The Relationship Between Eating Attitudes And Body Composition In Dietetic Students.

A Thesis

Presented in Partial Fulfillment of the Requirements for

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By

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Abstract

Background: Recent literature suggests that nutrition and dietetic students are at higher risk for developing behavioral traits associated with restrictive eating and low body weight. In general, the combination of low body weight and inadequate diet has been associated with poor bone mass. The relationships between restrictive eating attitudes, body image, and body composition or bone health have yet to be addressed in this pre-professional population.

Objectives: This descriptive, cross-sectional study describes anthropometric characteristics of dietetic students. Correlations between eating attitudes and body composition, specifically bone mineral density, fat mass, and lean body mass, as well as body image perceptions and resting metabolic rate in dietetic students were measured.

Participants: Thirty-three male and female dietetic students received a set of full body GE Lunar iDXA scans and a fasted resting metabolic rate estimate via indirect calorimetry (ReeVue). To assess restrictive eating attitudes and body image perceptions they completed a questionnaire comprised of the EDE-Q, Tendency to Diet Scale, Multi Body Shape Relations Questionnaire, and Figure Rating Scale.

Statistical Analysis: Variables of interest were uploaded into SPSS software for quantitative analysis. Eating attitudes were compared to data of the general population from Mond et al. For fair comparison, Mond et al. means for each subscale (restraint, eating, weight, and shape) were adjusted by the percentage of participants in each age group of our study to better standardize Mond scores and have a pooled age estimate.
similar to the make-up of our group. A series of five, independent one-sample t-tests were completed to compare current results to normative data. Alpha levels were adjusted based on the modified Bonferroni test and p-values were generated.

**Results:** Female dietetic students had greater restrictive eating attitudes than a general female population, and a majority of females had below average bone mineral density in the distal radius. The majority of all participants were within a normal body mass index (BMI), normal percent body fat, and had an average BMD Z-score at various sites, with the exception of the majority of females having lower BMD in the distal radius. Average RMR per gender was considered normal. Having greater restrictive eating attitudes does not necessarily translate to an underweight BMI, below normal body fat percentage, or below average BMD in dietetic students. This group of young pre-professionals would benefit from receiving a DXA scan during their undergraduate studies to identify and potentially improve low BMD. Incorporating an educational course into their curriculum that fosters a healthier understanding of eating psychopathology to better grow and serve as role models in their prospective health career could also be helpful for this group. Future collaborative research is needed to assess restrictive eating attitudes, energy availability and body composition in dietetic undergraduates across the country amongst different universities and in other countries.
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# Table of Contents

Abstract .......................................................................................................................... ii  
Acknowledgements ........................................................................................................ iv  
Vita .................................................................................................................................. v  
List of Abbreviations ..................................................................................................... viii  
List of Tables ................................................................................................................ x  
List of Figures ................................................................................................................ xi  
1. Background ................................................................................................................ 1  
  Objectives ................................................................................................................... 2  

2. Review of the Literature ............................................................................................ 4  
  Defining Disordered Eating ....................................................................................... 4  
    Defining The Spectrum ............................................................................................. 4  
  Eating Disorders and Disordered Eating in College Students ................................. 6  
    Prevalence of Eating Disorders in the College Population ..................................... 6  
    Risk Factors ............................................................................................................. 8  
    Stress / College Atmosphere .................................................................................. 10  
  Disordered Eating in Dietetic Students ..................................................................... 11  
    Societal Expectation ............................................................................................... 12  
  Prevalence of Disordered Eating in Dietetic Students ............................................. 13  
  Implications/Risks Related to Disordered Eating .................................................... 16  
    Body Mass Index (BMI) ........................................................................................... 16  
    Bone Mineral Density ............................................................................................ 17
Resting Metabolic Rate ......................................................................................... 20
Validation of Tools ................................................................................................. 21

3. Methods ........................................................................................................... 24
Statistical Analysis of Research Questions .......................................................... 28

4. Results ............................................................................................................ 33
Restrictive Eating Prevalence ............................................................................. 34
Correlations .......................................................................................................... 35
Questionnaire Responses ..................................................................................... 41
Bone Density, RMR, Body Composition ............................................................... 44

5. Discussion ....................................................................................................... 51
Limitations ............................................................................................................ 57
Conclusions .......................................................................................................... 59

References .......................................................................................................... 61

Appendix A: Study Questionnaire ...................................................................... 69

Appendix B: Comparison of Eating Attitude Assessment Tools Used in Current
Restrictive Eating Literature ............................................................................... 92
### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>aBMD</td>
<td>Areal Bone Mineral Density</td>
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<tr>
<td>AE</td>
<td>Appearance Evaluation</td>
</tr>
<tr>
<td>AN</td>
<td>Anorexia Nervosa</td>
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<tr>
<td>AO</td>
<td>Appearance Orientation</td>
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<tr>
<td>BF%</td>
<td>Body Fat Percentage</td>
</tr>
<tr>
<td>BMD</td>
<td>Bone Mineral Density</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index in kg/m²</td>
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<tr>
<td>BN</td>
<td>Bulimia Nervosa</td>
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<td>BSQ</td>
<td>Body Shape Questionnaire</td>
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<tr>
<td>DEBQ</td>
<td>Dutch Eating Behavior Questionnaire</td>
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<tr>
<td>DSM-V</td>
<td>Diagnostic and Statistical Manual of Mental Disorders</td>
</tr>
<tr>
<td>DXA</td>
<td>Dual-Energy X-ray Absorptiometry</td>
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<tr>
<td>EAT</td>
<td>Eating Attitudes Test</td>
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<tr>
<td>ED</td>
<td>Eating Disorder</td>
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<td>EDE</td>
<td>Eating Disorder Examination</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>EDE-Q</td>
<td>Eating Disorder Examination Questionnaire</td>
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<tr>
<td>EDI</td>
<td>Eating Disorder Inventory</td>
</tr>
<tr>
<td>EDNOS</td>
<td>Eating Disorders Not Otherwise Specified</td>
</tr>
<tr>
<td>HB</td>
<td>Harris-Benedict</td>
</tr>
<tr>
<td>Kg/m2</td>
<td>Kilograms per meters, squared</td>
</tr>
<tr>
<td>OSFED</td>
<td>Other Specified Feeding or Eating Disorders</td>
</tr>
<tr>
<td>MBSRQ</td>
<td>Multidimensional Body Shape Relations Questionnaire</td>
</tr>
<tr>
<td>NEDA</td>
<td>National Eating Disorders Association</td>
</tr>
<tr>
<td>NWO</td>
<td>Normal Weight Obesity</td>
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<tr>
<td>RMR</td>
<td>Resting Metabolic Rate</td>
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<tr>
<td>SPSS</td>
<td>Statistical Package for Social Science</td>
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<tr>
<td>TDS</td>
<td>Tendency to Diet Scale</td>
</tr>
<tr>
<td>TFEQ</td>
<td>Three-Factor Eating Questionnaire</td>
</tr>
<tr>
<td>U.S.</td>
<td>United States</td>
</tr>
<tr>
<td>UD</td>
<td>Ultra-Distal</td>
</tr>
</tbody>
</table>
List of Tables

TABLE 1. QUESTIONNAIRE TOOLS ...........................................................................................................27
TABLE 2. MOND AGE GROUPS AND EDE-Q MEANS AND STANDARD DEVIATIONS ..................30
TABLE 3. GEITZ SAMPLE FREQUENCY PER AGE GROUP .................................................................31
TABLE 4. DEMOGRAPHICS MALE AND FEMALE ..................................................................................33
TABLE 5. RAW EDE-Q SUBSCALE MEANS (FEMALE) .........................................................................35
TABLE 6. EDE-Q SUBSCALE MEAN SCORE COMPARISON WITH ADJUSTED MOND ET AL. EDE-Q SUBSCALE MEANS AFTER DIRECT STANDARDIZATION .................................................................35
TABLE 7. FEMALE CORRELATIONS BETWEEN EATING ATTITUDE QUESTIONNAIRES ................37
TABLE 8. CORRELATION BETWEEN EATING QUESTIONNAIRES AND BMD ....................................38
TABLE 9. CORRELATIONS BETWEEN EATING QUESTIONNAIRES AND BODY COMPOSITION MEASURES ......39
TABLE 10. CORRELATIONS BETWEEN BMD AND RMR ......................................................................40
TABLE 11. AVERAGE BONE MINERAL DENSITY Z-scores BY GENDER .................................................44
TABLE 12. FEMALE COMPARISON OF BMI AND BODY FAT PERCENTAGE MEASURED BY DXA ..........46
TABLE 13. MALE COMPARISON OF BMI AND BODY FAT PERCENTAGE MEASURED BY DXA ............47
TABLE 14. CALCULATED RMR COMPARISONS OBTAINED FROM REEVUE INDIRECT CALORIMETER .................................................................................................................................50
TABLE 15. COMPARISON OF EDE-Q MEANS FROM VARIOUS STUDIES .............................................53
TABLE 16. COMPARISON OF CLINICALLY SIGNIFICANT EDE-Q SCORES AMONG VARIOUS STUDIES ....54
List of Figures

