An Observational Study of Contextual Body Image in NCAA Division 1 Female Athletes

THESIS

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By

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Abstract

Background: Negative body image is an issue for many athletes, especially young females, and can potentially result in poor eating, low confidence, and even decreased athletic performance. While many tools have been designed to estimate body image, there are limitations with the currently used tools.

Objectives: The primary objective of this study was to evaluate the accuracy of silhouette identification (body image) by the collegiate athlete using realistic and actual athlete silhouettes from recent iDXA scans. This tool is referred to as the BUCKiDXA. A secondary objective was to evaluate the relationship of eating attitudes and body image in female collegiate athletes as estimated by the MBSRQ, BUCKiDXA silhouette differential, CBIQA, and the EDEQ.

Methods: This study created a new figural rating scale using iDXA soft tissue scans of varying BMI and fat percentages called the BUCKiDXA. Sixteen female collegiate NCAA Division 1 athletes participated in this study from various sports including field hockey, swimming, gymnastics, crew, and soccer. Each participant had received an iDXA scan between January and November 2016. Participants completed an online questionnaire that included the MBSRQ, CBIQA, and EDEQ, as well as demographic questions. Participants were then shown the BUCKiDXA, which included 18 scans of varying BMI and fat percentages as well as the actual iDXA scan of the athlete. Participants were asked two questions: first, which of these bodies looks most like you?
And second, which of these bodies would you be okay with looking like? Lastly, participants were asked to rank the following body parts, in order of most to least importance, regarding what they looked at when deciding acceptable BUCKiDXA scan bodies: mid-section, legs, hips, arms, and breasts.

**Results:** Six out of 16 participants (38%) could correctly identify their own body. According to the CBIQA, athletes felt more muscular in daily life than in their sport (p=0.001). Also, athletes felt that they had a larger morphology regarding fat, shape, and weight in sport when compared to their teammates than in daily life when compared to their peers (p=0.004). Athletes ranked mid-section and legs as most important in determining which BUCKiDXA bodies they would choose as acceptable, followed by hips, arms, and breasts.

**Limitation:** Some limitations to this study include a small sample size and participants’ heterogeneity of sports.

**Conclusions:** While this study had a low number of participants, there is much to learn from the findings. This research confirmed that athletes have a different body image in their daily life compared to their sport, especially regarding muscle and how they see themselves. Athletes ranked their legs and mid-section as the most important in determining which iDXA bodies they would choose as acceptable. Thirty-eight percent of athletes could identify their own iDXA scan from the BUCKiDXA. The presentation of the unique BUCKiDXA tool has potential to provide an improved way of measuring and educating athletes about body image. The BUCKiDXA should be validated with a larger population, including non-elite athletes.
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Chapter 1: Introduction

Background

Body image has been studied for many years. Body image affects both men and women, but studies show that women usually have a more negative body image than men\textsuperscript{1,2}. Studies also show that athletes have multiple body images in the context of sport as well as the context of daily life\textsuperscript{3}. It is important to study body image in collegiate athletes because negative body image can lead to decreased academic and sports performance, may negatively impact emotional and physical wellbeing, and may increase the chance of developing an eating disorder\textsuperscript{4,5}. Self-perception has an effect on how and what athletes eat\textsuperscript{6–8}.

Researchers have used the following tools to determine body image:

- Multidimensional Body-Self Relations Questionnaire (MBSRQ)\textsuperscript{1,9}
- Contextual Body Image Questionnaire for Athletes (CBIQA)\textsuperscript{10}
- Eating Disorder Examination Questionnaire (EDEQ)\textsuperscript{11}
- Figural Rating Scales\textsuperscript{12,13}

Each questionnaire focuses on certain populations. The MBSRQ is used to determine body image in the general population. The CBIQA is specifically for athletes to distinguish between their body image within their sport as well as in their daily life. The EDEQ is used to determine if a person has behaviors of someone with an eating disorder. Many versions of Figural Rating Scales have been used in research to determine body image, but these scales have
received much criticism in the past due to the unrealistic figural drawings as well as the ascending size order of the figures\textsuperscript{14–17}.

While research on body image has been conducted in the past, there is much still to learn. It is crucial to determine the best way to measure body image in certain populations due to criticism of previous tools and the importance of recognizing negative/positive body image. This can lead to a better understanding of how body image affects populations, especially elite collegiate female athletes.

**Significance of Study:** This study was designed to gather data about measuring body image in female collegiate athletes using a new method paired with previously validated tools to provide insight into the tool’s utility and range of body image in elite collegiate female athletes.

**Objectives**

This study seeks to evaluate the utility of a newly developed body image tool involving iDXA images, the BUCKiDXA. A secondary aim is to evaluate the relationship of eating attitudes and body image in female collegiate athletes as measured by MBSRQ, BUCKiDXA silhouette differential, CBIQA, and the EDEQ.

**Research Questions**

1. Can an athlete accurately identify her own iDXA silhouette from the BUCKiDXA?
2. Is the difference in selected current body image to desired body image the same using a traditional Figural Rating Scale compared to the difference using the BUCKiDXA?

3. In the MBSRQ, are appearance orientation and appearance evaluation scores correlated to the BUCKiDXA differential score?

4. Describe the similarities/differences in social versus athletic body images according to CBIQA.
Chapter 2: Review of Literature

Body Image

Body image is an important factor to consider when viewing a person’s nutritional health and habits. Self-perception has an effect on how and what someone eats\(^6\)\(^–\)\(^8\). Many studies have focused on determining body image of a population using different tools\(^1\),\(^11\),\(^12\),\(^18\). Tools include figural drawings (or scales) and questionnaires designed to measure a subject’s body image. Studies have been conducted on many populations such as women/men, athletes/non-athletes, and subjects with various diseases or conditions. Different tools and questionnaires have been created and validated to different populations. Some researchers have critiqued the current scales and others have created scales to more accurately measure body image.

Body image has been defined as one’s perception of their physical self, as well as the thoughts and feelings that a person experiences as a result of this perception\(^19\). Body image can be negative, positive, or a combination of both. Those with a positive body image tend to have higher self-esteem levels, better self-acceptance, and healthier outlooks and behaviors\(^19\). Body image is multi-dimensional including four components – perceptual, affective, cognitive, and behavioral\(^19\). The perceptual component is how one sees their body and what adjectives they would use to describe themselves. The affective dimension is defined as how one feels about their body and appearance. The cognitive
domain is the way a person thinks about their body and what they perceive others are thinking. The behavioral domain includes behaviors such as calorie restriction or intense physical activity that are undertaken to control weight or body shape in an effort to improve body image. Another term paired with body image is body dissatisfaction, which has been operationally defined as the discrepancy between one’s perceived and ideal morphology\textsuperscript{19}. Lastly, body size distortion occurs when a person is unable to see themselves accurately in the mirror, and perceives features and body size as distorted. There are many dimensions to one’s perceptions about their body.

Both genders experience body image issues, but negative body image is more prevalent in young women\textsuperscript{1}. A study on body dissatisfaction in adult women found that up to 38% of women in the study had a negative body image\textsuperscript{1}. Some researchers have labeled body dissatisfaction as a “normative” experience for girls and young women in socioeconomically developed settings\textsuperscript{2}. There are many proposed reasons for the high incidence of body dissatisfaction in young women. Research has demonstrated that societal factors have a powerful influence on young women regarding body image\textsuperscript{20}. This is due to the difference between the idealized images of female beauty found in the media and the bodies that women can realistically and naturally attain\textsuperscript{20,21}.

Body image in athletes is purported to play a strong role in eating and training habits\textsuperscript{6–8}. Studies have shown that while there is not a large percentage of athletes who have diagnosable eating disorders, many have signs and symptoms of developing disordered eating that are still problematic. One study found that while 2% of college athletes had a diagnosable eating disorder, 25.5% of the athletes in the study had subclinical signs of an eating disorder\textsuperscript{22}. In lean-focused sports such as swimming,
running, and gymnastics, a leaner body is considered to result in improved performance in the sport as well as a more aesthetic appearance. Among the first studies to focus on disordered eating and lean versus non-lean sports was by Beals and Hill in 2006\textsuperscript{23}. Athletes participating in these types of sports reported higher levels of body dissatisfaction and are more prone to eating disorders\textsuperscript{4,24}. However, body image plays a role for athletes in all sports. While elite athletes are more prone to body dissatisfaction, athletes in recreational leagues also experience negative body image\textsuperscript{4,25}. This dissatisfaction, especially in elite sports, also stems from coaching staff pressure to appear a certain way or have a specific body composition\textsuperscript{4,26}. Concerns related to body image negatively impact collegiate athletes in the physical and emotional realms, and sports performance is negatively impacted as well\textsuperscript{5}. When considering the increase in negative body image for women compared to men, it is evident that female collegiate athletes are at a higher risk for body dissatisfaction\textsuperscript{1,2}.

When measuring body image in athletes, it is important to consider context. Studies have confirmed that male and female athletes have multiple body images depending on the context or environment, specifically an athletic body image and a social body image\textsuperscript{3}. The athletic body image is defined as the internal image that one has of his/her body and the evaluation of that image within an athletic context, while the social body image is the body evaluation in the context of daily life\textsuperscript{27}. Athletes may be satisfied with their body in an athletic environment but are dissatisfied with their body in a social context, or vice versa\textsuperscript{10}. Many different sports have a culture that promotes a certain body type, so the body image of an athlete will depend on their body type as well as their sport\textsuperscript{24}. The idea of body image affecting athlete performance is prevalent. For instance,
DeBruin et al. contend that instead of being thin in order to be beautiful, gymnasts want to be thin because “thin is going to win”\textsuperscript{18}. Athletes are motivated to do what they can to perform at their utmost potential, and having a certain body composition or body type is often believed to influence performance.

**Tools**

**Picture-Based Tools**

One method to determine body image of participants is figural drawing scales. These tools usually consist of 5-12 drawings of various human silhouettes ranging from very thin to very obese\textsuperscript{12}. A participant is asked to choose which silhouette most looks like them, and then they are asked to choose which silhouette they would most want to look like. The numerical difference between the two chosen silhouettes is calculated as the differential. If the resulting number is positive, it indicates the participant wants to look thinner than think they currently look. If the number is negative, the participant would like to gain weight or mass. This sort of tool has been used in research to determine body image for many years.

