and mean measured height of 177.5 ± 8.3 cm. This led to a statistically significant mean difference of 1.1 ± 1.9 cm and mean percent error of 0.9 ± 0.8% (n=19, p=0.0260). There was not a statistically significant difference between height reporting error of the Active group and the Athlete sample (t=-0.05, p=0.9626).

There was no significant difference in self-reported weight and measured weight for either of the three physical activity groups. The sedentary group had a mean self-reported weight of 64.6 ± 6.1 kg and mean measured weight of 64.5 ± 6.8 kg. These values led to a mean difference of 0.1 ± 1.3 kg and mean percent error of 1.5 ± 1.1% (n=8, p=0.7575). The Somewhat Active group had a mean self-reported weight of 74.5 ± 24.4 kg and mean measured weight of 75.1 ± 23.8, which led to a mean difference of -0.6 ± 2.8 kg and mean percent error of 2.7 ± 2.9% (n=11, p=0.5129). Finally, the Active group had a mean self-reported weight of 82.3 kg ± 21.8 kg and mean measured weight of 82.7 ± 21.3 kg. This group had a mean difference of -0.4 ± 1.9 kg and mean percent error of 1.7 ± 1.8% (n=19, p=0.4038). There was no significant difference between weight reporting errors of the Active group and the Athlete sample (t=-0.56, p=0.5748).

The Active group significantly underreported BMI, while neither the Sedentary nor the Somewhat Active group had a significant difference between self-reported BMI and measured BMI. The Sedentary group had a mean self-reported BMI of 23.2 ± 2.1 kg/m^2 and mean measured BMI of 23.0 ± 2.3 kg/m^2, which led to a mean difference of 0.2 ± 0.8 kg/m^2 and mean percent error of 2.4 ± 2.1% (n=8, p=0.5876). The Somewhat Active group had a mean self-reported BMI of 25.8 ± 7.3 kg/m^2 and mean measured BMI of 26.2 ± 7.4 kg/m^2. This group had a mean difference of -0.4 ± 0.9 kg/m^2 and mean percent error of 2.8 ± 2.8%. The Active group had a self-reported BMI of 25.6 ± 5.7 kg/m^2 and measured BMI of 26.1 ± 5.7 kg/m^2. This led to a significant mean difference of -0.5 ± 0.7 kg/m^2 and mean percent error of 2.7 ± 1.9% (n=19, p=0.0126). There was not a significant difference between the BMI reporting error of the Active group and the Athlete sample (t=-0.44, p=0.6628).

Chapter 5

Conclusion

Online reporting of anthropometric data can be a valuable method of data collection. It can allow for distant data collection and it can also increase efficiency. However, there must be evidence that this method of data collection is valid. There have been studies that examined the relationship between self-reported and measured anthropometric values of many different populations. However, the literature regarding self-reporting errors of collegiate athletes is limited. Therefore, the purpose of this study was to determine whether or not collegiate athletes could self-report accurate, unbiased height, weight, and Body Mass Index (BMI) values. The main findings of this study were that athletes reported a taller height than they were measured and a lower weight than they were measured. Consequently, the self-reported BMI values were lower than the measured BMI values.

There were many variables investigated as potential factors in self-reporting bias. One of the variables that was investigated was the self-reporting bias based on the sport the athlete participated in. As a whole, athletes were found to be relatively accurate when self-reporting height. The total athlete sample had a mean percent error of 1.0% and mean difference of 1.1 cm. This is consistent with the findings from Knechtle et al. (2012), which found that both men and women athletes significantly overreported their height. It was also consistent with the self-reporting errors of the general population found in Merrill and Richardson (2009) and Krul et al. (2010). Men's Track and Field, Women's Track and Field, the combined Men's and Women's Sprinters/Jumpers/Hurdlers, and combined Men's and Women's Distance were found to significantly overreport their height. The Rowing team did not have a significant difference between self-reported and measured height. Even though the Rowing group did not have a consistent overreporting or underreporting of height, they had the largest percent error at 1.2%. The Sprinters/Jumpers/Hurdlers and Women's Track and Field groups had the largest mean differences at 1.0 cm each. The Distance group had the most accurate self-reported height at a percent error of 0.5%.