FIGURE 1. TENDENCY TO DIET SCORES BY GENDER ................................................................. 41
FIGURE 2. MBSRQ SCORES BY GENDER .................................................................................. 42
FIGURE 3. DIFFERENCES IN SILHOUETTE SCORE BY GENDER ...................................................... 43
FIGURE 4. BMD FREQUENCY OF Z-SCORES FOR FEMALES BY ANATOMICAL SITE ....................... 45
FIGURE 5. BMD FREQUENCY OF Z-SCORES FOR MALES BY ANATOMICAL SITE .......................... 45
FIGURE 6. FEMALE COMPARISON OF BMI AND BODY FAT PERCENTAGE .................................... 47
FIGURE 7. MALE COMPARISON OF BMI AND BODY FAT PERCENTAGE ...................................... 48
FIGURE 8. RMR MEASUREMENT ............................................................................................... 49
FIGURE 9. COMPARISON OF EDE-Q MEANS ............................................................................. 52
1. Background

While the prevalence of obesity has risen in the United States, so has the occurrence of eating disorders. This increase of eating disorder prevalence may be attributed to the inclusion of Other Specified Feeding or Eating Disorders (OSFED) in 2013, formerly known as Eating Disorder Not Otherwise Specified in 1994, in the *Diagnostic and Statistical Manual of Mental Disorders* that has gained recognition as another eating disorder diagnosis. Dietetic students may inadvertently try to meet standards of health and nutrition perpetuated by societal culture or self-expectation. The implications of this pressure must be acknowledged. Risks for eating disorders can include, but are not limited to, body dissatisfaction, dietary restriction, excessive exercise, female gender, and stress.

In many cases, eating disorders are initially diagnosed during young adulthood, more specifically in college aged individuals. The social and environmental stressors during the transition period into young adulthood, particularly college, can provoke the expression of disordered eating behaviors. Research evaluating restrictive eating attitudes and associated health measures in an undergraduate dietetic population in the United States is scarce. Studies that did assess restrictive eating attitudes found that dietetics students are more likely to report restrictive eating attitudes in comparison to other non-dietetic majors. This suggests that dietetic students are at risk for inadequate caloric intake and, thus, low energy availability. Low energy availability is a term that originates in the female athlete triad literature where female athletes low in
energy availability would be at higher risk for menstrual cycle disturbances and low bone mineral density. Energy availability is defined as the energy remaining for basic bodily functions after exercise energy expenditure is subtracted from dietary energy intake. Relationships between restrictive eating attitudes, body composition, bone mineral density, and resting metabolic rate have not been reported among dietetic students.

Evaluating restrictive eating, body image attitudes and body composition in dietetic students, will provide insight into the relationships between these components which may be useful in prevention or treatment of eating disorders in this population. Harmful eating attitudes and poor body-image perception may negatively impact body composition. If this group of pre-professionals engages in restrictive eating, it may reflect in the bone density values similar to the female athlete triad. Thorough evaluation of this population's body composition and eating attitudes may reinforce the importance of early BMD assessment or warrant inclusion of an educational course that focuses on self-evaluation while addressing disordered eating and body-image perception.

Significance of Study: This study is designed to gather data that will provide insight into the eating attitudes and body composition among dietetic students, and determine the need for future interventions to educate and modify any unhealthy trends.

Objectives

This descriptive, cross-sectional study seeks to examine and identify the relationship between restrictive eating attitudes and body composition in dietetic students. A secondary aim is to describe and identify any relationships between restrictive eating attitudes and resting metabolic rate quantified by a ReeVue indirect calorimeter.
Research Questions:

1. What is the prevalence of restrictive eating attitudes reported by dietetic students as determined by the EDE-Q?

2. Is there a relationship between eating attitudes and bone mineral density?

3. What is the body composition of dietetic students with a normal BMI?

4. Is there a relationship between eating attitudes and estimated resting metabolic rate?
2. Review of the Literature

The curriculum for nutrition professionals revolves around a healthy lifestyle with nutrition at its epicenter. Recent literature suggests that nutrition and dietetic collegiate students are more likely to demonstrate behavioral traits associated with eating disorders than students from other areas of study. However, the literature is lacking the accompanying physiological data to further evaluate the potential consequences that may result from restrictive attitudes and behaviors.

Restrictive eating attitudes in dietetic student populations from various countries and locations, such as Brazil, Portugal, Germany, South Africa and Italy, have been demonstrated in the recent literature. Restrictive eating is associated with eating disorders, however a causal relationship between restrictive eating and subsequent onset of eating disorders cannot be made using epidemiological or questionnaire data alone. Seeking to better understand the relationships of physical health to questionnaire data will help further identify associated risks.

Defining Disordered Eating

Defining The Spectrum

According to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-V*), all of the described criteria for an eating disorder must be met in order to be clinically diagnosed. Until 1994, anorexia nervosa (AN) and bulimia nervosa (BN) were the only two specified eating disorders. From 1994 to 2013, the DSM-IV also recognized a generic category derivative of an eating disorder known as “eating
disorders not otherwise specified” (EDNOS) which included disorders that did not completely meet all criteria for anorexia nervosa or bulimia nervosa. Upon the revision of the DSM in 2013, the DSM-V re-named EDNOS to “Other Specified Feeding or Eating Disorders” (OSFED) and included Binge Eating Disorder in addition to anorexia and bulimia. As described by the DSM-V, disordered eating is included under OSFED and is defined as "a wide range of irregular eating behaviors that do not warrant a diagnosis of a specific eating disorder." For the sake of this study, it is important to note that disordered eating will be evaluated based on eating attitudes and behaviors.

EDNOS eating disorders are just as serious and possibly more prevalent as AN and BN. In 2007, Fairburn et al. gathered 170 outpatient participants who were referred to eating disorder clinics in the UK. Each participant was assessed by an Eating Disorder Examination (EDE) interview to determine diagnoses of AN or BN based on DSM criteria. Those who did not meet DSM criteria were classified as EDNOS. Of the 170 participants, 102 participants (60.0%) were diagnosed as EDNOS, 8 were diagnosed with AN, 60 were diagnosed with BN and 7 were found to meet the DSM criteria for binge eating disorder. The EDE scores of EDNOS participants were described to demonstrate psychological characteristics of both BN and AN. In an adult outpatient setting, not only is EDNOS the most commonly diagnosed of the specified eating disorders, they are also similar to BN in terms of severity. Thus, the entire spectrum of eating disorders must be considered and addressed in clinical and non-clinical settings.

To further narrow the range of OSFED, this study examined disordered eating in the form of dietary restraint, also referred to as restrictive eating attitudes. Dietary restraint or restrictive eating is viewed as a cognitively conscious and deliberate effort to reach an improved body composition or weight by restricting food intake. These
behaviors can include strict dieting, weight, shape, and eating concerns, binging and purging.  

**Eating Disorders and Disordered Eating in College Students**

**Prevalence of Eating Disorders in the College Population**

According to the *National Eating Disorders Association (NEDA)* in 2013, “The increased pressure and stress of school and leaving home may lead to mental health problems among college students and a greater need for campus services.” This is also a period of development in which disordered eating is likely to arise, resurface or worsen for many young men and women. Eating disorders (ED) based on DSM V criteria are most likely to develop between ages 18 and 21. Over a 13-year period of time from 1995 to 2008 in California, the prevalence of eating disorders in a randomized undergraduate population significantly increased from 23% to 32% in females and 7.9% to 25% in males. In the 2013 Collegiate Survey Project conducted by NEDA, only 22.4% of the 163 universities offered year-round screening opportunities for all students. Colleges are tasked with the option of providing helpful resources and programs for their students to attenuate eating disorder behaviors although not all colleges can offer sufficient resources. College ED prevalence may be underreported considering not all students are screened for ED or seek treatment for mental health concerns. Eisenberg at al. examined the prevalence and correlates of eating disorder symptoms in a random sample of college students from a Midwestern U.S. university and found that 13.5% of women and 3.6% of men were positively screened for presence of eating disorder characteristics based on their SCOFF score. Of the students who had a positive screen, only 20% received mental health treatment. ED has risen in the college population, although this occurrence may be underreported.
Disordered eating in the general college population is well studied. Restrictive eating attitudes or disordered eating can be established before or during college. Literature has shown that, both male and female students without disordered eating traits prior to college were more likely to develop disordered eating traits within their first year of college.\textsuperscript{19} Berg et al. examined changes in ED prevalence in 324 female undergraduates at the beginning and end of a two-month period using the EDI-2. While there was a slight decrease in reported disordered eating over the period of the study, there was still a high prevalence of reported disordered eating as it was found in 40% of participants.\textsuperscript{20} Other researchers have had similar findings where disordered eating prevalence remains consistently high regardless of whether disordered eating behaviors were established before or during college.\textsuperscript{20,21}