The first of these scales was created and validated by Stunkard et al. in 1983 thus are often called the Stunkard scales\textsuperscript{13}. The Stunkard figural scales have received much criticism. Some argue that the silhouette drawings are unrealistic representations of the human form due to disproportionally sized arms and legs and poorly defined body figures\textsuperscript{14}. Others criticize that the Stunkard scales are not ideal due to restriction of range (9 figures present in the tool), participants choosing a limited subset of the tool due to the participant not wanting to choose very thin and very obese figures, and the ordering of
the tool from the thinnest silhouette to most obese\textsuperscript{15}. Researchers object to presenting the figures from thinnest to most obese because participants have been found to judge their own morphology as smaller when viewing the silhouettes in ascending order\textsuperscript{16,17}. Other figural scales have been criticized for inclusion of facial features (most of which are Caucasian) that may bias the subject\textsuperscript{28}. Scales which include silhouettes of differing heights have also been criticized for lacking accuracy in determining body image\textsuperscript{13}. There have been many renditions of silhouette scales in an effort to improve the ability to estimate and quantify body image.

Taking these criticisms into account, researchers have created guidelines that could improve the figural drawing scales. Some suggest using figures without clothing (as clothing tends to distract subjects from the actual size and shape of the body) and using figural line drawings that omit details such as facial features\textsuperscript{28,29}. Gardner also suggests that the figures be randomized by weight when presented to the participant to choose which silhouette looks most like them, then randomized again when the subject chooses which silhouette they would most want to look like\textsuperscript{15}. New figural rating scales may try to incorporate these improvements.

There are other methods besides figural scales that are used to estimate or quantify body image. Swami et al. used pictures of real women with varying BMIs (from 12.51 to 41.23) instead of silhouette drawings\textsuperscript{30}. The faces in the pictures were obscured, and all the women in the pictures wore the same simple clothing. The pictures were arranged from emaciated to obese, with two pictures for each of the five BMI categories (<15, 15-18.5, 18.5-24.9, 25-29.9, and >30). Other methods to determine body image include an adjustable mirror, distorting photograph technique, and computer software.
where a participant modifies the size and shape of an image of their body\textsuperscript{31–33}. While Swami’s photograph scale shows promise for a better tool, the others tools presented can be more time consuming than using a simple figural scale\textsuperscript{33}.

Some of the figural scales have linked each of the drawings to a body mass index (BMI). Tovee et al. contended that BMI based silhouettes are more effective at discrimination of visual cues than the prior silhouettes based on weight\textsuperscript{34}. BMI as well as body shape were the two most important cues when participants in a study were asked about female attractiveness. Bulik was one of the first to assign a BMI to each silhouette in a validated tool\textsuperscript{35}. Bulik’s lowest BMI was 18.3 and the highest BMI was 45.4 in a 9-drawing tool. Adding BMI to these scales increased the usefulness of the figural drawing scales as researchers could compare the participant’s BMI to the tool as part of the evaluation.

The results of studies that utilize figural scales to determine body image are similar. Overall, body dissatisfaction is correlated with negative body image\textsuperscript{12,35}. Specifically, Peterson conducted a study on adult females and found that subjects perceived their body as weighing 141 pounds (BMI 23.61) and wished for a body that weighed 130 pounds (BMI 21.63)\textsuperscript{12}. Bulik found similar results where only those choosing the thinnest two of nine silhouettes wished to have a larger morphology, and those choosing the third silhouette (20.9 BMI) and higher mostly wished to be thinner\textsuperscript{35}. The silhouette chosen most often by females as their current body was silhouette 4 (BMI 23.1), which was slightly lower than the actual mean BMI (24.1) of the women. The most commonly chosen desired figure was figure 3 (BMI 20.9), and rarely was a figure greater than silhouette 5 chosen (BMI 26.2). Those who chose figure 3 as their current
morphology were closest to being satisfied with their body, meaning there was a
differential score closest to zero. As actual current body morphology increased, the
discrepancy score tended to increase as well. The larger a participant’s morphology, the
smaller they wished to be. Bulik’s work confirmed that many females tend to have some
level of body dissatisfaction.

**Questionnaires**

More complex questionnaires are also used to attempt to quantify body image.
Three questionnaires that have been used and validated are the Multidimensional Body-
Self Relations Questionnaire (MBSRQ)\(^1\)\(^,\)\(^9\), the Contextual Body Image Questionnaire for
Athletes (CIBQA)\(^10\), and the Eating Disorder Examination Questionnaire (EDEQ)\(^11\).
These questionnaires ask participants specific questions regarding how they “see” their
body and the relationship they have with their own body image. Through analysis of the
results compared with normative values, researchers can determine the degree of a
participant’s negative, positive, or neutral body image.

The Body-Self Relations Questionnaire (BSRQ) is a questionnaire that was
created by Winstead and Cash in 1984. In later years, Cash added additional items to the
BSRQ to create the Multidimensional Body-Self Relations Questionnaire (MBSRQ)\(^1\).
The MBSRQ is validated in a broad population. This tool provides an attitudinal and
multi-dimensional assessment of weight-related variables as well as body image\(^9\). The
full questionnaire contains 69 questions that measure satisfaction as well as orientation
with body appearance. The MBSRQ measures participants’ attitudes towards three
domains: physical appearance, physical fitness, and health. Within each of these three
domains are two sub-scales: appearance evaluation (satisfaction with one’s own body), and orientation (the degree of cognitive importance of body image as well as certain behaviors that are related to body image). Appearance orientation (AO) is an especially important subscale to consider when looking at disordered eating with athletes. One study found that AO was one of the most important factors when it comes to understanding disordered eating in collegiate athletes. This strengthens the use of the MBSRQ in this population.

The MBSRQ is set up in a 5-point Likert-style response format where choices range from “1. definitely disagree” through “5. definitely agree”. In this tool, body image is quantified in subscales by summing the points from the Likert scale with a few questions reverse scored. Brown studied the validity for the MBSRQ in 1990, and reported internal consistency for the different subscales of the MBSRQ that ranged from 0.67-0.85 for males and 0.71-0.86 for females. The MBSRQ is considered a valid and useful tool for use in body image research and application.

The MBSRQ has been utilized in many past studies. For example, Kato used the tool when studying body image disturbances in NCAA Division 1 and 3 female athletes. Athletes in this study (n=118) participated in a variety of sports: basketball, track/field/cross country, softball, volleyball, soccer, tennis, swimming/diving, and ice hockey. The MBSRQ results showed that overall, 24.2% of Division 1 and 30.7% of Division 3 female athletes were very dissatisfied or mostly dissatisfied with their overall appearance. However, when looking at the subscales of the MBSRQ, Division 1 athletes were found to be less satisfied specifically with their appearance evaluation, lower torso, and body area satisfaction compared to Division 3 athletes. In general, it was found that
one-third of athletes in competitive collegiate environments were very likely to have a negative body image and to be dissatisfied with their current body. This is comparable to the percent of adult women with body dissatisfaction, which has been found to be up to 38%1. It is evident that body image issues are very common with the female population.

The Contextual Body Image Questionnaire for Athletes (CBIQA) was created by DeBruin in 2011 to address the apparent multiple body images of athletes10. DeBruin proposed that athletes see themselves differently in sport as compared to daily life. This is known as “body satisfaction transiency” because athletes tend to have different levels of body satisfaction based on the context of their environment3,39,40. DeBruin created the CBIQA to more accurately measure the contextual body images of athletes. This questionnaire contains 30 body image questions that are divided into four groups (in both sport and daily life contexts): appearance, muscul arity, thin-fat self-evaluations, and thin-fat perceived opinions of others. These subscales are described in Table 4. The CBIQA is scored by subscale according to the method published by DeBruin et al10. DeBruin’s original work established the tool validity and modelled the utility in athletes in two related studies.

The first DeBruin study included 152 female participants who were all general athletes and exercisers participating in lean/weight-related sports (such as ice skating, gymnastics, or dance) as well as non-lean sports (such as ball or team sports)10. Through analysis of the results, the four questionnaire sub-scales of the CBIQA were found to be internally valid and reliable. Cronbach’s alphas of the scales ranged from 0.83 to 0.95 (Table 1). Validation of this new tool was an important step for wider consideration as a body image tool for athletes.
### Table 1  CBIQA Subscale Reliabilities - Cronbach’s Alphas<sup>10</sup>

<table>
<thead>
<tr>
<th></th>
<th>Thin Fat-Self</th>
<th>Thin Fat-Others</th>
<th>Appearance</th>
<th>Muscularity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily Life</strong></td>
<td>0.93</td>
<td>0.83</td>
<td>0.89</td>
<td>0.86</td>
</tr>
<tr>
<td><strong>Sport</strong></td>
<td>0.95</td>
<td>0.87</td>
<td>0.94</td>
<td>0.88</td>
</tr>
</tbody>
</table>

DeBruin’s second-step study on 52 highly competitive female athletes evaluated athletes who participated in lean-focused sports (such as gymnastics and synchronized swimming)<sup>10</sup>. The athletes were also categorized by presence of disordered eating according to the EDEQ. DeBruin found that elite athletes had a more negative body image in the sport context than in the daily life context. Additionally, athletes with disordered eating were found to have a more negative body image than athletes without disordered eating, specifically in the self-evaluation of thinness/fatness in daily life. In the sport context, athletes with disordered eating were more negative about their appearance, muscularity, as well as self-evaluation of thinness than non-disordered eating athletes. This second study was asserted to demonstrate the external validity of the CBIQA.

The landmark findings of the DeBruin study demonstrated that athletes have two different body images: sport context and daily life context. Athletes had a more negative body image in the sport context than in the daily life context. In daily life context, athletes compared themselves to others who tended to have less fit bodies than the typical
athlete, so they may have felt better about their own bodies. However, in a sport context, the standard of comparison was more lean and athletic bodies, so female athletes tended to have more negative feelings about their own bodies. This was found to be true when studying female athletes who participated in lean-focused sports. Athletes participating in lean-focused sports where their bodies have more contour exposure (such as swimming and diving) tend to be more critical about their physical appearance. However, the opposite was true when studying body image for athletes in non-lean sports such as rugby. In these “masculine sport types,” female athletes’ body satisfaction was more positive in the sport context and more negative in the daily life context. Females in non-lean sports have bodies that help them perform well in their sport; however, their more masculine bodies do not fit the beauty standard in daily life of thin and lean women. This has the potential to cause body dissatisfaction for these athletes. The study of these multiple body images is compelling and research using this dichotomy will be interesting to follow through time.

There are risks that come with lean sports. One example is menstrual dysfunction. Studies have shown that women in lean focused sports are more likely to have menstrual dysfunction than women in non-leanness focused sports. This is sometimes the result of disordered eating that some athletes experience when attempting to attain a body that they believe is ideal for their lean-focused sport. The disordered eating is often paired with menstrual dysfunction and loss of bone mass, which is often referred to as the Female Athlete Triad.