The athletes in this sample consistently underreported weight. The total sample had a mean percent error of 2.0% and mean difference of -0.7 kg. This is consistent with the results from Knechtle et al. (2012) where they also found that athletes underreport their weight. It was also consistent with the self-reporting errors of the general population found in Merrill and Richardson (2009) and Krul et al. (2010). Men's Track and Field, Women's Track and Field, the combined Men's and Women's Sprinters/Jumpers/ Hurdlers, and combined Men's and Women's Distance were found to significantly underreport their weight. The Rowing team did not have a significant difference between self-reported and measured weight. Women's Track and Field had the largest weight reporting discrepancy at 2.8% and mean difference of -1.3 kg. Even though the Rowing team did not have a significant difference between self-reported and measured weight, the Men's Track and Field team had the smallest percent error at 1.6%.

The overestimation of height and underestimation of weight led to a greater underestimation of BMI for the total sample. The athlete sample had a mean percent error of 3.0% and mean difference of -0.5 kg/m^2. This is consistent with the results from Knechtle et al. (2012) where they found that also found that athletes underreport their BMI. It was also consistent with the self-reporting errors of the general population found in Merrill and Richardson (2009) and Krul et al. (2010). Men's Track and Field, Women's Track and Field, the combined Men's and Women's Sprinters/Jumpers/ Hurdlers, and combined Men's and Women's Distance were found to significantly underreport their BMI. The Rowing group did not have a significant difference between self-reported and measured BMI. The Women's Track and Field team had the greatest reporting discrepancy with a mean percent error of 4.2% and mean difference of -0.8 kg/m^2. The Men's Track and Field group had the smallest percent error, at 2.1%. Although the Rowing team did not have a significant difference between self-reported and measured BMI, they still had a larger percent error than the Men's Track and Field group.

Gender was also investigated as a variable of reporting discrepancy. Both male and female athletes significantly overreported their height. Males had a mean percent error of 0.7% and females had a mean percent error of 1.1%. Males were more accurate when reporting height. There was a significant difference between the mean percent errors of the two groups (t=2.44, p=0.02). Regarding weight, males were found to significantly underreport weight with a mean percent error of 1.6%. Females were not found to have a statistically significant difference between the self-reported and measured values. Although, the female group had a mean percent error of 2.1%. These results show that although there is not a definitive overreporting or underreporting of weight in this group, there were still large errors. There was a not significant difference between the mean percent errors of the two groups (t=0.98, p=0.32). Both males and females had a statistically significant underreporting of BMI. The percent error for the BMI misreporting was greater in females, at 3.5%, with males being at 2.1%. There was a significant difference between the male and female group when reporting BMI ($t=2.17$, $p=0.03$). So female athletes were found to have a greater percent error for all three sets of anthropometric data. These findings are somewhat consistent with previous findings in the literature. Other studies typically found that males had a greater overreporting of height than females, while females had a greater underreporting of weight and BMI than males (Merrill & Richardson, 2009; Krul et al., 2010; Larson, 2000).

Previous research has found that athletes of different body sizes tended to be more or less accurate in reporting anthropometric values than athletes of other body sizes. Knechtle et al. (2012) found that smaller athletes had greater height overreporting discrepancies than larger athletes. They also found that heavier athletes tended to underreport weight to a greater extent than lighter athletes. This study did not match the results from Knechtle et al. (2012). Regarding height, athletes in the Normal BMI group (18.5-24.9 kg/m^2), Overweight BMI group (25.0-29.9 kg/m^2), and Obese BMI group (over 30.0 kg/m^2) all significantly overreported their height. The Obese group actually had the largest percent error at 1.4%, which is contrary to previous research. The Normal group had a mean percent error of 1.0% and the Overweight group was the most accurate with a mean percent error of 0.8%. In regard to weight, only one of the three groups significantly underreported their weight, which was the Normal group. The lightest group had a mean percent error of 2.0%, while the Overweight and Obese groups did not have a significant difference between self-reported weight and measured weight. This also contradicts the research by Knechtle et al. (2012). In addition, all three BMI groups significantly underestimated BMI. The Normal and Overweight groups each had a mean percent error of 3.0% and the obese group had a mean percent error of 2.7%.