It has been shown that as an individual has higher frequency of dieting, the more they struggled with disordered eating traits and body image dissatisfaction.\textsuperscript{22,23} For example, Gingras et al. found that female chronic dieters had greater body dissatisfaction and like their appearance less, based on the Multi Body Shape Relations Questionnaire (MBSRQ), in comparison to normative reference data ($p= .001$).\textsuperscript{23} A study by Juarascio et al. sought to examine the relationship between dieting, body dissatisfaction, disordered eating and anxiety and depression in 472 undergraduate women.\textsuperscript{24} The EAT-26 and Eating Inventory was used to assess disordered eating and dieting and the body shape questionnaire was used to assess body dissatisfaction. Higher scores on the EAT-26 were correlated with greater body dissatisfaction. Results from this study demonstrated that body image dissatisfaction is a greater predictor of disordered eating than dieting frequency.\textsuperscript{24} Body image is likely reflected in disordered eating and dieting.
Cohen and Petrie measured correlates of disordered eating symptoms in 334 undergraduate females. Eating attitudes, body attitudes, and mood or self-esteem were assessed using the Questionnaire for Eating Disorder Diagnoses (Q-EDD), Body Parts Satisfaction Scale-Revised, Body Shape Questionnaire (BSQ), Beliefs About Attractiveness Scale, Rosenberg Self-Esteem Scale and 7-item mood scale. Women were categorized as asymptomatic (no disordered eating) symptomatic (disordered eating) or eating disordered based on their Q-EDD scores. One hundred and thirty (38.9%) participants were classified as symptomatic, 32 (9.6%) were eating disordered and 172 (51.5%) were asymptomatic. The eating disordered and symptomatic groups were not significantly different; however, both had higher scores of anxiety, stress, and guilt, and lower scores of happiness, confidence, and self-esteem than the asymptomatic group. In addition, the eating disordered and symptomatic group had statistically significant greater body dissatisfaction and adoption of "sociocultural attitudes" about the importance of being physically fit, thin, and attractive than the asymptomatic group. Based on their results, Cohen and Petrie determined that disordered eating participants were more similar to those with eating disorders and their disordered eating behaviors were related to greater body dissatisfaction and internalization of societal beauty standards. Body image dissatisfaction and greater attention to societal beauty standards are probable correlates of disordered eating.

**Risk Factors**

Body image perception and a stressful atmosphere may influence the occurrence of disordered eating or eating disorders in young adults. Silva et al. examined the relationship between eating attitude behaviors and body image dissatisfaction in college nutrition students in Brazil using the Eating Attitudes Test (EAT) and BSQ. Of the 175 female participants, 13.7% showed dissatisfaction with body image, and overweight
nutrition students were 5-7 times more likely to be dissatisfied with body image. Body dissatisfaction is usually the backdrop for disordered eating behaviors.

Studies showing media influence on body image in college-aged females are common in the literature. Monro and Huon sought to determine the effects of media-portrayed idealized images on women's body shame and appearance anxiety. Twenty-four magazine advertisements were shown to 37 female university students. Half of the advertisements included body-related products and the other half did not include body-related products. Half of each advertisement group contained media-portrayed idealized images. Appearance anxiety and body shame were measured, via different scales, before and after exposure to the images. Appearance anxiety and body-shame increased when participants were exposed to idealized images. Exposure to constant body-perfect media likely serves to increase body dissatisfaction.

Other sociocultural factors can influence ED or ED behaviors. Hawkins et al. explored these factors in 145 college women and 21 ED diagnosed women recruited from a clinical practice. Risk factors of disordered eating or body were not tested in the college women prior to enrollment. The researchers aimed to determine if “thin-ideal” media images influence women’s body dissatisfaction, self-esteem, internalization of the “thin-ideal” and eating disorder symptoms. Participants were randomly placed into either the “thin-ideal” condition (n=74) or the neutral-image (n=71) control group. The experimental group was exposed to images from magazines for 30 minutes. Images had to meet a certain set of criteria, such as showing 90% of the model's body or not represent an advertisement for dieting. The control group was shown advertisements from magazines that did not contain any people. The Body Satisfaction subscale of the EDI, Rosenberg Self-Esteem scale, Profile of Mood States and Sociocultural Attitudes Towards Appearance Questionnaire, and Anorexia Bulimia Inventory were used to
measure body satisfaction, self-esteem, negative affect, and disordered eating symptoms. Individuals in the ED thin-deal group had statistically significant higher body dissatisfaction, overall negative mood, and significantly lower self-esteem in comparison to the non-clinical groups. Individuals in the non-ED “thin-ideal” group displayed higher body dissatisfaction than the neutral image group as well. Idealized media images may have a stronger influence on body-dissatisfaction in women that have ED or ED behaviors.

**Stress / College Atmosphere**

Adjusting to college can be a stressful and overwhelming experience. This increased stress could trigger and maintain disordered eating behaviors in some instances. Striegel-Moore et al. sought to discover if there were any changes in disordered eating behaviors in a co-ed undergraduate population from the beginning to the end of their freshman year.¹⁹ Four hundred and three females and 546 males were recruited and given various scales to measure stress, work and family orientation, body image and disordered eating. Females with no history of dieting prior to college were significantly more likely to engage in dieting or binging behaviors by the end of their freshman year. The initial adjustment to college can prove to be more stressful to freshman, increasing their risk for disordered eating.

Similarly, non-dieting males were more likely to report dieting at the end of the year. In both genders, those who reported history of dieting at the beginning of the year were unlikely to report dieting cessation by the end of the year.¹⁹ Worsening of disordered eating behaviors was correlated with increased feelings of stress, perceived ineffectiveness, and greater negative feelings of weight throughout the first year of college.¹⁹ In a different study, Sassaroli and Ruggiero recruited 145 non-clinical females that completed the EDI, Multidimensional Perfectionism Scale and the Penn State Worry
There was an association between individuals with scores indicating greater ED risk during stressful situations and in those with low self-esteem. Increased feelings of stress can be associated with the onset of ED or ED behaviors.

**Disordered Eating in Dietetic Students**

Constant exposure to food and nutrition related topics coupled with the desire to attain a physical appearance reflective of societal beauty standard and their professional credibility may make dietetic students more susceptible in adoption of abnormal eating behaviors than the general population. The Commission on Dietetic Registration through the Academy of Nutrition and Dietetics quantified the national census of Registered Dietitians to be 89,300 in December of 2013, of which 84,177 were female and 3,160 were male. In studies that include both males and females in the dietetic population, females comprise the majority of the sample size due to the dietetic profession being a female-dominant health profession. Since the dietetics profession is primarily female, it would follow that there may be a higher prevalence of restrictive eating in this population.

Alternatively, students with pre-existing disordered eating may enroll in dietetics training as a personal interest. Hughes and Desbrow conducted a qualitative study that interviewed 63 applicants seeking acceptance into a Master of Nutrition and Dietetics program in Australia. Nearly 30% of participants reported that a personal experience, like obesity or an eating disorder, inspired them to pursue a career in nutrition. Strauss et al. had similar findings where undergraduate dietetic students from the U.S. indicated that a former or existing eating disorder drove them to enter the field of nutrition and dietetics. It is uncertain whether personal eating attitudes of dietetic students can influence their professional practice.
Societal Expectation

Students in nutrition can feel pressured to maintain an appropriate body weight and image to correspond with society’s thin beauty standards.7,35,36 In a profession centered on health and wellness, dietetic students may feel pressured to uphold a certain appearance and weight in order to viewed as a credible professional.37 In 2009, Atkins and Gingras conducted a qualitative study that interviewed a focus group made up of 14 dietetic students to understand their educational experience.37 In assessing students’ understanding of their body, one student vocalized that he wanted to be a healthy body weight before he becomes a dietitian so his advice is “more credible, more believable”. Similarly, another student expressed that she felt like she had to be thin and that deviance from thin could take away from dietetic students’ credibility. Atkins and Gingras interpreted this as a phenomenon likely specific to dietetic students because they will use their own bodies as a means to practice all the nutrition information they’ve learned, which may alter their relationship with food.37 Dietetic students may feel their physical appearance is a testament to how well they understand and can apply their nutrition education.

Nutrition students may have the perception that they are being scrutinized when it comes to imperfections in diet or appearance which can reinforce or lead to restrictive dietary patterns or other disordered eating characteristics.36 McArthur and Howard conducted a qualitative study to examine why dietetic students would desire to lose weight and their attitudes towards their weight-loss methods using a valid and reliable questionnaire created by the researchers.36 Of the 128 participants, 95 had tried to lose weight over the previous 2 years. The most frequent motives for wanting to lose weight included improving appearance and increasing self-esteem. Some participants wrote in that they wanted to lose weight for their dietetics major, or “to look like the women in
magazines and on TV”. Weight loss techniques included some dietary restraint behaviors such as low-fat foods/snacks consumption, eating smaller portions, counting fat grams, balanced diet low in calories and eating fewer servings. Dietetic students may practice disordered eating behaviors to lose weight in hopes of improving their appearance.

**Prevalence of Disordered Eating in Dietetic Students**

Literature has demonstrated the prevalence of disordered eating in dietetic students. Most of the studies examining disordered eating in this population have been conducted in various countries outside the United States. An array of tools and questionnaires have been developed to measure the different facets of disordered eating. In 2010, Korinth et al. utilized the German adaptation of the Three-Factor Eating Questionnaire (TFEQ) to assess for eating disorders and unhealthy eating behaviors in co-ed nutrition students in their first and seventh semester in comparison with a non-nutrition control group from German universities. Nutrition students scored significantly higher in dietary restraint than the control group with a mean score of 7.0 compared to 5.7, respectively. There was less dietary restriction reported in the seventh semester nutrition students, supporting the notion that nutrition education does not increase and may decrease disordered eating behaviors. Interestingly, this study also emphasized that restrictive eating attitudes can manifest from either potentially harmful and rigid control behaviors or healthy and flexible control behaviors. Rigid control involves strict and disciplined eating behaviors which may be more commonly found in eating disorders, where as flexible control has better outcomes of healthy weight management. In South Africa, scores from the EAT and TFEQ indicated students in the dietetic programs were also found to have a greater prevalence of dietary restraint when
compared with non-dietetic students. Disordered eating was found in 33% of dietetic students compared with 16% of non-dietetic students. The results from these studies depict the prevalence of higher restrictive eating behaviors among dietetic students.