Finally, the EDEQ is a questionnaire that is used to assess for eating disorders and behaviors in an attempt to control body shape and weight. Before the EDEQ was created
as a stand-alone questionnaire, the Eating Disorder Examination (EDE) was used in clinical settings to determine whether a patient had an eating disorder. The EDE is an oral interview questionnaire including 22 items divided into four subscales: restraint, eating concern, weight concern, and shape concern. Questions are related to behaviors experienced during the last 28 days and are rated on a 7-point rating scale (0 meaning that a behavior was not present, and 6 meaning that it is present daily). The subscales are numerically scored, and contribute to a global score. However, it was determined after use of the EDE that creating a non-interview questionnaire-based EDE (the EDEQ) would be more desirable and practical. The EDEQ was created to save time and avoid the potential bias of patients being asked sensitive questions in a face-to-face setting. The EDEQ is suggested to be a more honest tool than the EDE due to the anonymous nature of a questionnaire.

Many studies have been conducted showing the validity and reliability for the EDEQ. Mond et al. administered the questionnaire along with the EDE interview to a group of 208 women aged 18-45 to determine concurrent and criterion validity. Correlations between the four subscales of the EDE and EDEQ ranged from 0.68 for Eating Concern to 0.78 for Shape Concern (Table 2). For all subscales, scores on the EDEQ were significantly higher than the EDE. The mean difference ranged from 0.25 for Restraint to 0.85 for Shape Concern (Table 2). Despite these differences, the EDEQ was found to have acceptable criterion validity and good concurrent validity. This makes the EDEQ an acceptable questionnaire to be used in lieu of the EDE.
Table 2 Comparisons of the EDE and EDEQ Subscale Scores: Correlations and Differences$^{45}$

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Correlation coefficient, r value</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restraint</td>
<td>0.71*</td>
<td>0.25</td>
</tr>
<tr>
<td>Eating Concern</td>
<td>0.68*</td>
<td>0.37</td>
</tr>
<tr>
<td>Weight Concern</td>
<td>0.77*</td>
<td>0.52</td>
</tr>
<tr>
<td>Shape Concern</td>
<td>0.78*</td>
<td>0.85</td>
</tr>
</tbody>
</table>

* p<0.001

The EDEQ has been used for many studies in the past involving athletes. One study by Nichols et al. looked at the prevalence of disordered eating (DE) and menstrual irregularity (MI) among high school athletes in leanness (L) and non-leanness (NL) focused sports$^{24}$. Through the EDEQ and questions regarding menstrual cycles, it was found that 20% of all participants met the criteria for DE and 20.1% for MI. No differences in DE were found between L and NL athletes. MI was more prevalent in L athletes (26.7%) than in NL athletes (16.6%). While no differences were found in DE between L and NL athletes, the large difference between MI for L and NL athletes should be considered as a marker of nutritional status.

Another study by Darcy et al. focused on the EDEQ with 1637 male and female students at NCAA Division 1 universities who belonged to one of four classification after screening: low activity (LA), recreational athletes (REC), competitive athlete not
participating in recreational sports (CA), and competitive athlete participating in recreational sports (CR)\textsuperscript{25}. Females scored significantly higher on the EDEQ than males in all categories. LA students scored lower on Restraint, Weight Concern, and Global score than REC and CR students. CA athletes scored significantly lower than REC and CR groups on every subscale. Overall, it was suggested that competitive athletes are somewhat protected from disordered eating, and engaging in recreational sports may increase risk for disordered eating. Alternatively, maybe body concern is a motivator for college-aged individuals to participate in recreational sports.

Shanmugan and Davies used the EDEQ to look at the influence of perfectionism, disordered eating, and gender in 192 male and female athletes\textsuperscript{46}. The only independent predictor of athletes’ eating psychopathology identified was self-critical perfectionism in the female athletes. This supports the idea that female athletes are more likely to have a negative body image than men, and it also shows that this negative body image is potentially due to self-criticism.

Another Shanmugam et al. EDEQ study focused on interpersonal relationship difficulties as a risk factor for eating psychopathology in 122 male and female athletes with a mean age of 21.22 years\textsuperscript{26}. Athletes completed a multi-section questionnaire including the EDEQ, Sport-Specific Quality of Relationship Inventory (S-SQRI), and the Experiences in Sports Relationships Questionnaire (ESR). This study found that eating pathology was significantly affected by the perceived level of interpersonal conflict with the coach. Pressure from coaches is another potential area of influence in an athlete’s life from which negative body image may stem.
Other questionnaires and tools have been developed to measure body image. Franzoi and Shields found that the Body Esteem Scale (BES) revealed the multidimensionality of body image between males and females\(^47\). The most important dimensions for females regarding body image were sexual attractiveness, weight concern, and physical condition. The work by Franzoi and Shields is similar to the work of others in that it suggests females have a greater degree of negative body esteem than males\(^{20,21,46}\).

The Sociocultural Attitudes Towards Appearance Questionnaire (SATAQ) is also designed to evaluate body image, more specifically to assess women’s acceptance of social standards of appearance. Heinberg et al. found from using this questionnaire that the two most important factors for women were awareness and acknowledgement of social pressure to appear a certain way and an acceptance of these standards\(^48\). In the end, the study found that the most important factor for women regarding predicting body image disturbance was the internalization of the societal standard set for females’ appearances.

In conclusion, body image has been a focus of study for many years. Body image affects both men and women, but it has been found that women tend to have a more negative body image than men. It has also been found that athletes have multiple body images in the context of sport as well as the context of daily life. Studies on athletes and the EDEQ have found many factors that affect eating psychopathology. Researchers have used tools such as figural drawing scales and questionnaires such as the MBSRQ (general population), CBIQA (specifically for athletes), EDEQ, BES, and SATAQ to determine body image of subjects. While much research on body image has been
conducted in the past, there is much still to learn about body image and subsequent health behaviors and how this affects populations, especially young female elite athletes.
Chapter 3: Methods

NCAA Division 1 intercollegiate athletes at The Ohio State University with an iDXA scan on file from January 2016 through November 2016 were invited to participate in this study. Study methods and procedures were approved by the Institutional Review Board prior to study recruitment (Social IRB #2016B0293). Approved study recruitment included an email sent out to each eligible participant on teams including field hockey, gymnastics, soccer, basketball, crew, and swimming. Once an athlete agreed to participate via email or in-person, a member of the research team met with the athlete to obtain informed consent and administer the survey as well as the BUCKiDXA. To assure athlete anonymity and privacy, each athlete was assigned a subject number, and data was entered and stored by subject ID with no personal identifiers. The study used an iPad for the digital survey (hosted on Qualtrics), and included a hard copy BUCKiDXA scale tailored to each participant.

The BUCKiDXA was created as a novel and improved version of the Figural Rating Scale. This scale included 18 iDXA scan soft tissue images with BMIs ranging from 16 to 31. The scale included two scans for each of the following BMI categories: 16, 18, 20, 22, 24, 26, 28, and 31. For each BMI pair, there was a lower percent body fat option and a higher percent body fat option. The actual percentages along with BMI, height, weight and differential between paired scans are outlined in Table 3.
Table 3  BMI, Height, Weight, and Fat Percentage for BUCKiDXA Scans Include in the New Tool

<table>
<thead>
<tr>
<th>Scan</th>
<th>BMI</th>
<th>BMI Pair Dif</th>
<th>Height (in)</th>
<th>Height Dif (in)</th>
<th>Weight (lbs)</th>
<th>Weight Dif (lbs)</th>
<th>Fat %</th>
<th>Fat % Dif</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>17.1</td>
<td>66</td>
<td>106</td>
<td></td>
<td></td>
<td></td>
<td>10.1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>16.2</td>
<td>66</td>
<td>100</td>
<td>2</td>
<td>27.7</td>
<td>17.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>18.7</td>
<td>62</td>
<td>102</td>
<td></td>
<td></td>
<td></td>
<td>15.7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>18.3</td>
<td>62</td>
<td>100</td>
<td>2</td>
<td>31.3</td>
<td>15.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>20</td>
<td>60</td>
<td>102</td>
<td></td>
<td></td>
<td></td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>20</td>
<td>60</td>
<td>102</td>
<td>0</td>
<td>31.1</td>
<td>15.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>22.3</td>
<td>65</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
<td>20.5</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>22.2</td>
<td>65</td>
<td>133</td>
<td>1</td>
<td>31</td>
<td>10.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>23.1</td>
<td>61</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td>23.5</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>23.1</td>
<td>61</td>
<td>122</td>
<td>0</td>
<td>31</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>24.6</td>
<td>61</td>
<td>130</td>
<td></td>
<td></td>
<td></td>
<td>25.4</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>24.4</td>
<td>61</td>
<td>129</td>
<td>1</td>
<td>34.1</td>
<td>8.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>26.2</td>
<td>66</td>
<td>162</td>
<td></td>
<td></td>
<td></td>
<td>24.9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>26.1</td>
<td>66</td>
<td>162</td>
<td>0</td>
<td>32.7</td>
<td>7.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>27.7</td>
<td>68</td>
<td>182</td>
<td></td>
<td></td>
<td></td>
<td>24.1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>28.2</td>
<td>68</td>
<td>185</td>
<td>3</td>
<td>36.2</td>
<td>12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>30.9</td>
<td>67</td>
<td>197</td>
<td></td>
<td></td>
<td></td>
<td>26.9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>30.6</td>
<td>67</td>
<td>195</td>
<td>2</td>
<td>37.8</td>
<td>10.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Every effort was made to choose paired scans where BMI, height, and weight were similar and to ensure that fat percentages differences were at least 7.5% for the pair of scans at each BMI. For presentation to the athletes, these scans were printed to scale according to the details recorded in appendix A. They were then cut into individual 3x5 cards and laminated. For randomized presentation to subjects, the eighteen scans were numbered randomly on the back of each card. The scan number was recorded regarding
which scan corresponded with which weight, height, BMI, and body fat percentage for later calculations.

Prior to participation in the study, the athlete’s most current iDXA scan was exported from the iDXA computer exactly as the other scans (according to the details recorded in appendix A). The image was then printed, cut, and laminated identical to the other scans. The participant’s scan was labeled with the number 19 as well as their subject number on the back so researchers could determine which of the scans belonged to which participant. If athletes saw the back of the card, they would not have been able to tell which scan was theirs due to each card being labeled with an arbitrary number. The digital survey included demographic information (sport, height, weight, age, and self-identified ethnicity), the Stunkard Figural Rating Scale for current and desired body morphology, the MBSRQ sub-scales to determine body satisfaction and investment, the CBIQA, and EDEQ to objectify the behavioral attributes of the athlete’s body image. For the MBSRQ part of the questionnaire, only the physical appearance section (Appearance Orientation and Appearance Evaluation) was used due to the length of the questionnaire. The research team felt this combination of the available tools would reflect the body image satisfaction and attitudes of the participants.