To this point, there have been no studies that tested both athletes and non-athlete in the same study. Independent sample t-tests were completed for the total athlete sample, female athletes, male athletes, Normal BMI athletes, Overweight BMI athletes, Obese BMI athletes, to their respective non-athlete counterparts. These tests were completed for height, weight, and BMI. The results of the t-tests show that there is a significant disparity between the self-reported and measured height of female athletes and female non-athletes (t=2.53, p=0.14). The non-athlete females had a mean percent error of 0.9% and mean difference of -0.2 cm while the female athletes had a mean percent error of 1.1% and mean difference of 1.2 cm, making the non-athletes more accurate. There is also a significant disparity between the mean differences of self-reported and measured BMI of the Normal BMI class athletes and Normal BMI class non-athletes (t=2.10, p=0.04). The non-athlete Normal BMI group was more accurate than the athlete group. The non-athlete group had a mean percent error of 2.8% and mean difference of -0.1 kg/m^2, while the athlete group had a mean percent error of 3.0% and mean difference of -0.6 kg/m^2. For the remaining groups, there was not a significant difference. In addition, physically active non-athletes and athletes did not have a significant difference in height, weight, or BMI. There has been limited research that studied the difference between athlete and non-athlete self-reporting bias, but there has been research that studied self-reporting bias between individuals that complete a high level of physical activity and individuals that were not physically active. Villanueva (2001) found that women who were physically active were more likely to overreport their weight. Gunnare et al. (2013) found that more frequent physical activity led to a greater underreporting of weight for both genders. Bes-Rastrollo et al. (2011) found that physical activity did not significantly affect self-reporting errors. Since there are no consistent findings in the literature, and the only findings compared highly physically active to non-active individuals, it is hard to compare the results of this study to the literature.

Strengths and Limitations

Strengths of the study include a diverse sample containing athletes that participate in aerobic sports (distance runners) and anaerobic sports (sprinters/jumpers/hurdlers). It was important to test different kinds of athletes because they have different performance needs, and thus different body shapes. Anerobic athletes typically have more mass and are built for shorter exercise bouts. While aerobic athletes are built for endurance tasks, and typically have less mass than anaerobic athletes. Therefore, distance runners and sprinters should not be exclusively considered in one group as “athletes”. Another strength of this study was testing a secondary non-athlete sample and comparing it to the primary sample of athletes. Previous studies did not compare athlete to non-athlete values directly, and usually only used the results from separate studies. The non-athlete sample was drawn from the same student population as the athlete sample. Another strength of this study was that it investigated Division I athletes. Athletes that participate in NCAA Division I were not used in previous studies that studied the accuracy of self-reported anthropometric data.

Finally, one of the greater strengths of this study was that it calculated mean difference and mean percent error to determine accuracy of self-reported anthropometric values. Previous studies that investigated the accuracy of self-reported data of the general population usually drew conclusions by the mean difference between self-reported and measured values. However, mean difference can sometimes be ineffective or draw erroneous conclusions because of varying body sizes. For example, if two groups of individuals were each found to have a mean difference of -1.0 kg. Group A had a mean weight of 80 kg and Group B had a mean weight of 100 kg. Therefore, Group A had a mean percent error of 1.2% and Group B had a mean percent error of 1.0%. So, Group B was actually more accurate given their body weight, despite both groups having the same mean difference.

Limitations of this study included testing a small number of teams, as only the Rowing, Women's Track and Field, Men's Track and Field, and Volleyball teams participated in the study. The research team conceived a study protocol that attempted to best accommodate athletes and coaches so that there would not be a great interference with their practice. However, many teams still decided not to participate in the study due to the possibility of interfering with practice. Another possible limitation of this study was the timing that testing was completed. This study did not aim to target athletes while they were in their competition season. Instead, teams were met at the most convenient point in the season. This could be a limitation since performance data that is retrieved online arises from competitions.

Conclusion

In conclusion, the results indicate that athletes self-report accurate, yet biased height, weight, and Body Mass Index values. The total athlete study, and each individual team, resulted in low percent errors for all three anthropometric data sets. There have been few studies that completed percent error for their sample. Gunnare et al. (2013) found that the general population had a percent error of 1.9% when reporting weight, while the athletes in this study had a mean percent error of 2.0%. No studies completed percent error for height or BMI self-reporting. Athletes had the lowest percent error when reporting height. Athletes had a slightly greater percent error when reporting weight, and athletes had the greatest percent error when reporting BMI. With the exception of the Rowing team, every team overreported height, underreported weight, and underreported BMI. The aim of this study was to determine if athletes were able to self-report accurate height, weight, and BMI values. This was done in order to validate other studies that have used or plan to use online surveys to retrieve information from athletes. Before the self-reported anthropometric values of collegiate athletes are used for other research purposes, the researcher should determine if the likely self-reporting error is within an acceptable range for their purposes.