Some studies may not directly distinguish eating disorders but do contribute to the risk factor literature. Eating behaviors were compared among 18-27 year old undergraduate dietetic students and students studying non-nutrition related courses in Portugal. The Dutch Eating Behavior Questionnaire (DEBQ), Binge Eating Scale, and General Eating Self-Efficacy Scale, were utilized to assess for emotional and external eating, binge eating severity and eating self-efficacy, respectively. Similarly, in comparison to the students studying other courses, dietetic students were found to practice higher dietary restraint and have greater prevalence of binge eating. The prevalence of eating disorders was not accounted for in this study; however, the traits studied can be considered as eating disorder risks. Dietetic students are more likely to display characteristics of eating disorders in comparison with non-dietetic students.

Researchers have identified traits characteristic of eating disorders in the dietetic population. Bo et al. examined the prevalence of eating disorders, muscle dysmorphia, and orthorexia between dietetic students and exercise science students with biology students serving as a control group in Turin, Italy. Based on four questionnaires, a self-made demographics questionnaire, a questionnaire used to diagnose orthorexia nervosa (ORTO-15), the Muscle Dysmorphic Disorder Inventory, and the EAT-26, participants enrolled in dietetics had a higher frequency of dieting and showed a two-fold higher likelihood of eating disorders than students from the other areas of study. There was a statistically significant association between dietetic students and prevalence of eating disorder traits, where approximately one-fifth of the dietetic students revealed traits of eating disorders. In interpreting these results, the differences between sample
sizes must be considered. Of the 489 total students enrolled, 32 were dietetic students, in comparison with 230 exercise students and 227 biology students. In 2013, Mealha et al. found similar results when examining the relationship between eating disorder development in dietetic and nutrition students and other degree programs. They looked at physical activity, nutritional status and eating behaviors using the EAT-26, EDI, International Physical Activity Questionnaire, a modified food frequency questionnaire, and body composition using bioelectrical impedance analysis. All 189 participants were female, and enrolled in either a nutrition degree or other academic area of study. Nutrition students had double the prevalence of psychological and behavioral tendencies that are typically connected with eating disorders in Portugal compared to students in other majors. Nutrition students have a higher prevalence of eating concerns than other students.

Since disordered eating is a multifactorial condition, it is important to look at aspects beyond eating behaviors. In Brazil, Silva et al. evaluated the relationship between eating behaviors, dissatisfaction with body image and nutritional status in female undergraduate students studying nutrition; 21.7% of 175 total participants had increased risk for developing eating disorders based on EAT and BSQ scores. Those who were considered overweight based on anthropometric measures were more susceptible to develop eating disorders than the students at normal weight. This finding may be attributed to the overweight students having higher body-image dissatisfaction. Aside from the limitations presented from using a cross-sectional study, the approximate 25% withdrawal rate and exclusion of male participants, and inability to distinguish cause and effect further prevent these findings to be implemented into clinical practice. Nevertheless, the results are similar to the other reviewed studies illustrating the need for additional investigation of disordered eating in nutrition students. Taken together,
these studies suggest that while nutrition students may have increased disordered eating risks, it does not necessarily mean they have clinical eating disorders.

Implications/Risks Related to Disordered Eating

**Body Mass Index (BMI)**

BMI, or weight and height, has been inextricably correlated to bone density in many studies through time. It has also been demonstrated to have an interesting relationship with disordered eating. In 2015, Poinhos et al. reported that first year female students studying nutrition had an insignificantly lower BMI compared to fourth year nutrition students, with a mean BMI of 19.7 and 20.6, respectively. These values were also lower than the other courses studied (basic education, history, psychology, dental medicine, electro-technical engineering, history of art, political science, geography and architecture); however, these differences were also insignificant. On average, the nutrition students displayed a normal BMI although they were found to have greater restrictive eating attitudes than non-nutrition students as determined by the DEBQ. One may think dietetic students with disordered eating would have a lower BMI; however, they have been shown to typically have a normal BMI.

Kassier et al. examined BMI and dietary restraint amongst dietetic and non-dietetic students. Of the dietetic group, two-thirds of participants were found to have a BMI within normal range (BMI 19-25 kg/m²), based on World Health Organization criteria. Although not significant, nearly half of the non-dietetic group was considered overweight based on BMI. There was still a prevalence of disordered eating as assessed by the TFEQ and EAT-26, despite having a normal BMI. BMI may not be a typical trait analyzed when assessing for prevalence of eating disorders; however, it may have an important role despite the lack of statistical significance. The similarity in BMI between the dietetic and non-dietetic students contributes to the theory that the
necessary energy needs are being met through food consumption, and that restrained eating does not necessarily mean consumption of food is less than caloric needs resulting in weight loss or lower BMI.\textsuperscript{7}

In a different female dietetic student population, McArthur and Howard found that while 85.2\% of the 128 participants were considered to have a normal BMI, 38.3\% of them thought they were overweight.\textsuperscript{38} It is possible this disconnect from actual BMI and perceived BMI can be attributed to recent weight-loss attempts reported by 95 of these 128 participants. Despite attempts to lose weight through dietary restriction, the majority of students’ had a normal BMI, supporting that dietary restraint doesn’t automatically result in lower BMI.

While sometimes used as a surrogate for obesity, BMI describes a ratio between height and weight, and is not an indicator of body composition. Individuals with a normal BMI who are currently dieting or have a dieting history can have a higher body fat percentage compared to those who have never dieted.\textsuperscript{44} People may actually have an above average body fat percentage despite having what is considered to be a healthy or normal BMI. This concept is known as normal weight obesity (NWO) which describes a person who has a normal body weight when defined by BMI, but also has a high amount of body fat.\textsuperscript{45} Individuals with NWO can have increased risk of metabolic syndrome.\textsuperscript{45} Given many reports of NWO, analysis of body composition, such as a DXA scan, will be more accurate than use of BMI.

**Bone Mineral Density**

There is a lack of research that assesses the relationship between restrictive eating attitudes and bone mineral density (BMD) in nutrition students. The research that is available in other populations theorizes that restrictive eating may induce a state of physiological stress that stimulates hormonal changes which in turn may negatively
interfere with BMD. While the hormonal milieu of the body is very complex, candidate hormones that may relate to restrictive eating and poor energy availability include estrogen, cortisol, insulin, leptin and IGF-1. Studies designed to look at the hormonal mechanisms of bone adequacy are expensive and require resources and expertise.

The literature surrounding the relationship between dietary restraint as a proxy for energy availability, menstrual dysfunction and bone health has been widely studied in relation to the female athlete triad. It is believed that estrogen deficiency can serve as an interconnecting factor for these three factors. Bedford et al. reported a prospective study to explore the relationship between cognitive dietary restraint, subclinical ovulatory disturbances, cortisol and change in bone density over two years. One hundred and twenty-three healthy weight female students aged 19-35 years at the University of British Columbia were given the Baecke physical activity questionnaire of physical activity, a diet history questionnaire, and the Eating Disorder Examination Questionnaire (EDE-Q). Daily temperatures were taken to determine luteal activity or ovulation cycles. Urine analysis, height, weight and areal bone mineral density (aBMD) taken by DXA were also collected. Women with more frequent subclinical ovulatory disturbances (SOD) had less positive lumbar spine aBMD. Additionally, women with higher cognitive dietary restraint were more likely to have SOD. The findings of this study suggested that disordered eating could effect menstrual function as well as bone health.

Barr et al. assessed the relationships between menstrual cycle and dietary restraint in 27 women with normal BMI and normal menstrual cycle characteristics. The TFEQ and DXA were tools used to measure restrictive eating and BMD. The participants were divided into two groups based on degree of dietary restraint.
comparison with the lower restraint group, the group with higher dietary restraint had a lower average luteal length, indicating a disruption in ovulatory function. These results of these studies cannot indicate any causational relationship; however, the findings are intriguing and allude to a possible association between cognitive dietary restraint, ovulatory disturbances, and BMD.