After using an iPad taking the online survey in the presence of the researcher, participants were presented with the personalized BUCKiDXA tool. The participant’s scan was presented along with the other 18 scans, so for each participant there was a total of 19 scans. The order of the scans was randomized using a random number generator formatted in 5 columns and 4 rows and therefore did not appear in order of increasing BMI. Participants were first asked which of the scans looked most like them. They were
told that they could touch and/or move the scans if they wanted. When the participants chose a scan, the number of their chosen scan was recorded. This scan was then placed back on the table with the other images. The participants were then asked to determine which scans they would be “okay with” looking like. They were again permitted to touch and/or move the scans, and they were told that they could choose as many or as few images as they wished. The numbers of their chosen scans were recorded.

BMI differentials for the Stunkard and BUCKiDXA scale were scored for comparison. The Stunkard scale was scored by subtracting the BMI of the chosen ideal scan from the BMI of the chosen current scan according the BMI’s of Bulik\(^35\). Scoring of the BUCKiDXA tool was done in a way to mimic the Stunkard differential scoring (by BMI). Since participants chose multiple scans for “ideal” bodies using the BUCKiDXA tool, the average BMIs of these chosen ideal scans was calculated. Then, the average BMI of the chosen ideal scans from the BUCKiDXA was subtracted from the BMI of the chosen current scan from the BUCKiDXA. BMI differential scores from the Stunkard tool were compared with average BMI differentials of the BUCKiDXA tool.

To determine which body parts the athletes focused on most when choosing how they wanted to look, the participants were presented with 5 small, laminated pieces of paper. Each paper represented body parts they might consider in choosing the ideal silhouette: hips, arms, legs, mid-section, and breasts. Participants were asked to put these body parts in order of most to least important based on what body parts they prioritized when deciding which iDXA scans would be acceptable for them to look like. The papers were numbered on the back from 1-5 (1 for hips, 2 for arms, 3 for legs, 4 for mid-section, and 5 for breasts) for tracking purposes. After the participant was finished rearranging
the papers, the order of the body parts they chose was recorded. As a thank you for participation in the study, participants were given a choice between a $5 Panera or Starbucks gift card.

Once data was collected, the tools were scored based on guidelines in the literature (see Table 4). The MBSRQ was scored globally and by subscale (appearance orientation and appearance evaluation) according to the methods published by Cash and Green\textsuperscript{49}. The EDEQ was scored globally and by subscale (restraint, eating concern, shape concern, and weight concern) according to the methods published by Fairburn et al\textsuperscript{11}. The CBIQA was scored by subscale (muscularity, appearance, thin-fat self, and thin-fat others) according to the methods published by De Bruin et al\textsuperscript{10}. Description of subscales as well as normative data per scale are presented in Table 4.
<table>
<thead>
<tr>
<th>Original Work</th>
<th>Purpose</th>
<th>Subscales</th>
<th>Validation</th>
<th>Potential Score Ranges</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MBSRQ</strong></td>
<td>Winstead and Cash (1984), Cash and Green (1986)</td>
<td>To evaluate the cognitive and behavioral components of body image</td>
<td>AE: Appearance Evaluation AO: Appearance Orientation</td>
<td>C. Alpha: 0.79</td>
<td>15 to 61</td>
</tr>
<tr>
<td><strong>EDEQ</strong></td>
<td>Fairburn (1994)</td>
<td>To assess the psychopathy of eating behaviors and attitudes</td>
<td>R: Restraint E: Eating Concern W: Weight Concern S: Shape Concern</td>
<td>C. Alpha: 0.81-0.95</td>
<td>R, E, W: 5 to 35 S: 8 to 56</td>
</tr>
<tr>
<td><strong>CBIQA</strong></td>
<td>DeBruin et al. (2011)</td>
<td>To assess the difference in contextual body image between sport and in daily life</td>
<td>Muscularity Appearance Thin-Fat Self (how one sees themselves regarding weight, fat, and shape) Thin-Fat Others (how one thinks others see them regarding weight, fat, shape)</td>
<td>C. Alpha: 0.83-0.95</td>
<td>1 to 7 **4 is neutral</td>
</tr>
<tr>
<td><strong>Stunkard</strong></td>
<td>Stunkard et al. (1983)</td>
<td>To determine dissatisfactions and perceptions of body image</td>
<td>No Subscales</td>
<td>Comparison of silhouette ratings and BMI: 0.64-0.92 (Cohn et al. 1987)</td>
<td>-8 to 8</td>
</tr>
</tbody>
</table>
Statistical analysis was conducted using SPSS version 22 on a PC platform. Data from the online survey were exported by subject number to an excel spreadsheet and scored according to tool instructions. The data from the BUCKiDXA tool was collated into the same spreadsheet and uploaded to SPSS. The data were analyzed using non-parametric procedures due to a small sample size (n=16). Correlations were examined using Spearman correlations, and comparisons between the traditional Stunkard tool and the BUCKiDXA tool were evaluated using Wilcoxon matched-pair signed-rank test. Descriptive statistics were also used to answer the research questions. Statistical significance was assumed to be p < 0.05 a priori.
Chapter 4: Results

The study successfully recruited and consented 16 NCAA Division 1 female athletes from field hockey, soccer, swimming, gymnastics, and crew. Three athletes (18.8%) participated in crew, three athletes were gymnasts, one athlete (6%) participated in field hockey, three athletes were soccer players, and six athletes (37.5%) were swimmers. Table 5 summarizes the number of participants from each sport. Table 6 depicts the demographic information of the participants. The mean age of participants was 20.5 ± 1.36 years old. Mean height was 67.3 ± 3.32 inches, and mean weight was 148.2 ± 20 pounds. Mean BMI for the participants was 23 ± 2.34, and mean body fat percentage was 24 ± 4.15%.

Table 5   Number of Participants per Sport

<table>
<thead>
<tr>
<th>Sport</th>
<th>Participants</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>3</td>
<td>18.8%</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>3</td>
<td>18.8%</td>
</tr>
<tr>
<td>Field Hockey</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Soccer</td>
<td>3</td>
<td>18.8%</td>
</tr>
<tr>
<td>Swimming</td>
<td>6</td>
<td>37.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Table 6  Demographics of Participants

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.5</td>
<td>1.36</td>
<td>18.2-22.9</td>
</tr>
<tr>
<td>Height (in)</td>
<td>67.3</td>
<td>3.32</td>
<td>61-71.5</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>148.2</td>
<td>20.00</td>
<td>115-179</td>
</tr>
<tr>
<td>BMI</td>
<td>23.0</td>
<td>2.34</td>
<td>19.5-26.9</td>
</tr>
<tr>
<td>Fat %</td>
<td>24.0</td>
<td>4.15</td>
<td>19-33.3</td>
</tr>
</tbody>
</table>

When asked which of the BUCKiDXA scans looked most like them, six of the sixteen participants (38%) could correctly identify their own scan. When asked which of the scans the participants would be okay with looking like, most participants chose scans that were a lower BMI and had varying body fat percentages (Figure 1). The scan that was chosen most often (chosen by 12 of the 16 participants, or 75%) was a scan with a BMI of 20 and a fat percentage of 16% (Figure 2). Eight of the sixteen participants (50%) chose their own scan as one of the bodies that they would be okay with looking like. The results of the silhouette choices are further detailed in Figure 1.
**Figure 1** BUCKiDXA Scans Chosen as “Okay With” Looking Like

<table>
<thead>
<tr>
<th>Subject Number</th>
<th>BMI 17 16 19 18 20 22 23 25 24 26 28 28 31 31</th>
<th>%Fat 10 28 16 31 16 31 21 31 24 31 25 34 25 33 24 36 27 38</th>
<th>Scan # 12 18 1 4 2 5 3 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24 29</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>22 24</td>
<td>x x x x x x x x x x</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>26 33</td>
<td>x x x x</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>27 33</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>21 22</td>
<td>x x x x</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>21 24</td>
<td>x x x x x x x x x x</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>23 22</td>
<td>x x x x x x x x x x x</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>24 22</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>20 19</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>26 30</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>22 23</td>
<td>x x x x</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>22 24</td>
<td>x x x x x x x x x x x x x x x x x</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>25 26</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>20 24</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>20 22</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>25 23</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8 6 8 5 10 12 9 10 3 6 8 2 2 2 3 2 0 1 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Paired scans in order from smallest BMI (top left) to largest (bottom right). Outlined scan is the scan chosen most often by participants (BMI 20, fat 16%).

Note: This order was not how these scans were presented to each subject.

Wilcoxon non-parametric statistics were used to compare the Stunkard scale and the BUCKiDXA tool using BMI differential (scoring explained in methods section). Upon analysis of the data, one of the participants chose a current body on the Stunkard scale that represented a BMI of 33 when her actual BMI was 26.5. Since the highest represented BMI for the BUCKiDXA was 31, this participant was excluded for this
specific statistical analysis. Therefore, the Wilcoxon statistic was performed on 15 subjects. When the aforementioned individual was removed from analysis, there was no significant difference between the BUCKiDXA differential and the Stunkard differential scores (average difference = 0.772, p = 0.173).

The MBSRQ section of the questionnaire was analyzed using a non-parametric Spearman correlation test for the relationships of the BUCKiDXA silhouette choices with the appearance orientation (AO) and appearance evaluation (AE) subscales. The coefficients for the two subscales were found to be slightly negatively correlated with the BUCKiDXA differential, but these negative correlations did not reach statistical significance (AO r=-0.053, p=0.845) (AE r=-0.2, p=0.458). This data does not support a correlation between the BUCKiDXA differential score and the MBSRQ appearance subscales, suggesting that body dissatisfaction is not necessarily correlated to wanting to have a smaller morphology in this small group of athletes.

The CBIQA subscale comparison was analyzed using the non-parametric Wilcoxon related-samples signed rank test. When comparing muscularity, participants felt significantly more muscular in daily life than in their sport (p=0.001). When comparing appearance, athletes showed little difference in how they felt about their bodies’ appearance in sport and in daily life (p=0.812). For the thin-fat self subscale, athletes felt that they had a larger morphology in sport when compared to their teammates than in daily life when compared to their peers (p=0.004). In terms of the thin-fat others subscale, athletes felt that fellow athletes as well as non-athlete peers saw their body in a similar way in sport and daily life regarding fat, shape, and weight (p=0.673). Analysis
of the CBIQA found significant differences between daily life and sport in the subscales of muscularity as well as thin-fat self.