Recommendations for Future Research and Action

Future research could investigate why there are consistent reporting discrepancies among athletes. Do athletes consistently overreport height and underreport weight on purpose or due to psychological reasons? There is a possibility that these reporting errors occur due to positive body image associations with being taller or lighter. The reporting errors could also be due to association with positive performance results, which would explain the consistent overreporting of height. Another possibility is that the self-reporting errors are by coincidence. The reporting errors could possibly be due to daily weight variations from increased caloric intake and caloric expenditure due to the extensive practice and competition schedule, but this does not explain the consistent overreporting of height.

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Appendix A: Informed Consent Form

Informed Consent

Principal Investigator: Jacob Hausch, Undergraduate Student
Faculty Advisor: Dr. Andrew Cornett, Professor of Exercise Science

Purpose: The purpose of this research study is to analyze self-reported height and weight values of competitive
athletes and individuals in the general population.

Funding: This research is unfunded.

Study Procedures: Participation in this study requires one in-person session, which will be held at the EMU Running Laboratory or an EMU athletic facility. At the beginning of the session, you will complete a survey, which will take approximately 5 minutes. Due to the nature of this study, we cannot describe the study procedures in full detail. Your participation is voluntary, and you can refuse to participate at any time.

Types of Data Collected: We will ask questions about your height, weight, and your physical activity level. We will also ask questions regarding your age, race/ethnicity, and gender.

Risks: The primary risk of participation in this study is a potential loss of privacy. Some of the survey questions are personal in nature and may make you feel uncomfortable. You do not have to answer any questions that make you uncomfortable or that you do not want to answer.

Benefits: You will not directly benefit from participating in this research.

Confidentiality: We will keep your information confidential by using a code to identify your information. The code will be linked to your name using a separate key. Your information will be stored in a password-protected computer file. The principal investigator and the research team will have access to the information you provide for research purposes only. We may share your information with other researchers outside of Eastern Michigan University. If we share your information, we will remove any and all identifiable information so that you cannot reasonably be identified. The results of this research may be published or used for teaching. Identifiable information will not be used for these purposes.

Contact Information: If you have any questions about the research, you can contact the Principal Investigator, Jacob Hausch at jhausch@emich.edu. You can also contact Jacob Hausch's faculty sponsor, Dr. Andrew Cornett at acornet2@emich.edu or by phone at 734-487-2810. For information about your rights as a participant in research, you can contact the Eastern Michigan University Office of Research Compliance at 734-487-3090 or human.subjects@emich.edu.

Voluntary participation: Participation in this research study is your choice. You may refuse to participate at any time, even after signing this form, with no penalty or loss of benefits to which you are otherwise entitled. You may choose to leave the study at any time with no loss of benefits to which you are otherwise entitled. If you leave the study, the information you provided will be kept confidential. You may request, in writing, that your identifiable information be destroyed. However, we cannot destroy any information that has already been published.

Statement of Consent: By clicking on the "Next" button below, I am indicating that (1) I have read this form; (2) I am at least 18 years of age; and (3) I give my consent to participate in this research study.

Appendix B: Survey

General Information

1. What is your participant number? (If you haven't received a participant number, then please ask the survey administrator for one.)

____

2. What is your age in years?
Years: ____________

3. To which gender identity do you most identify?
   - Female
   - Male
   - Transgender female
   - Transgender male
   - Gender variant/Non-conforming
   - Prefer not to answer
   - Not listed (please specify): __________

4. Which race/ethnicity best describes you? (Please choose only one.)
   - American Indian or Alaskan Native
   - Asian/Pacific Islander
   - Black or African American
   - Hispanic
   - White/Caucasian
   - Multiple ethnicity/Other (please specify): ______________

Self-Reported Weight

5. What is your current weight in pounds when you are wearing gym shorts and a t-shirt but no shoes?
Pounds: ___________

6. When is the last time you or someone else measured your weight?
   - Within the last day
   - Within the last week
   - Within the last month
   - Within the last year
   - None of the above