 Individuals who engage in caloric restriction may have differences in bone-related measures besides BMD. Nickols-Richardson et al. recruited 65 women with a mean age of 20.4 years to examine the relationship between cognitive dietary restraint, biomarkers of bone turnover, salivary cortisol and BMD. A Hologic DXA was used to measure BMD at the lumbar spine, non-dominant femur and forearm as well as total body. Osteocalcin and N-telopeptide of type-1 collagen (NTx) were measured for markers of bone turnover. No significant relationship between cognitive dietary restraint and BMD loss at any site was reported. Serum osteocalcin was inversely related to cognitive eating restraint, indicating individuals with higher restraint had lower rates of bone turnover. Van Loan and Keim examined the relationship between cognitive eating restraint, bone mineral content (BMC) and total-body BMD in women within 90-150% of their ideal body weight (100 lbs + 5lbs x number of inches over 5 feet) aged 18-45 years. BMC is the amount of bone mineral in bone tissue measured in grams, whereas BMD is the BMC mass per bone volume measured in g/cm². Fifty-two percent of the 185 measured women were considered to have restrictive eating characteristics. There were no significant associations with eating restraint and BMD; however, there was a negative relationship between eating restraint and BMC. While eating restraint likely influences bone health, BMD is too multi-factorial to be simplified to diet restriction.
Resting Metabolic Rate

Indirect calorimetry is a useful method to determine energy needs through measurement of expired oxygen to estimate oxygen use by the body.\textsuperscript{56,57} Resting metabolic rate (RMR) is utilized in clinical and nonclinical settings to determine bodily energy requirements at rest as well as the fuel source during exercise (mixture of carbohydrate and fat) when CO\textsubscript{2} is also measured. Energy restriction has been correlated with a decrease in RMR. In a cross-sectional study conducted in 1991, Poehlman et al. recruited 44 non-obese females without clinical eating disorders to determine the influence of dietary restraint and endurance training on RMR. Body composition (underwater weighing), RMR by indirect calorimetry, VO\textsubscript{2} max, physical activity, and dietary restraint (TFEQ) were all collected in these participants. The individuals exhibiting the highest level of dietary restraint had a lower RMR ($r = -0.29$) and higher percentages of body fat ($r = 0.31$).\textsuperscript{58} It is unclear whether dietary restraint is the direct cause of decreased RMR or increased body fat. A depressed RMR related to dietary restraint can make it difficult to lose weight in terms of fat mass, and make an individual more prone to regaining any lost weight.\textsuperscript{59}

In Germany, Platte et al. also utilized indirect calorimetry and the TFEQ to assess for the relationship between RMR, diet-induced thermogenesis (DIT) and restrained eating.\textsuperscript{60} Healthy normal weight university women were given the TFEQ to categorize them as a restrained eater (n=12) or non-restrained eater (n=12). Indirect calorimetry using a ventilated hood system was used to measure RMR and DIT. Participants were given 100 g of glucose in 100 ml water to measure the postprandial RMR, or DIT. While both groups had the same increase in DIT, RMR was significantly lower in the restrained eaters than the non-restrained eaters.\textsuperscript{60} Upon these findings, the same group of researchers did a second study to determine if there was a connection
between repeated cycles of weight loss and reduced RMR. The same protocols and methods were used as in the first study with different classifications of groups. Two groups of restrained eaters were designated-restrained eaters with recent weight-reducing diets and restrained eaters with no recent weight-reducing diets. While there was a lower RMR in comparison to the predicted RMR based on the Harris-Benedict equation in both groups, no differences in RMR or DIT were reported between the two groups. Resting metabolic rate, measured by indirect calorimetry, and dietary restriction have been shown to have an inverse relationship.

Other studies have also shown associations between dietary restraint and suppressed metabolic rate. Laessle et al. used indirect calorimetry via ventilated hood system to measure RMR in 33 healthy university women with normal BMI. The German version of TFEQ was given to the participants to assess the degree of dietary restraint. A higher degree of dietary restraint was significantly and negatively associated with RMR producing a partial correlation value of -.46. Overall, RMR is considerably less in individuals with restrictive eating behaviors as compared to a predicted equation (i.e., Harris Benedict) or when compared with non-restrictive eaters of roughly the same weight, age and gender.

Validation of Tools

The Eating Disorder Examination Questionnaire (EDE-Q) has been widely utilized to assess for disordered eating or restrictive eating behaviors and eating attitudes. The EDE-Q is a validated standardized self-reported screening tool comprised of four subscales garnered from 28 questions that assesses eating attitudes and behaviors over the past 28 days. The subscales include eating concern, shape concern, weight concern, and dietary restraint, all of which have acceptable internal reliability. The Cronbach’s alpha score for the reliability of scales are as follows:
Restraint ($\alpha=.830$), Eating Concern ($\alpha=.86$), Shape Concern ($\alpha=.92$), Weight Concern ($\alpha=.87$) and Global Score ($\alpha=.90$).\(^65\)

Body image refers to an individual’s mental perceptions and feelings about their body via cognitions, attitudes and behaviors.\(^66\) Negative self-evaluation of body image can be a contributing factor to disordered eating.\(^67\) In order to control or maintain a certain physical appearance or body shape, restrictive eating or excessive physical activity may be adopted. The multidimensional body shape relations questionnaire (MBSRQ), is a validated self-report tool to assess for attitudes related to body shape concerns or weight using a 5-point Likert scale.\(^68,69\) It is comprised of three subscales: weight attitudes scale, body areas satisfaction scale and the body shape relations questionnaire subscales (BSRQ).\(^69\) The BSRQ then contains three domains: physical fitness, physical appearance and health.\(^68\) For this study, the physical appearance domain from the BSRQ was used to evaluate body image based on Appearance Orientation (AO) and Appearance Evaluation (AE). AE describes the extent to which an individual likes his/her appearance whereas AO describes the “degree of cognitive importance” or investment in an individual’s appearance.\(^69\) These subscales have been shown to be reliable in an undergraduate population (Cronbach’s alpha=.90) and have also been used in studies related to eating behaviors and body image.\(^69,70\)

The Tendency to Diet Scale (TDS) is a self-report, self-assessment tool comprised of 15 questions related to attitudes and behaviors that are specific to dieting where higher scores signify a greater tendency to diet. The TDS was first established and proven valid (Cronbach’s alpha=.79) in the RENO diet-heart study.\(^71\) This questionnaire is commonly used among this group of Ohio State University researchers.
The Stunkard body figure rating scale is a visual tool that measures body-image perception. Also referred to as the silhouette score, it consists of nine female or male figures numbered one through nine that range from appearing extremely thin (1) to extremely obese (9). Participants are first asked to select a figure they feel reflects their current physical appearance most accurately, and then asked to select which figure they would consider an ideal body-figure. A score is calculated by subtracting the ideal figure number from their current figure number. Although there has been criticism of this tool it has been demonstrated that the correlations of this figure rating scale are higher than newly developed scales and that it can be used as a gross measure of body-image perception.
3. Methods

This study is a descriptive analysis of eating attitudes and body composition in dietetic students. Students eligible for recruitment were enrolled in the Medical Dietetics Nutrition Assessment course 4900 (MD 4900) at The Ohio State University for the autumn 2015 semester, and were between the ages of 18-35 years old. The main objective of MD 4900 is to teach students about nutrition assessment, and the selected laboratory pedagogy is self-assessment of various health parameters. For the autumn 2015 semester, 51 total students were enrolled in MD 4900. Recruitment to participate in the study involved a verbal invitation to all students during their MD 4900 class. Participants were excluded if they were pregnant, or had any known medical circumstance affecting bone metabolism. All interested participants consented prior to participating in this IRB-approved study (IRB # 2015H0235).

Each participant completed a set of iDXA scans and resting metabolic rate (RMR) estimation in the morning after an overnight fast. A two-compartment model was used by the GE Lunar iDXA to assess body composition (%region fat) and bone density for the total body scan as well as the trabecular sites of hip, lumbar spine and distal radius. The iDXA has been repeatedly supported as an accurate and reliable tool to estimate body composition.\textsuperscript{77,78} The iDXA emits low radiation and is a fairly efficient instrument to utilize in evaluating BMD, fat mass and FFM.\textsuperscript{77,78(p21)} As a part of the iDXA procedure, a urine sample was collected in female participants to ensure negative for pregnancy, and a standard Health-o-meter scale/stadiometer was used to assess height (nearest
centimeter) and weight (nearest tenth of a pound) of each subject. After
completing the iDXA scan, a research staff member administered a resting metabolic
rate analysis via a Korr ReeVue indirect calorimeter. Participants were reclined in a
supine position and oriented to the machine and process. Each participant remained still
during the machine measurement. As indicated by the machine at the end of the test,
the participant’s data was entered manually to predict gender, age and body size
comparison data. Actual RMR estimates from oxygen consumption were used for this
study.

Following the RMR measurement, participants completed an on-line questionnaire
to examine restrictive eating attitudes using questions pertaining to eating attitudes,
body image perceptions, and various demographics such as age and gender.
Information regarding body image and eating attitudes were obtained by using the
Eating Disorder Examination Questionnaire (EDE-Q), the Multidimensional Body Self
Relations Questionnaire (MBSRQ), the Stunkard body figure rating scale, and the
Tendency to Diet scale (TDS). Each of these tools were included as part of the on-line
questionnaire in the secure Qualtrics survey system (see appendix A).