When athletes were asked to rank which body parts they prioritized most when deciding which BUCKiDXA scans would be acceptable for them to look like, participants chose the mid-section as the most important body part (7 participants ranked as most important). Legs were second in importance after mid-section (6 athletes chose legs as next important). These body parts were followed in importance by hips, arms, and breasts. Figure 3 summarizes the frequency of the priorities placed on each body part.

Even though there were low numbers in each sport enrolled in the study, body parts chosen as most important by athletes per sport was also studied. According to these results, it is possible that sport does not influence which body parts are prioritized when considering the perfect body. All 5 sports had at least one participant choose mid-section as the body part that is most important. Almost all sports had at least one athlete chose legs, and the only sport to not have anyone chose legs was field hockey where there was only one participant representing the sport. Hips were chosen only by soccer and swimming athletes. Overall, body parts chosen as most important vary between as well as within sports.
Figure 3  Ranking of the Importance of Body Parts When Choosing “Acceptable” Bodies in BUCKiDXA Scale
Table 7  Body Part Chosen as Most Important per Sport

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Crew n=3</th>
<th>Gymnastics n=3</th>
<th>Field Hockey n=1</th>
<th>Soccer n=3</th>
<th>Swimming n=6</th>
<th>TOTAL n=16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Section</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Legs</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Hips</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Arms</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Breasts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Chapter 5: Discussion

There were a variety of sports represented in this study. The heterogeneity of athletes regarding sport participation in this study may have influenced how athletes responded to body image questions. For instance, an athlete participating in field hockey may be more accustomed to being around fellow athletes with a higher fat percentage than gymnasts would be.

The athletes in this study have some interesting comparisons with average American females ages 20-29 as published by Hoffman 51. This sample of athletes were slightly taller than the average adult female by 3.2 inches. On average, the athletes in this study were 7.7 pounds lighter in weight than the average adult female. The mean BMI for this sample was 23 which is considered healthy. These comparisons are depicted in Table 8. The range of BMIs in this athlete sample was 19.5-26.9 so participants were in both the healthy and “overweight” (25-30) categories, though BMI is not of great use in athletes.

Table 8 Comparison for Height and Weight Between This Study and Average Adult Females Aged 20-29

<table>
<thead>
<tr>
<th></th>
<th>Average Height (in)</th>
<th>Average Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This Study</td>
<td>67.3</td>
<td>148.2</td>
</tr>
<tr>
<td>Hoffman 51</td>
<td>64.1</td>
<td>156.5</td>
</tr>
<tr>
<td>Difference</td>
<td>+3.2</td>
<td>-7.7</td>
</tr>
</tbody>
</table>
The athletes in this study also compare well to the other NCAA Division 1 athletes. Fornetti et al. and Prior et al. have determined the average body fat percentages for collegiate NCAA Division 1 females participating in various sports (Table 9)\textsuperscript{52,53}. The average body fat for the athletes in this study was $24 \pm 4.15$, which is slightly higher than the published values.

Table 9  Average Body Fat Percentage per Sport for NCAA Division 1 Athletes
Compared to This Study\textsuperscript{52,53}

<table>
<thead>
<tr>
<th>Sport</th>
<th>Gymnastics</th>
<th>Crew</th>
<th>Soccer</th>
<th>Swimming</th>
<th>Field Hockey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This Study</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.8%</td>
<td>30.0%</td>
<td>22.9%</td>
<td>23.3%</td>
<td>29.3%</td>
<td></td>
</tr>
<tr>
<td><strong>Average BF%</strong></td>
<td>19.1 ± 2.2%</td>
<td>21.9 ± 2.3%</td>
<td>21.8 ± 2.7%</td>
<td>23.5 ± 5.8%</td>
<td>20.9 ± 4.1%</td>
</tr>
</tbody>
</table>

This study demonstrated that not all athletes were able to accurately identify an iDXA soft tissue image of their own body. It should be noted that many of these teams receive 1 to 2 iDXA scans each year that they are a NCAA Division 1 athlete at Ohio State. Many of the participants in this study have the opportunity to look at their iDXA scan at each of these occasions. Despite these athletes’ familiarity with iDXA scans, only six of the sixteen participants could correctly choose their own scan in the BUCKiDXA tool. The other ten participants incorrectly chose an iDXA scan that they thought was
themselves. This shows how athletes often have a skewed body image, as they are not fully aware of what their bodies look like from an outside perspective.

When asked which bodies they would be “okay with” looking like, most of the participants chose iDXA scans that had lower BMIs and mixed fat percentages. Much of the time, participants chose “acceptable” bodies that ranged from a fat percentage of 16 to 31 percent. It seems, from looking at Figure 1, that a lower BMI has more of an impact in what an athlete sees as “acceptable” than a lower fat percentage. It is common for athletes to want to be lean, but these athletes were apparently unable to discern body fatness using the BUCKiDXA tool. However, the scan that was chosen most often (by 75% of participants) as being acceptable was a very lean scan with a BMI of 20 and a fat percentage of 16%. This result is similar to the Bulik study where the figure chosen most often was figure 3 which corresponded to a BMI of 20.9 (fat percentage information was not included), and the Peterson study where the BMI for the figure chosen most often was 21.6\textsuperscript{12,35}. Since the participants’ average BMI was 23 and average fat percentage was 24%, this suggests that most of the participants would be happy if their body was about 3 points lower in BMI and 8% lower in body fat percentage. The outcome that many females want to look smaller than they currently are is consistent with the literature\textsuperscript{1,2}.

The new BUCKiDXA tool has a few limitations. Firstly, muscle definition is not evident from looking at the iDXA soft tissue scans so it may have been difficult for an athlete to determine if they would have truly wanted to look like the different scans or not. The two-dimensional nature of these scans is also a limitation as subjects are only seeing the frontal view. Recruitment into a study on body image may limit the athletes
willing to participate which can also skew the results. Despite these limitations, the BUCKiDXA is an improvement from the black and white pen drawings presented in the Stunkard tool.

When viewing the data comparing the Stunkard tool to the new BUCKiDXA scale, one of the participants chose a current silhouette on the Stunkard scale that represented a body that had a BMI of 33 while she had a BMI of 26.5. Since the created BUCKiDXA tool has BMIs ranging from 16 to 31, this participant was not included in this statistical analysis. Making the two tools (Stunkard and BUCKiDXA) more similar regarding represented BMIs would result in a more accurate comparison of the tools. This could be done either by adding bodies with higher BMIs to the BUCKiDXA tool or by omitting any silhouette on the Stunkard scale that exceeds a BMI of 31. The results of the current analysis (n=15) showed no statistically significant difference between the two tools, but including the data of athletes like the excluded athlete is likely important due to her large difference between actual BMI and the BMI of the silhouette chosen.

The Stunkard scale has fewer silhouettes as part of the tool (9) compared to the BUCKiDXA tool (19). Most of the previously used tools have anywhere from 5 to 12 silhouettes\textsuperscript{15}, and the new BUCKiDXA tool has many more silhouettes than prior tools. This allows for more body types, shapes, and morphologies to be represented in this newly created tool. The more scans also increase the difficulty for an athlete to pick out which one is their current body. Another unique piece of the new BUCKiDXA tool is that it contains the actual body of the participant, which has not been demonstrated in any previous figural rating scale. It would be expected that with more participants, a greater
difference in BMI differential would have been seen using the Stunkard scale. This is because when using the BUCKiDXA scale, the participant can choose from a lot more bodies and they are able to choose multiple bodies for their “ideal.” This activity may have educational value in helping athletes see that many body types and body fat percentages can be appealing with hopes that they would be less idealistic in their self-image.

Body image was also explored in this analysis using the MBSRQ. When the AE and AO subscales were analyzed to test for correlation with the BUCKiDXA differentials, a very weak and insignificant negative correlation were computed for both subscales (-0.2 and -0.053 respectively). Had these correlations been significant, interpretation for the AE and AO subscales would have been split compared with expected results. For AE and BUCKiDXA differential ($r=-0.2, p=0.458$), the direction of the coefficient would have meant that the higher the AE score (i.e. more pleased with body), the smaller the differential (better satisfaction) between BMI of the chosen current scan and the average BMI of the chosen ideal scans. This makes sense, because the happier a person is with their body, the closer their ideal bodies would be to their current body. For AO and BUCKiDXA differential ($r=-0.053, p=0.845$), this would have meant that the higher the AO (meaning the more time and effort a person puts into their appearance), the smaller the differential. While this is a very weak and insignificant negative correlation, it is still directionally unexpected. Typically, one who puts a lot of effort and time into their appearance would be more dissatisfied with how their body looks (which would merit a higher BUCKiDXA differential score). However, someone
who works very hard on their appearance does not necessarily have a negative body image, and may just care a lot about their appearance. One must use caution even attempting to interpret the results of these correlational analyses due to the insignificant p-values.

The findings from the CBIQA data strengthen the concept that athletes have different body images in their sport as compared with daily life\textsuperscript{10}. Athletes in this study felt more muscular in daily life than in their sport (p=0.001). Athletes are often more muscular than the average person and this may cause them to notice their increased musculature when comparing themselves to their non-athlete peers. Interestingly, athletes felt the same about their body’s appearance in sport and in daily life. This suggests that while athletes do notice that they are muscular, they are accepting of this fact and do not feel like it makes their appearance more- or less-beautiful in sport and in daily life.

Regarding fat, shape, and weight, athletes felt that they had a larger morphology in sport when compared to their teammates than in daily life when compared to their peers (p=0.004). This may have been because in sport, athletes are comparing themselves to other athletes who have similar athletic bodies. However, in daily life, athletes are surrounded by all types of people, athletic and non-athletic, with varying body types. This contributes to their feelings of being more fit when compared to non-athlete peers versus when compared to athletic teammates. Our results indicated that participants felt that fellow athletes as well as non-athlete peers saw their body in a similar way in sport and daily life regarding fat, shape, and weight. This suggests that athletes do not believe that others’ perceptions of themselves change in sport compared to daily life. However,
as mentioned before, participants did indicate that they look different in sport and in daily life despite what they believe others think.

When asked to rank body parts in order of importance in desired appearance choices, the body part ranked number one in importance most often was the mid-section. This was following in importance by legs, hips, arms, and breasts. In general, the athletes in this study focused on the mid-section and lower body. This might be expected as an area of body concern, as women have a more gynoid fat distribution and tend to hold more fat in their hips and legs.