Self-Reported Height

7. What is your current height in feet and inches when you're not wearing shoes?
   Feet: __________
   Inches: __________

8. When is the last time you or someone else measured your height?
   - Within the last day
   - Within the last week
   - Within the last month
   - Within the last year
   - None of the above

Collegiate Athletics Participation (Athletes Only)

9. Are you a member of a collegiate athletics team at EMU?
   - Yes
   - No

10. Which sport do you play?
   - Baseball
   - Basketball
   - Cross Country
   - Diving
   - Football
   - Golf
   - Gymnastics
   - Rowing
   - Soccer
   - Swimming
   - Track & Field
   - Volleyball
   - Years:

11. For how many years have you participated in this sport? ___________

Exercise Information (Non-Athletes Only)

12. On average, how many sessions per week do you exercise?
    - 0
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - Other (please specify): ____________

13. How long does your average exercise session last?
    - 15 minutes
    - 30 minutes
    - 45 minutes
    - 60 minutes
    - 90 minutes
    - 120 minutes or more

Appendix C: Initial IRB Permission Letter

Sep 25, 2018 1:53 PM EDT

Jacob Hausch
Eastern Michigan University, School HPHP

Re: Expedited Review - Initial - UHSRC-FY18-19-29 Accuracy of Self-Reported Height and Weight

Dear Jacob Hausch:

The Eastern Michigan University Human Subjects Review Committee has rendered the decision below for Accuracy of Self-Reported Height and Weight. You are approved to conduct your research.

Decision: Approved

Selected Category:

Findings: You must use stamped copies of your recruitment and consent forms.

To access your stamped documents, follow these steps: 1. Open up the Dashboard; 2. Scroll down to the Approved Studies box; 3. Click on your study ID link; 4. Click on "Attachments" in the bottom box next to "Key Contacts"; 5. Click on the three dots next to the attachment filename; 6. Select Download.

Renewals: This approval is valid for one year and expires on September 24, 2019. If you plan to continue your study beyond September 24, 2019, you must submit a continuing review application in Cayuse IRB at least 14 days prior to September 24, 2019 so that your approval does not lapse.

Modifications: All changes to this study must be approved prior to implementation. If you plan to make any changes, submit a modification request application in Cayuse IRB for review and approval. You may not implement your changes until you receive a modification approval letter.

Problems: All deviations from the approved protocol, unanticipated problems, adverse events, subject complaints, or other problems that may affect risk to human subjects or alter their willingness to participate must be reported to the UHSRC. Complete the incident report application in Cayuse IRB.

Please contact human.subjects@emich.edu with any questions or concerns.

Sincerely,
Eastern Michigan University Human Subjects Review Committee

Appendix D: IRB Renewal Letter

Aug 25, 2019 2:25 PM EDT

Jacob Hausch
Eastern Michigan University, School HPHP

Re: Renewal - UHSRC-FY18-19-29 Accuracy of Self-Reported Height and Weight

Dear Dr. Jacob Hausch:

The Eastern Michigan University Human Subjects Review Committee has renewed your approval for Accuracy of Self-Reported Height and Weight. The approval is effective from September 25, 2019 through September 23, 2020. You may continue your research.

Findings: You must use stamped copies of your consent and recruitment documents. To access your stamped documents, follow these steps: 1. Open up the Dashboard; 2. Scroll down to the Approved Studies box; 3. Click on your study ID link; 4. Click on "Attachments" in the bottom box next to "Key Contacts"; 5. Click on the three dots next to the attachment filename; 6. Select Download.

Renewals: This approval is valid for one year and expires on September 23, 2020. If you plan to continue your study beyond September 23, 2020, you must submit a continuing review application in Cayuse IRB at least 30 days prior to September 23, 2020 so that your approval does not lapse.

Modifications: All changes to this study must be approved prior to implementation. If you plan to make any changes, submit a modification request application in Cayuse IRB for review and approval. You may not implement your changes until you receive a modification approval letter.

Problems: All deviations from the approved protocol, unanticipated problems, adverse events, subject complaints, or other problems that may affect risk to human subjects or alter their willingness to participate must be reported to the UHSRC. Complete the incident report application in Cayuse IRB.

Please contact human.subjects@emich.edu with any questions or concerns.

Sincerely,
Eastern Michigan University Human Subjects Review Committee