All tools were scored independently. The 28-item EDE-Q was scored according
to instructions using a 7-point rating scale in which each of the four subscales are scored
separately. A global score was then calculated by averaging the individual scores of the
subscales. A group mean was calculated by averaging all individual scores for each
subsacle as well as the global scores. Any subscale score of $\geq 4$ was considered to be
clinically significant.\(^1\) TDS was scored using a rating scale that varied per question. The
highest score a participant could receive was 61, where a higher score indicates greater
tendency to diet. Score totals for each participant were calculated after scores were
adjusted for reverse scoring questions. The MBSRQ was scored based on a 5-point
rating scale. AO and AE subscales were utilized, totaling 19 questions. AO scores can range from 12-60 where a higher score indicates greater critique and investment in appearance. AE scores can range from 7-35 where a higher score indicates greater satisfaction with appearance. Each subscale score was calculated for each participant after reverse scoring adjustments and then group averages were calculated. Table 1 provides an overview of the questionnaire tools.
<table>
<thead>
<tr>
<th>SUBSCALES</th>
<th>ORIGINAL WORK</th>
<th>PURPOSE</th>
<th>VALIDATION</th>
<th>POTENTIAL SCORE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDE-Q</strong></td>
<td>(R) Restraint</td>
<td>Assesses attitudes and behaviors of eating</td>
<td>C. Alpha: .81-.95</td>
<td>5.0-15</td>
</tr>
<tr>
<td></td>
<td>(E) Eating Concern</td>
<td>psychopathology in clinical and community population</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(W) Weight Concern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(S) Shape Concern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MBSRQ</strong></td>
<td>Physical Appearance</td>
<td>To evaluate cognitive, behavioral and affective components of body-image</td>
<td>Brown and Cash (1990)</td>
<td>AE: 7-35, AO: 12-60</td>
</tr>
<tr>
<td></td>
<td>-Appearance Orientation</td>
<td></td>
<td>C.A.: .75-.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Appearance Evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tendency To Diet</strong></td>
<td>No Subscales</td>
<td>Assess attitudinal and behavioral factors in relation to dieting</td>
<td>C.A = .79</td>
<td>15-61</td>
</tr>
<tr>
<td><strong>SILHOUETTE SCORE</strong></td>
<td>No Subscales</td>
<td>Assess body-image perceptions and dissatisfaction</td>
<td>Stunkard (2000): Association between silhouette ratings and BMI: .64-.92 (Cohn et al 1987)</td>
<td>-8 to 8</td>
</tr>
</tbody>
</table>

**TABLE 1. QUESTIONNAIRE TOOLS**

C.A. = Cronbach’s Alpha. EDE-Q subscale scores ≥4 are considered clinically significant. Higher appearance orientation score indicates more investment in appearance. Higher appearance evaluation score indicates greater satisfaction with appearance. Higher Tendency to Diet score indicates greater tendency to diet. More positive silhouette score correlates with desire to be a smaller body-figure, where a more negative score indicates desire to have a bigger body figure.
Statistical Analysis of Research Questions

Results from the DXA scans, and questionnaires were exported into an excel worksheet and the RMR values were manually entered into the same file, then imported into SPSS software program version 23.0 for analysis. The statistical methods for each question were as follows:

1. **What is the prevalence of restrictive eating attitudes reported by dietetic students as determined by the EDE-Q?**

The EDE-Q was the only questionnaire used that specifically targeted attitudes of eating restraint via the restraint subscale. In order to investigate if female dietetic students had greater restrictive eating attitudes than the general female population, subscale scores were compared to data from Mond et al. While it is recognized that comparison to an Australian population could contribute some variance, Mond et al. was used for comparison instead of other U.S. EDE-Q data because of their mainly homogenous Caucasian non-clinical sample population which included all ages of the current sample.  

The Mond study included an Australian community sample of 5,255 females between the ages of 18 and 42 years. Due to the differences in sample size and age group distribution between the Mond data and our study, it was necessary to adjust the Mond means based on our age frequencies to better standardize Mond scores for fair comparison. Scores were adjusted to standardize Mond’s means for each subscale (restraint, eating, weight, and shape) using our percentage of participants in each age group to provide an age-similar pooled mean for comparison (sample calculation given in Equation 1).
Table 2 reflects the raw Mond data from ages 18 to 32 years (n=3,300). A series of five, independent one-sample t-tests were completed to compare dietetic student means to Mond et al. Because the multiple comparisons were not independent, the a priori alpha levels were adjusted based on the number of comparisons, the t-tests to compare our sample means with the standardized Mond means followed the modified Bonferroni test (Holm procedure). Responses from male participants’ EDE-Q questionnaire were excluded from any EDE-Q data analysis and correlational measures due to the lack of reliable normative data in young adult males.
<table>
<thead>
<tr>
<th>AGE</th>
<th>18-22</th>
<th>20-27</th>
<th>28-32</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1188</td>
<td>908</td>
<td>1296</td>
</tr>
<tr>
<td>Restraint Score</td>
<td>Eating Weight Shape Global</td>
<td>Restraint</td>
<td>Eating</td>
</tr>
<tr>
<td>Mean</td>
<td>1.28</td>
<td>0.97</td>
<td>1.69</td>
</tr>
<tr>
<td>SD</td>
<td>1.41</td>
<td>1.13</td>
<td>1.89</td>
</tr>
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</table>

**Table 2.** MOND Age Groups and EDE-Q Means and Standard Deviations
<table>
<thead>
<tr>
<th>Age Group</th>
<th>18-22</th>
<th>23-27</th>
<th>28-32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Participants in Age Group</td>
<td>18</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>As a Percentage</td>
<td>64%</td>
<td>29%</td>
<td>7%</td>
</tr>
</tbody>
</table>

**Table 3. Geitz Sample Frequency per Age Group**

Mond mean adjustment Sample Calculation

Using Table 2. Mean restraint scores multiplied by Table 3 age percentages

Adjusted Mean for Restraint Subscale= \((1.29 \times 0.64) + (1.34 \times 0.29) + (1.28 \times 0.07)\)

**Equation 1. Sample Mean Standardization Calculation**

2. **Is there a relationship between eating attitudes and bone mineral density?**

   Correlational analyses between EDE-Q subscales, TDS scores, MBSRQ scores, and bone Z-scores (L1L4 Z-score, radius UD Z-Score, femoral neck Z-score, and total body Z-score) were completed for males and females separately via non-parametric Spearman correlations. An a priori p-value of <0.05 was considered statistically significant.
3. **Is there a correlation between eating attitudes and estimated resting metabolic rate?**

   Similar to analyzing the relationship between eating attitudes and BMD, correlational analyses between EDE-Q subscales, TDS scores, MBSRQ scores, and RMR measurements were completed for females via the non-parametric Spearman correlation. An a priori p-value of <0.05 was considered statistically significant.

4. **What is the percent fat mass of dietetic students with a normal BMI?**

   BMI and percent fat mass were each categorized using ordinal scales. BMI for each subject was ranked as a 0, 1 or 2, where each number corresponded with a BMI range based on the World Health Organization’s criteria. A BMI <18.5 kg/m\(^2\) (underweight) received a 0, a BMI between 18.5-25 kg/m\(^2\) (normal) received a 1, and a BMI >25 kg/m\(^2\) (overweight) received a 2. The same ranking procedure was used to categorize percent body fat using the American College of Sports Medicine’s guidelines for percent body fat in standard adults under the age of 34 years.\(^8\) For females, a body fat percentage (BF%) <20% (below average) was ranked a 0, BF% 20-35% (average) ranked a 1, BF% 35-38% (above average) ranked a 2, and BF% >38% (obese) ranked a 3. For simplicity, ranks 2 and 3 were combined to mean any BF% >35% (above average). For males, a BF% <8% (below average) was ranked a 0, BF% 8-22% (average) ranked a 1, BF% 22-25% (above average) ranked a 2, and BF% >25% (obese) ranked a 3. For simplicity, ranks 2 and 3 were combined to mean any BF% >22% (above average). BMI categories and BF% categories were then cross-tabulated to identify simultaneous occurrence of normal BF% and normal BMI.
4. Results

Completed DXA scans, RMR measurements and questionnaires were collected from 33 participants, giving a 64.7% response rate from invited participants. Demographic data of participants is shown in Table 4. All 33 students participated in the study to completion (female: n= 28, male: n=5). Female participants averaged 22.6 years of age, 64.9 inches in height, 139.9 pounds in weight, with a BMI of 23.3 kg/m² and 27.9% body fat. Male participants averaged approximately 23.2 years of age, 70.6 inches in height, 172.6 pounds in weight, with a BMI of nearly 24.3 kg/m² and 26.7% body fat. A total of 85.7% of female and 100% of male participants self-identified as Caucasian, and 14.3% of the female participants self-identified as Asian (n=4). Both genders exhibited a wide range of percent body fat and weight. Male data has been provided for interest, but the sample size was too low for meaningful correlations.