The importance of certain body parts does not seem to be different for athletes playing different sports. When charted out by sport (as in Table 7), it is apparent that athletes prioritized varying choices of body parts (mid-section, legs, or hips) as most important when choosing the “okay looking like” silhouettes. This is likely due to the number of participants in this study. It would be interesting with a future larger study to ask the importance of body parts for many different sports and compare the findings alongside sport body stereotypes and perceptions of how an athlete in a certain sport “should look”.

The information gathered through this study can be used to help deal with the negative body image experienced by many young female athletes. Programs have been developed, such as The Whole Image for Athletes (WIA), that provide online education focused on enhancing body image and preventing eating disorders in collegiate athletes\(^5\). The BUCKiDXA tool has the potential to strengthen interventions such as the WIA to promote positive body image for young athletes.
In the future, this study could be improved in a couple ways. First, it would be interesting to ask each participant if they had seen their own iDXA scan in the past. This would have shed more light onto why some athletes were able to choose their own iDXA scan while others were not. Regarding the body part ranking, it would be interesting to compare the women’s responses to the responses of homosexual men when asked which of the same body parts they find most important when determining the attractiveness of a woman. These changes may help researchers understand more about body dissatisfaction in this population.

Limitations

The BUCKiDXA tool is a newly developed tool that has not been validated yet. This study was unable to validate the BUCKiDXA tool due to low participant numbers. The low numbers were due to graduate student time constraints. The potentially sensitive nature of this study may have prevented more athletes from participating. This study should be viewed as pilot work to foster ideas of how to help athletes improve their body image, and how to strengthen the BUCKiDXA tool. Another limitation to this study is the heterogeneity of sports represented. These sports all have varying stereotypical body types, and due to the low number of participants in each sport, a statistical comparison between sports could not be completed.

In conclusion, this study shows that athletes are generally not able to identify their own body when presented with a group of iDXA soft tissue silhouettes. Athletes tend to not be able to distinguish body fat by looking at the BUCKiDXA tool, and they are more
concerned with the morphology of the body in general. There may be educational value in helping athletes think about the range of body fatness they chose as acceptable relative to their beliefs about what percent body fat they would want to be. More research is needed in this area to learn more about this issue to better address body image in the athletic population.
References:


40. Body Image Concerns In Female Exercisers and Athletes: A Feminist Cultural Studies Perspective.


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Appendix A: Scan Export Process
Scan Export Process: BUCKiDXA

1. Each iDXA image included in this tool was adjusted for height within the tool.

2. Each soft-tissue image was adjusted to 100% within the iDXA software, and the image was clipped using the Window’s snipping tool from the top of the image’s head to the bottom of the toes.

3. The image was then superimposed on a 3”x5” black rectangle on PowerPoint, then adjusted to reflect the height of the athlete.
   - 60” tall in real life was adjusted to 4” tall on the image.
   - For each inch of real height, 0.07” was added to the computerized image using the modify picture tool with the aspect ratio of the image on locked. For example, if an athlete was 65”, then their scan height would be adjusted to 4.35”.
Appendix B: Questionnaire
Body Image Athletes

What is your subject number in the study?

Which OSU sport do you play?

☐ Soccer
☐ Basketball
☐ Gymnastics
☐ Swimming
☐ Synchronized swimming
☐ Volleyball
☐ Track (Running)
☐ Track (Field)
☐ Track (Running and Field)
☐ Field hockey
☐ Hockey
☐ Spirit team
☐ Cross Country
☐ Crew

What is your height in inches?

How tall would you choose as your ideal height?

_____ Height in inches

What is your current weight in pounds?
How much would you choose as your ideal weight?

______ Pounds

How do you identify your ethnicity?

☐ Asian
☐ African
☐ Black American
☐ Indian
☐ Latino
☐ Native Hawaiian or Pacific Islander
☐ White
☐ Other

You described yourself as other ethnicity, please provide us with your ethnicity.

**Menstrual Cycle History**

Estimate how many periods you've had in the past 12 months (1 year

Have you missed any periods in the last three to four months?

☐ Yes
☐ No

Have you been on medicine for birth control or contraceptives the past 3-4 months?

☐ Yes
☐ No
What sort of contraceptive have you been using?

- Oral contraceptive pills
- "Depo"
- Other

**Body Image**

Please indicate the extent to which each statement pertains to you personally. There are no right or wrong answers and remember this questionnaire is intentionally de-identified and confidential. Just give the answer that is most accurate for you.

Before going out in public, I always notice how I look.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I am careful to buy clothes that will make me look my best.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree
My body is sexually appealing.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I constantly worry about being or becoming fat.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I like my looks the way they are.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I check my appearance in a mirror whenever I can.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree
Before going out, I usually spend a lot of time getting ready.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I am very conscious of even small changes in my weight.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

Most people would consider me good-looking.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

It is important that I always look good.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree
I use very few grooming products.

○ Definitely Disagree
○ Mostly Disagree
○ Neither Agree nor Disagree
○ Mostly Agree
○ Definitely Agree

I like the way I look without my clothes on.

○ Definitely Disagree
○ Mostly Disagree
○ Neither Agree nor Disagree
○ Mostly Agree
○ Definitely Agree

I am self-conscious if my grooming isn't right.

○ Definitely Disagree
○ Mostly Disagree
○ Neither Agree nor Disagree
○ Mostly Agree
○ Definitely Agree

I usually wear whatever is handy without caring how it looks.

○ Definitely Disagree
○ Mostly Disagree
○ Neither Agree nor Disagree
○ Mostly Agree
○ Definitely Agree
I like the way my clothes fit me.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I don't care what other people think about my appearance.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I take special care with my hair grooming.

- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I dislike my physique

- Strongly Disagree
- Mostly Disagree
- Neither agree nor Disagree
- Agree
- Strongly Agree
I am physically unattractive.<br>
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

I never think about my appearance.
- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I am always trying to improve my physical appearance.
- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree

I am on a weight-loss diet
- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree
I have tried to lose weight by fasting or going on crash diets.

- Never
- Rarely
- Sometimes
- Often
- Very often

I think I am:

- Very underweight
- Somewhat underweight
- Normal weight
- Somewhat overweight
- Very overweight

From looking at me, most other people would think I am:

- Very underweight
- Somewhat underweight
- Normal weight
- Somewhat overweight
- Very overweight
Use this 1 to 5 scale to indicate how dissatisfied or satisfied you are with the following areas or aspects of your body.

<table>
<thead>
<tr>
<th>Area</th>
<th>very dissatisfied</th>
<th>mostly dissatisfied</th>
<th>neither satisfied nor dissatisfied</th>
<th>mostly satisfied</th>
<th>very satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face (facial features, complexion)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Hair (color, thickness, texture)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lower torso (buttocks, hips, thighs, legs)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Mid torso (waist, stomach)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Upper torso (chest or breasts, shoulders, arms)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Muscle tone</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Weight</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Height</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Overall appearance</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Referring to the image above, which of these looks most like you?

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

Referring to the image above, which of these would you most like to look like

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
On how many of the past 28 days…

Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday
Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you had a definite desire to have a totally flat stomach?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday
Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you had a definite fear of losing control over eating?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday
Have you had a definite fear that you might gain weight?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you felt fat?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Have you had a strong desire to lose weight?

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

Over the past 28 days, how many times have you eaten what others would regard as an unusually large amount of food (given the circumstances)?

* The value must be between 0 and 99, inclusive.
On how many of these times did you have a sense of having lost control over your eating (at the time you were eating)? The value must be between 0 and 99, inclusive.

Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)? The value must be between 0 and 28, inclusive.

Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight? The value must be between 0 and 99, inclusive.

Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight? The value must be between 0 and 99, inclusive.

Over the past 28 days, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape or amount of fat, or to burn off calories? The value must be between 0 and 99, inclusive.

Please note that for these questions the term "binge eating" means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.
Over the past 28 days, on how many day have you eaten in secret (ie, furtively)?... Do not count episodes of binge eating.

- No days
- 1-5 days
- 6-12 days
- 13-15 days
- 16-22 days
- 23-27 days
- Everyday

On what proportion of the times that you have eaten have you felt guilty (felt that you've done wrong) because of its effect on your shape or weight?.... Do not count the episodes of binge eating

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime

Over the past 28 days, how concerned have you been about other people seeing you eat?.... Do not count the episodes of binge eating

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime
Has your weight influenced how you think about (judge) yourself as a person?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime

Has your shape influenced how you think about (judge) yourself as a person?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime

How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime
How dissatisfied have you been with your weight?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime

How dissatisfied have you been with your shape?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime

How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath of shower)?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime
How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?

- None of the times
- A few of the times
- Less than half of the times
- Half of the times
- More than half of the times
- Most of the time
- Everytime
The next questions deal with how satisfied you are with your body and your appearance. There are no true or false answers. Do not think too long about your answers and do not skip any questions.

In daily life,

<table>
<thead>
<tr>
<th></th>
<th>very ugly</th>
<th>ugly</th>
<th>somewhat ugly</th>
<th>neither ugly or beautiful</th>
<th>somewhat beautiful</th>
<th>beautiful</th>
<th>very beautiful</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think my appearance is:</td>
<td></td>
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<tr>
<td>I think my appearance compared to others is:</td>
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76
In daily life,

<table>
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<tr>
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Appendix C: Publishable Document
Introduction

This pilot study was designed to gather data about measuring body image in female collegiate athletes using a new method paired with previously validated tools to provide insight into the tool’s utility and range of body image in elite collegiate female athletes.

Objectives

This study seeks to evaluate the utility of a newly developed body image tool involving iDXA soft tissue images called the BUCKiDXA. A secondary aim is to evaluate the relationship of eating attitudes and body image in female collegiate athletes as measured by MBSRQ, BUCKiDXA silhouette differential, CBIQA, and the EDE-Q.

Research Questions

1. Can an athlete accurately identify her own iDXA silhouette.

2. Is the difference in selected current body image to desired body image the same using a traditional Figural Rating Scale compared to the difference using the iDXA image scale?

3. In the MBSRQ, are appearance orientation and appearance evaluation scores correlated to the BUCKiDXA differential score?

4. Describe the similarities/differences in social versus athletic body images according to CBIQA.

Background

Body image has been studied for many years. Body image affects both men and women, but studies show that women usually have a more negative body image than men\textsuperscript{1,2}. Studies also show that athletes have multiple body images in the context of sport.
as well as the context of daily life. It is important to study body image in collegiate athletes because negative body image can lead to decreased academic and sports performance, may negatively impact emotional and physical wellbeing, and may increase the chance of developing an eating disorder. Self-perception has an effect on how and what athletes eat.