<table>
<thead>
<tr>
<th></th>
<th>FEMALE (n=28)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MEAN (+/- SD)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MEAN (+/- SD)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEIGHT (in)</td>
<td>64.9 (+/- 2.60)</td>
<td>59.00</td>
<td>70.70</td>
<td>70.6 (+/- 1.28)</td>
<td>69.30</td>
<td>72.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wt (LBS)</td>
<td>139.9 (+/- 24.63)</td>
<td>110.00</td>
<td>196.80</td>
<td>172.6 (+/- 23.41)</td>
<td>147.80</td>
<td>204.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI kg/m²</td>
<td>23.3 (+/- 3.17)</td>
<td>18.70</td>
<td>33.00</td>
<td>24.3 (+/- 2.68)</td>
<td>21.60</td>
<td>28.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>27.9 (+/- 6.87)</td>
<td>14.30</td>
<td>47.00</td>
<td>26.7 (+/- 6.87)</td>
<td>16.30</td>
<td>34.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (Years)</td>
<td>22.6 (+/- 2.81)</td>
<td>20.00</td>
<td>32.00</td>
<td>23.2 (+/- 2.70)</td>
<td>21.00</td>
<td>26.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4. Demographics Male and Female**
Restrictive Eating Prevalence

Table 5 provides the details of the data from the EDE-Q current study sample and Table 6 provides an overview of the compared EDE-Q values. Of the 28 female responses, the restraint and eating concern subscales of the EDE-Q were absent of any scores exceeding 4. There were a total of 3 (10.7%) and 4 (14.3%) scores greater than the cut-off score of 4 in the weight and shape concern subscales, respectively. There was one global score greater than 4 (3.6%). The average scores for the subscales, excluding the global score, ranged from 1.62 to 2.45 with eating concern having the lowest average and shape concern having the highest average. To be able to assess how eating attitudes in this sample of dietetic students compared to a general population, data from Mond et al. was standardized to the current sample’s age frequency to be able to fairly compare subscale means. After standardizing Mond et al. mean scores and adjusting alphas, the means became 1.30, 0.85, 1.88, 2.28 and 1.58 for the restraint, eating, weight, shape and global score respectively with adjusted alphas of .017, .013, .025 and .05. The series of independent t-tests yielded positive and statistically significant differences for the restraint (p=.008), eating (p<.000) subscales and for the global score (p=.012). There were no differences in the weight or shape subscales.
Correlations

Tables 7-10 summarize the correlations between questionnaires, BMD Z-scores, RMR, body fat percentage and lean muscle mass in females. Correlations were considered statistically significant (sig.) if $p = .05$. There was a statistically significant correlation between eating attitudes and one skeletal site; radius UD Z-score was
negatively correlated with MBSRQ AO (p=.030). There were no significant correlations found between RMR and eating attitudes.

Other associations were found during our analysis. The EDE-Q global score and all subscale items were significantly correlated with the other subscale items. The EDE-Q global score and all subscale items were significantly correlated with the MBSRQ AE score, TDS, and silhouette score. Only shape concern and the global score of the EDEQ were significantly negatively correlated with AE of the MBSRQ. The EDE-Q eating concern subscale was significantly correlated with the MBSRQ AO score (p=.039), while the AE score was significantly correlated with silhouette score (p=.000) and TDS score (.002). Percent body fat was significantly correlated with silhouette score (p=.013).

Radius UD Z-score was correlated with L1L4 Z-Score (p=.005). Femoral neck Z-score was significantly correlated with total body Z-score (p=.005). All aforementioned significant correlations were positive unless noted otherwise. No other significant correlations between variables were observed.
### Table 7. Female Correlations Between Eating Attitude Questionnaires

<table>
<thead>
<tr>
<th></th>
<th>EDEQ_E</th>
<th>EDEQ_W</th>
<th>EDEQ_S</th>
<th>Global</th>
<th>MBSRQ_AE</th>
<th>MBSRQ_AO</th>
<th>TDS</th>
<th>SILSCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDEQ_R</td>
<td>0.549</td>
<td>0.754</td>
<td>0.712</td>
<td>0.820</td>
<td>-0.474</td>
<td>0.247</td>
<td>0.614</td>
<td>0.470</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.002*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.011*</td>
<td>0.026</td>
<td>0.001*</td>
<td>0.012*</td>
</tr>
<tr>
<td>EDEQ_E</td>
<td>0.793</td>
<td>0.839</td>
<td>0.857</td>
<td>-0.412</td>
<td>0.392</td>
<td>0.741</td>
<td>0.469</td>
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</tr>
<tr>
<td>Sig.</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.012*</td>
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</tr>
<tr>
<td>EDEQ_W</td>
<td>0.917</td>
<td>0.971</td>
<td>0.692</td>
<td>0.238</td>
<td>0.842</td>
<td>0.531</td>
<td>0.469</td>
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<tr>
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<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.000*</td>
<td>0.004*</td>
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<td></td>
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<tr>
<td>Sig.</td>
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<td>0.003*</td>
<td>0.313</td>
<td>0.000*</td>
<td>0.012*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Global</td>
<td>-0.639</td>
<td>0.273</td>
<td>0.824</td>
<td>0.554</td>
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<td></td>
<td></td>
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<tr>
<td>Sig.</td>
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<td>0.000*</td>
<td>0.002*</td>
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<td></td>
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<tr>
<td>MBSRQ_AE</td>
<td>-0.111</td>
<td>-0.555</td>
<td>-0.668</td>
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<td></td>
<td></td>
<td></td>
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<td>0.000*</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>MBSRQ_AO</td>
<td></td>
<td>0.334</td>
<td>0.064</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sig.</td>
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<td>0.748</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>0.149</td>
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<tr>
<td>Sig.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant values <p=.05, shaded. TDS= Tendency to Diet Scale, SILSCORE=Stunkard silhouette score, MBSRQ_AO & MBSRQ_AE= Multi Body Shape Relations Questionnaire Appearance Orientation and Appearance Evaluation Subscales. EDEQ_R,E,W,S= Eating disorder examination questionnaire subscales Restraint, Eating concern, Weight concern and Shape concern. Global= EDEQ Global score
| EDEQ_R | Correlation Coefficient | -0.216 | 0.001 | -0.225 | -0.187 |
|        | Sig.                     | 0.269  | 0.966 | 0.250  | 0.340  |
| EDEQ_E | Correlation Coefficient | 0.008  | -0.050 | -0.198 | 0.024  |
|        | Sig.                     | 0.966  | 0.799 | 0.312  | 0.904  |
| EDEQ_W | Correlation Coefficient | -0.101 | 0.040 | -0.190 | -0.093 |
|        | Sig.                     | 0.609  | 0.840 | 0.334  | 0.636  |
| EDEQ_S | Correlation Coefficient | -0.048 | 0.019 | -0.179 | 0.060  |
|        | Sig.                     | 0.809  | 0.925 | 0.361  | 761.000 |
| Global | Correlation Coefficient | -0.098 | -0.008 | -0.221 | -0.058 |
|        | Sig.                     | 0.620  | 0.969 | 0.259  | 0.768  |
| MBSRQ_AE | Correlation Coefficient | 0.143  | -0.179 | 0.007  | 129.000 |
|        | Sig.                     | 0.467  | 0.363 | 0.986  | 0.514  |
| MBSRQ_AO | Correlation Coefficient | -0.186 | -0.152 | -0.410 | -0.054 |
|        | Sig.                     | 0.343  | 0.440 | 0.030  | 0.783  |
| TDS    | Correlation Coefficient | -0.107 | -0.193 | 0.312  | -0.103 |
|        | Sig.                     | 0.588  | 0.325 | 0.106  | 0.600  |
| SILSCORE | Correlation Coefficient | 0.074  | 0.198 | 0.093  | 0.114  |
|        | Sig.                     | 0.708  | 0.312 | 0.636  | 0.563  |

**Table 8. Correlation between eating questionnaires and BMD**
<table>
<thead>
<tr>
<th></th>
<th>Percent Body Fat</th>
<th>Total Lean Body Mass</th>
<th>RMR (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDEQ_R</td>
<td>Correlation Coefficient</td>
<td>0.110</td>
<td>-0.179</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.578</td>
<td>0.363</td>
</tr>
<tr>
<td>EDEQ_E</td>
<td>Correlation Coefficient</td>
<td>0.248</td>
<td>-0.300</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.203</td>
<td>0.121</td>
</tr>
<tr>
<td>EDEQ_W</td>
<td>Correlation Coefficient</td>
<td>0.177</td>
<td>-0.201</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.367</td>
<td>0.305</td>
</tr>
<tr>
<td>EDEQ_S</td>
<td>Correlation Coefficient</td>
<td>0.168</td>
<td>-0.260</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.393</td>
<td>0.181</td>
</tr>
<tr>
<td>Global</td>
<td>Correlation Coefficient</td>
<td>0.228</td>
<td>-0.233</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.244</td>
<td>0.233</td>
</tr>
<tr>
<td>MBSRQ_AE</td>
<td>Correlation Coefficient</td>
<td>-0.276</td>
<td>-0.102</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
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<td>0.604</td>
</tr>
<tr>
<td>MBSRQ_AO</td>
<td>Correlation Coefficient</td>
<td>0.269</td>
<td>-0.050</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.166</td>
<td>0.799</td>
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<tr>
<td>TDS</td>
<td>Correlation Coefficient</td>
<td>0.103</td>
<td>-0.227</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.601</td>
<td>0.246</td>
</tr>
<tr>
<td>SILSCORE</td>
<td>Correlation Coefficient</td>
<td>0.464</td>
<td>-0.102</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
<td>0.013*</td>
<td>0.604</td>
</tr>
</tbody>
</table>

**TABLE 9. CORRELATIONS BETWEEN EATING QUESTIONNAIRES AND BODY COMPOSITION MEASURES**
<table>
<thead>
<tr>
<th></th>
<th>Correlation Coefficient</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RMR (kcal)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Body Z-Score</td>
<td>-0.006</td>
<td>0.977</td>
</tr>
<tr>
<td>L1-L4 Z-Score</td>
<td>0.289</td>
<td>0.135</td>
</tr>
<tr>
<td>Radius UD Z-Score</td>
<td>0.236</td>
<td>0.227</td>
</tr>
<tr>
<td>Femoral Neck Z-Score</td>
<td>-0.017</td>
<td>0.932</td>
</tr>
<tr>
<td>Percent Body Fat</td>
<td>-0.027</td>
<td>0.892</td>
</tr>
<tr>
<td>Total Lean Body Mass</td>
<td>0.012</td>
<td>0.951</td>
</tr>
</tbody>
</table>

**TABLE 10. CORRELATIONS BETWEEN BMD AND RMR**
Questionnaire Responses

The TDS possible score ranges from 15-61, where a higher score indicates a greater tendency to diet. On average, females in this study displayed a greater tendency to diet than males, although the t-test differences were not statistically significant (p=.05). The bar graph of these differences (Figure 1) demonstrates a 2.4-point difference between genders.