Researchers have used the following tools to determine body image:

- Multidimensional Body-Self Relations Questionnaire (MBSRQ)
- Contextual Body Image Questionnaire for Athletes (CBIQA)
- Eating Disorder Examination Questionnaire (EDEQ)
- Figural Rating Scales

Each questionnaire focuses on certain populations. The MBSRQ is used to determine body image in the general population. The CBIQA is specifically for athletes to distinguish between their body image within their sport as well as in their daily life. The EDEQ is used to determine if a person has behaviors of someone with an eating disorder. Many versions of Figural Rating Scales have been used in research to determine body image, but these scales have received much criticism in the past due to the unrealistic figural drawings as well as the ascending size order of the figures.

While research on body image has been conducted in the past, there is much still to learn. It is crucial to determine the best way to measure body image in certain populations due to criticism of previous tools and the importance of recognizing negative/positive body image. This can lead to a better understanding of how body image affects populations, especially elite collegiate female athletes.
Methods

NCAA Division I intercollegiate athletes at The Ohio State University with an iDXA scan on file from January 2016 through November 2016 were invited to participate in this study. Study methods and procedures were approved by the Institutional Review Board prior to study recruitment (Social IRB #2016B0293). Approved study recruitment included an email sent out to each eligible participant on teams including field hockey, gymnastics, soccer, basketball, crew, and swimming. Once an athlete agreed to participate via email or in-person, a member of the research team met with the athlete to obtain informed consent and administer the survey as well as the personalized BUCKiDXA tool. To assure athlete anonymity and privacy, each athlete was assigned a subject number, and data was entered and stored by subject ID with no personal identifiers. The study used an iPad for the digital survey (hosted on Qualtrics) and included a hard copy BUCKiDXA scale activity tailored to each participant.

The BUCKiDXA was created as an improved version of the Figural Rating Scale. This scale included 18 iDXA scan images with BMIs ranging from 16 to 31. The scale included two scans for each of the following BMI categories: 16, 18, 20, 22, 23, 24, 26, 28, and 31. For each BMI pair, there was a lower percent body fat option and a higher percent body fat option. The actual percentages along with BMI, height, weight and differential between paired scans are outlined in Table 10.
Table 10  BMI, Height, Weight, and Fat Percentage for DXA Scans

<table>
<thead>
<tr>
<th>Scan</th>
<th>BMI</th>
<th>BMI Pair Dif</th>
<th>Height (in)</th>
<th>Height Dif (in)</th>
<th>Weight (lbs)</th>
<th>Weight Dif (lbs)</th>
<th>Fat %</th>
<th>Fat % Dif</th>
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<td>66</td>
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<td>0</td>
<td>195</td>
<td>2</td>
<td>37.8</td>
<td>10.9</td>
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</table>
Every effort was made to choose paired scans where BMI, height, and weight were similar, and to ensure that fat percentages differences were at least 7.5% for the pair of scans at each BMI. For presentation to the athletes, these scan images were copied and adjusted to scale to accurately reflect subject height. They were then cut into individual 3x5 inch cards and laminated. For randomized and unbiased scan presentation to subjects (and research team tracking), the eighteen scans were numbered randomly on the back of each card. The scan number was recorded regarding which scan corresponded with which weight, height, BMI, and body fat percentage for later calculations.

Prior to participation in the study, the athlete’s most current iDXA soft tissue scan was copied from the iDXA software exactly as the other BUCKiDXA scans. The image was processed and prepared identical to the other scans. The participant’s scan was labeled with the number 19 as well as their subject number on the back in order to determine which of the scans belonged to which participant.

The digital survey included demographic information (sport, height, weight, age, and self-identified ethnicity), the Stunkard Figural Rating Scale for current and desired body size, the MBSRQ sub-scales to determine body satisfaction and investment, and the CBIQA. For the MBSRQ part of the questionnaire, only the physical appearance section (Appearance Orientation and Appearance Evaluation) was used due to the length of the questionnaire.

After taking the online survey, participants were presented with the personalized BUCKiDXA silhouette set. The participant’s scan was presented along with the other 18 scans, so for each participant there were 19 scans. The order of the scans was
randomized using a random number generator, and formatted in 5 columns and 4 rows. The scans did not appear in order of increasing BMI, the arrangement was truly randomized for each subject. Participants were first asked which of the scans looked most like them. They were told that they could touch and/or move the scans if they wanted. When the participants chose a scan, the number of their chosen scan was recorded. This scan was then placed back on the table with the other images. The participants were then asked to determine which scans they would be “okay with” looking like. They were again permitted to touch and/or move the scans, and they were told that they could choose as many or as few images as they wished. The numbers of their chosen scans were recorded.

Once data was collected, the tools were scored based on guidelines found in the literature. The MBSRQ was scored globally and by subscale (appearance orientation and appearance evaluation) according to the method published by Cash and Green\textsuperscript{46}. The CBIQA was scored by subscale (muscul arity, appearance, thin-fat self, and thin-fat others) according to the method published by De Bruin et al\textsuperscript{9}.

BMI differentials for the Stunkard and BUCKiDXA scale were scored. The Stunkard scale was scored by subtracting the BMI of the chosen ideal scan from the BMI of the chosen current scan. Scoring of the BUCKiDXA tool was done in a way to mimic the Stunkard differential scoring. Since participants chose multiple scans for “ideal” bodies using the BUCKiDXA tool, the average BMIs of these chosen ideal scans was calculated. Then, the average BMI of the chosen ideal scans from the BUCKiDXA was
subtracted from the BMI of the chosen current scan from the BUCKiDXA to yield the BUCKiDXA differential similar to Stunkard differential based on BMIs.

Statistical analysis was conducted using SPSS version 22 on a PC platform\textsuperscript{47}. Data from the online survey were exported by subject number to an excel spreadsheet and scored according to tool instructions\textsuperscript{1,10,11,13}. The data from the hard copy DXA tool was collated into the same spreadsheet and uploaded to SPSS. The data were analyzed using non-parametric procedures due to a low sample size (n=16). Correlations were examined using Spearman correlations, and comparisons between the traditional Stunkard tool and the new DXA tool were evaluated using Wilcoxon matched-pair signed-rank test. Descriptive statistics were also used to answer the research questions. Statistical significance was assumed to be $p < 0.05$ \textit{a priori}.

**Results**

The study successfully recruited and consented 16 NCAA Division 1 female athletes from field hockey, soccer, swimming, gymnastics, and crew. Three athletes (18.8\%) participated in crew, three athletes were gymnasts, one athlete (6\%) participated in field hockey, three athletes were soccer players, and six athletes (37.5\%) were swimmers. Table 11 summarizes the number of participants from each sport. Table 12 depicts the demographic information of the participants. The mean age of participants was $20.5 \pm 1.36$ years old. Mean height was $67.3 \pm 3.32$ inches, and mean weight was $148.2 \pm 20$ pounds. Mean BMI for the participants was $23 \pm 2.34$, and mean body fat percentage was $24 \pm 4.15\%$. 

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### Table 11  Number of Participants per Sport

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<th>Sport</th>
<th>Participants</th>
<th>Percentage</th>
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<td>Crew</td>
<td>3</td>
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</tr>
<tr>
<td>Gymnastics</td>
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</tr>
<tr>
<td>Field Hockey</td>
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<td>6%</td>
</tr>
<tr>
<td>Soccer</td>
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</tr>
<tr>
<td>Swimming</td>
<td>6</td>
<td>37.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td><strong>100%</strong></td>
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### Table 12  Demographics of Participants

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<th>SD</th>
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<td>115-179</td>
</tr>
<tr>
<td>BMI</td>
<td>23.0</td>
<td>2.34</td>
<td>19.5-26.9</td>
</tr>
<tr>
<td>Fat %</td>
<td>24.0</td>
<td>4.15</td>
<td>19-33.3</td>
</tr>
</tbody>
</table>
When asked which of the iDXA scans looked most like them, six of the sixteen participants (38%) could correctly identify their own iDXA scan using the BUCKiDXA. When asked which of the scans the participants would be okay with looking like, most participants chose scans that were a lower BMI and had varying body fat percentages (Figure 1). The scan that was chosen most often (chosen by 12 of the 16 participants, or 75%) was a scan with a BMI of 20 and a fat percentage of 16% (Figure 5). Eight of the sixteen participants (50%) chose their own scan as one of the bodies that they would be okay with looking like. The results of the silhouette choices are further detailed in Figure 4.
### Figure 4 Subject Chosen iDXA Scans, “Okay With” Looking Like (from BUCKiDXA)

<table>
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<tr>
<th>Scan #</th>
<th>Self</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>1</th>
<th>4</th>
<th>2</th>
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<td>%Fat</td>
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<td>3</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Paired scans in order from smallest BMI (top left) to largest (bottom right)

Outlined scan is the scan chosen most often by participants (BMI 20, fat 16%).

Note: this order was not how these scans were presented to each subject.

Wilcoxon non-parametric statistics were used to compare the Stunkard scale and the BUCKiDXA tool using BMI differential (scoring explained in methods section).

Upon analysis of the data, one of the participants chose a current body on the Stunkard scale that represented a BMI of 33 when her actual BMI was 26.5. Since the highest represented BMI for the BUCKiDXA was 31, this participant was excluded for this specific statistical analysis. Therefore, the Wilcoxon statistic was performed on 15
subjects. When the aforementioned individual was removed from analysis, there was no significant difference between the BUCKiDXA differential and the Stunkard differential scores.

The MBSRQ section of the questionnaire was analyzed using a non-parametric Spearman correlation test for the relationships of the BUCKiDXA silhouette choices with the two subscales: appearance orientation (AO) and appearance evaluation (AE). The coefficients for the two subscales were found to be slightly negatively correlated with the BUCKiDXA differential, but these negative correlations did not reach statistical significance (AO $r=-0.053$, $p=0.845$) (AE $r=-0.2$, $p=0.458$). This data does not support a correlation between the BUCKiDXA differential score and the MBSRQ appearance subscales, meaning that body dissatisfaction is not correlated to wanting to have a smaller morphology.

The CBIQA subscale comparison was analyzed using the non-parametric Wilcoxon related-samples signed rank test. When comparing muscularity, participants felt significantly more muscular in daily life than in their sport ($p=0.001$). When comparing appearance, athletes showed little difference in how they felt about their bodies’ appearance in sport and in daily life ($p=0.812$). For the thin-fat self subscale, athletes felt that they had a larger morphology in sport when compared to their teammates than in daily life when compared to their peers ($p=0.004$). In terms of the thin-fat others subscale, athletes felt that fellow athletes as well as non-athlete peers saw their body in a similar way in sport and daily life regarding fat, shape, and weight ($p=0.673$). Analysis
of the CBIQA found significant differences between daily life and sport in the subscales of muscularity as well as thin-fat self.

**Discussion**

There were a variety of sports represented in this study. The heterogeneity of athletes regarding sport participation in this study may have influenced how athletes responded to body image questions. For instance, an athlete participating in field hockey may be more accustomed to being around fellow athletes with a higher fat percentage than gymnasts would be.

The athletes in this study have some interesting comparison with average American females ages 20-29 as published by Hoffman\(^5\). This sample of athletes were slightly taller than the average adult female by 3.2 inches. On average, the athletes in this study were 7.7 pounds lighter in weight than the average adult female. The mean BMI for this sample was 23 which is considered healthy. These comparisons are depicted in Table 13. The range of BMIs in this sample was 19.5-26.9 so participants were in both the healthy and overweight (25-30) categories, though BMI is not of great use in athletes.
Table 13  Comparison for Height and Weight Between This Study and Average Adult Females Aged 20-29

<table>
<thead>
<tr>
<th></th>
<th>Average Height (in)</th>
<th>Average Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This Study</td>
<td>67.3</td>
<td>148.2</td>
</tr>
<tr>
<td>Hoffman⁵¹</td>
<td>64.1</td>
<td>156.5</td>
</tr>
<tr>
<td>Difference</td>
<td>+3.2</td>
<td>-7.7</td>
</tr>
</tbody>
</table>

The athletes in this study also compare well to the other NCAA Division 1 athletes. Fornetti et al. and Prior et al. have determined the average body fat percentages for collegiate NCAA Division 1 females participating in various sports (Table 14)⁵²,⁵³. The average body fat for the athletes in this study was $24 \pm 4.15$, which is slightly higher than the published values.

Table 14  Average Body Fat Percentage per Sport for NCAA Division 1 Athletes Compared to This Study⁵²,⁵³

<table>
<thead>
<tr>
<th>Sport</th>
<th>Gymnastics</th>
<th>Crew</th>
<th>Soccer</th>
<th>Swimming</th>
<th>Field Hockey</th>
</tr>
</thead>
<tbody>
<tr>
<td>This Study</td>
<td>23.8%</td>
<td>30.0%</td>
<td>22.9%</td>
<td>23.3%</td>
<td>29.3%</td>
</tr>
<tr>
<td>Average BF%</td>
<td>$19.1 \pm 2.2%$</td>
<td>$21.9 \pm 2.3%$</td>
<td>$21.8 \pm 2.7%$</td>
<td>$23.5 \pm 5.8%$</td>
<td>$20.9 \pm 4.1%$</td>
</tr>
</tbody>
</table>

This study demonstrated that not all athletes were able to accurately identify an iDXA soft tissue image of their own body. It should be noted that many of these teams receive 1 to 2 iDXA scans each year that they are a NCAA Division 1 athlete at Ohio State. Many of the participants in this study have the opportunity to look at their iDXA...
scan at each of these occasions. Despite these athletes’ familiarity with iDXA scans, only six of the sixteen participants could correctly choose their own scan in the BUCKiDXA tool. The other ten participants incorrectly chose an iDXA scan that they thought was themselves. This shows how athletes often have a skewed body image, as they are not fully aware of what their bodies look like from an outside perspective.

When asked which bodies they would be “okay with” looking like, most of the participants chose iDXA scans that had lower BMIs and mixed fat percentages. Much of the time, participants chose “acceptable” bodies that ranged from a fat percentage of 16 to 31 percent. It seems from looking at Figure 1 that a lower BMI has more of an impact in what an athlete sees as “acceptable” than a lower fat percentage. It is common for athletes to want to be lean, but these athletes were apparently unable to discern body fatness using the BUCKiDXA tool. However, the scan that was chosen most often (by 75% of participants) as being acceptable was a very lean scan with a BMI of 20 and a fat percentage of 16%. This is similar to the Bulik study where the figure chosen most often was figure 3 which corresponded to a BMI of 20.9 (fat percentage information was not available), and the Peterson study where the BMI for the figure chosen most often was 21.6\textsuperscript{12,35}. Since the participants’ average BMI was 23 and average fat percentage was 24%, this suggests that most of the participants would be happy if their body was about 3 points lower in BMI and 8% lower in body fat percentage. The impression that many females want to look smaller than they currently are is consistent with the literature\textsuperscript{1,2}.

The BUCKiDXA tool itself has a few limitations. Firstly, muscle definition is not evident from looking at the iDXA scans so it may have been difficult for an athlete to
determine if they would have truly wanted or not wanted to look like the different scans. Another limitation is that the scans are only the frontal view, so the participants are only seeing one side of the bodies. Despite these limitations, the BUCKiDXA is an improvement from the black and white pen drawings presented in the Stunkard tool.

When viewing the data comparing the Stunkard tool to the new BUCKiDXA scale, one of the participants chose a current silhouette on the Stunkard scale that represented a body that had a BMI of 33 while she had a BMI of 26.5. Since the created BUCKiDXA tool has BMIs ranging from 16 to 31, this participant was not included in this statistical analysis. Making the two tools (Stunkard and BUCKiDXA) more similar regarding represented BMIs would result in a more accurate comparison of the tools. This could be done either by adding bodies with higher BMIs to the BUCKiDXA tool or by omitting any silhouette on the Stunkard scale that exceeds a BMI of 31. The results of the current analysis (n=15) showed no statistically significant difference between the two tools.

The Stunkard scale has fewer silhouettes as part of the tool (9) compared to the BUCKiDXA tool (19). Most of the previously used tools have anywhere from 5 to 12 silhouettes\textsuperscript{15}, and the new BUCKiDXA tool has many more silhouettes than prior tools. This allows for more body types, shapes, and morphologies to be represented in this newly created tool. The more scans also increase the difficulty for an athlete to pick out which one is their current body. Another unique piece of the new BUCKiDXA tool is that it contains the actual body of the participant, which has not been demonstrated in any previous figural rating scale. It would be expected that with more participants, a greater
difference in BMI differential would have been seen using the Stunkard scale. This is because when using the BUCKiDXA scale, the participant can choose from a lot more bodies and they are able to choose multiple bodies for their “ideal.” This activity may have value in helping athletes see that many body types and body fat percentages can be appealing with hopes that they would be less idealistic in their self-image.

Body image was also explored in this analysis using the MBSRQ. When the AE and AO subscales were analyzed to test for correlation with the BUCKiDXA differentials, a very weak and insignificant negative correlation were computed for both subscales (-0.2 and -0.053 respectively). Had these correlations been significant, interpretation for the AE and AO subscales would have been split compared with expected results. For AE and BUCKiDXA differential (r=-0.2, p=0.458), the direction of the coefficient would have meant that the higher the AE score (i.e. more pleased with body), the smaller the differential (better satisfaction) between BMI of the chosen current scan and the average BMI of the chosen ideal scans. This makes sense, because the happier a person is with their body, the closer their ideal bodies would be to their current body. For AO and BUCKiDXA differential (r=-0.053, p=0.845), this would have meant that the higher the AO (meaning the more time and effort a person puts into their appearance), the smaller the differential. While this is a very weak and insignificant negative correlation, it is still directionally unexpected. Typically, one who puts a lot of effort and time into their appearance would be more dissatisfied with how their body looks (which would merit a higher BUCKiDXA differential score). However, someone who works very hard on their appearance does not necessarily have a negative body
image, and may just cares a lot about their appearance. One must use caution even attempting to interpret the results of these correlational analyses due to the insignificant p-values.

The findings from the CBIQA data strengthen the concept that athletes have different body images in their sport as compared with daily life. Athletes in this study felt more muscular in daily life than in their sport (p=0.001). Athletes are often more muscular than the average person and this may cause them to notice their increased muscularity when comparing themselves to their non-athlete peers. Interestingly, athletes felt the same about their body’s appearance in sport and in daily life. This suggests that while athletes do notice that they are muscular, they are accepting of this fact and do not feel like it makes their appearance more- or less-beautiful in sport and in daily life.

Regarding fat, shape, and weight, athletes felt that they had a larger morphology in sport when compared to their teammates than in daily life when compared to their peers (p=0.004). This may have been because in sport, athletes are comparing themselves to other athletes who have similar athletic bodies. However, in daily life, athletes are surrounded by all types of people, athletic and non-athletic, with varying body types. This contributes to their feelings of being more fit when compared to non-athlete peers versus when compared to athletic teammates. Our results indicated that participants felt that fellow athletes as well as non-athlete peers saw their body in a similar way in sport and daily life regarding fat, shape, and weight. This suggests that athletes do not believe that others’ perceptions of themselves change in sport compared to daily life. However,
as mentioned before, participants did indicate that they look different in sport and in daily life despite what they believe others think.

The information gathered through this study can be used to help deal with the negative body image experienced by many young female athletes. Programs have been developed such as The Whole Image for Athletes (WIA) that provide online education focused on enhancing body image and preventing eating disorders in collegiate athletes\(^5\). The BUCKiDXA tool has the potential to strengthen interventions such as the WIA to make them even more effective at promoting positive body image for young athletes.

In the future, this study could be improved in a couple ways. First, it would be interesting to ask each participant if they had seen their own iDXA scan in the past. This would have shed more light onto why some athletes were able to choose their own iDXA scan while others were not. Regarding the body part ranking, it would be interesting to compare the women’s responses to the responses of men when asked which of the same body parts they find most important when determining the attractiveness of a woman. These changes would help the researcher understand more about body dissatisfaction in this population.

Limitations

The BUCKiDXA tool is a newly developed tool that has not been validated yet. This study was unable to validate the BUCKiDXA tool due to low participant numbers. The low numbers were due to time constraints, which is another limitation to this study. The potentially sensitive nature of this study may have prevented more athletes from
participating. This study should be viewed as pilot work to foster ideas of how to help athletes improve their body image. Another limitation to this study is the heterogeneity of sports represented. These sports all have varying typical body types, and due to the low number of participants in each sport, a statistical comparison between sports could not be completed.

In conclusion, this study shows that athletes are generally not able to pick out their own body when presented with a group of iDXA silhouettes. Athletes tend to not be able to distinguish body fat by looking at body silhouettes, and they are more concerned with the morphology of the body in general. There may be educational value in helping athletes think about the range of body fatness they chose as acceptable relative to their beliefs about what percent body fat they would want to be. More research is needed in this area to learn more about this issue to better address body image in the athletic population.