*Higher score indicates greater tendency to diet

**Figure 1. Tendency to Diet Scores by Gender**
The results on the MBSRQ were similar between genders. AE results from the MBSRQ showed the averages between genders were within a one-point difference indicating a similar degree of body satisfaction. However, females had a higher average score for the AO subscale, although not statistically significant \( (p=.05) \).

**Figure 2. MBSRQ scores by gender**

The Stunkard silhouette scores demonstrated that fifty percent \( (n=14) \) of females had a score of 1, indicating desire to be one body size smaller. Nine females and 3
males had a score of 0, indicating they did not wish to change their body-figure. Four females and one male had a score of 2, indicating they would like to be two body-figures smaller. One male and one female wished to be one body figure larger, with a score of -1. These results are displayed in bar graph format for easier viewing in Figure 3.

*more positive score indicates desire for a smaller figure, more negative score indicates desire for a larger figure.

**Figure 3. Differences in Silhouette Score by Gender**
Bone Density, RMR, Body Composition

Table 11 outlines the average values for the various DXA sites by gender while Figures 6 and 7 demonstrate the frequencies of inadequate bone mass values from females and males, respectively. BMD was expressed as Z-scores (age-adjusted). All females had a total body BMD Z-score greater than -1. The majority of females had a Z-score >-1 at the femoral neck and L1L4 sites indicating normal BMD for their age and gender. Of the sites measured, one female had a Z-score <-2 at the L1L4 site. BMD Z-scores for the radius UD had a wider distribution. Over half (57.1%) of the females were below -1.0 Z-score at the radius UD site. Total body BMD and femoral neck BMD Z-scores were greater than -1 in all males. The majority (4/5, 80%) of males had adequate bone mass (<-1.0) at the L1L4 and radius UD sites.

<table>
<thead>
<tr>
<th></th>
<th><strong>FEMALE (n=28)</strong></th>
<th></th>
<th><strong>MALE (n=5)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>MEAN (+/- SD)</strong></td>
<td><strong>MINIMUM</strong></td>
<td><strong>MAXIMUM</strong></td>
<td><strong>MEAN (+/- SD)</strong></td>
</tr>
<tr>
<td>TOTAL BODY</td>
<td>.90 (+/- 1.00)</td>
<td>-.673</td>
<td>3.92</td>
<td>1.93 (+/- 1.44)</td>
</tr>
<tr>
<td>NECK</td>
<td>0.07 (+/- .97)</td>
<td>-1.94</td>
<td>2.34</td>
<td>1.02 (+/- 1.94)</td>
</tr>
<tr>
<td>L1L4</td>
<td>-0.02 (+/- 1.12)</td>
<td>-2.11</td>
<td>3.00</td>
<td>-0.29 (+/- 73)</td>
</tr>
<tr>
<td>RADIUS UD</td>
<td>-.65 (+/-1.67)</td>
<td>-2.86</td>
<td>2.80</td>
<td>-0.57 (+/- 1.01)</td>
</tr>
</tbody>
</table>

**Table 11. Average Bone Mineral Density Z-scores By Gender**
**Figure 4.** BMD frequency of Z-scores for females by anatomical site.

**Figure 5.** BMD frequency of Z-scores for males by anatomical site.
In an effort to demonstrate the utility of BMI in this sample, body composition and BMI were categorized and cross-tabulated by strata to examine the frequency of matching with attention to normal weight obesity (NWO). Based on these results, 3 females and 2 males are classified as NWO. Of the 24 females within the normal BMI category, 21 were considered to have a normal or lean body fat percentage. All of the 4 females within the overweight BMI category were also considered to have a normal or lean body fat percentage. Of the three men within a normal BMI, one was considered to be within a normal body fat percentage while the other two were considered to have above normal percentage body fat. The other two male participants were in the overweight BMI category with above normal body fat percentages.

<table>
<thead>
<tr>
<th>Body Fat (%) Category</th>
<th>&lt;20% (Lean)</th>
<th>20-35% (Average)</th>
<th>&gt;38% (Above Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI &lt;18.5 kg/m²</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BMI 18.5-25 kg/m²</td>
<td>2</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>BMI &gt;25 kg/m²</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**TABLE 12. FEMALE COMPARISON OF BMI AND BODY FAT PERCENTAGE MEASURED BY DXA**
Figure 6. Female comparison of BMI and body fat percentage

<table>
<thead>
<tr>
<th>Body Fat (%) Category</th>
<th>&lt;8% (Lean)</th>
<th>8-22% (Average)</th>
<th>&gt;22% (Above Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI &lt;18.5 kg/m²</td>
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<td>0</td>
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<tr>
<td>BMI 18.5-25 kg/m²</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>BMI &gt;25 kg/m²</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 13. Male comparison of BMI and body fat percentage measured by DXA
Indirect calorimetry estimates from the Korr machine are reported in estimated calories (kcal). The average RMR was 1,466 kcal females and 1,820 kcal for males. Figure 8 is provided for visualization of the range of measured RMR values in this cohort. One female did not maintain a proper mouth seal throughout the RMR measurement, and thus was excluded from RMR reporting. To assess RMR normalcy, the Harris Benedict (HB) equation (Equation 2 below) was applied to each subject to calculate an expected RMR. ReeVue RMR values were compared with the calculated HB RMR for reference using a one-sample two-tailed t-test. There were no significant differences for either males (p=0.3727) or females (p=0.9668) indicating that the RMR of
this sample is not significantly different from the expected HB RMR. Table 14 details the measured and estimated values for RMR. Eleven females and two males had an RMR lower than their HB RMR. Five of the 11 females were lower by 100-200 calories. One of the 2 males and 2 of the 11 females were lower by 200-242 calories.

\[
\begin{align*}
\text{Female: } & \text{RMR} = 655.1 + 9.56 \times \text{wt} + 1.85 \times \text{ht} - 4.68 \times \text{age} \\
\text{Male: } & \text{RMR} = 66.47 + 13.75 \times \text{wt} + 5 \times \text{ht} - 6.76 \times \text{age}
\end{align*}
\]

**Equation 2. Harris-Benedict Equations**

\*Wt= weight in kg. Ht= height in cm. Age= age in years

**Figure 8. RMR Measurement**
<table>
<thead>
<tr>
<th>Female (n=27)</th>
<th>Harris Benedict RMR</th>
<th>ReeVue RMR</th>
<th>Comparison (ReeVue minus HB)</th>
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<tr>
<td>1454</td>
<td>1613</td>
<td>159</td>
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</tr>
<tr>
<td>1662</td>
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<td>1563</td>
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<td></td>
</tr>
<tr>
<td>1725</td>
<td>1930</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>1569</td>
<td>1872</td>
<td>303</td>
<td></td>
</tr>
</tbody>
</table>

**Table 14. Calculated RMR comparisons obtained from ReeVue indirect calorimeter**
5. Discussion

The main objective of this study was to identify correlations between restrictive eating attitudes and body composition in terms of percent body fat, lean mass, and bone mineral density. Furthermore, we examined the relationship between restrictive eating attitudes and RMR. Data from dietetic students in this cohort did not display many significant relationships between restrictive eating attitudes and body composition or RMR.

The female dietetic students in this cohort had significantly higher global, restraint, and eating scores on the EDE-Q compared to data from an Australian nonclinical population.\(^1\) This implies that female dietetic students have greater restrictive eating attitudes. Similarly, a previous study that produced EDE-Q data for nonclinical university females in the United States reported having greater restraint, eating and global scores.\(^{85}\) Interestingly, this study and the U.S data found the same three components to be greater than the Australian data. Quick et al. reported data of the EDE-Q in a diverse sample of U.S female and male undergraduates.\(^{80}\) In comparison with Luce et al., Quick et al. found significantly greater shape concern scores and significantly lower eating, restraint, and global scores.\(^{80}\) Without adjusting means for sample size or age distribution, all EDE-Q subscale scores from the current results were greater than EDE-Q data with smaller standard deviations.
These results suggest that female undergraduates in the U.S have greater restrictive eating attitudes than Australians, and dietetic students have greater restrictive eating attitudes than the general female undergraduate population in the U.S. Previous studies have shown similar results where undergraduate nutrition students had greater restrictive eating attitudes compared to students from other areas of study, despite using different tools to measure restrictive eating attitudes.\textsuperscript{6,8,10,43} The observed differences in findings between the two U.S EDE-Q data studies imply that EDE-Q scores are likely influenced by other factors than the participant’s country.

\*Geitz, Quick and Luce means not adjusted

**FIGURE 9. COMPARISON OF EDE-Q MEANS**
**TABLE 15. COMPARISON OF EDE-Q MEANS FROM VARIOUS STUDIES**

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>N</th>
<th>Restraint (Mean (SD))</th>
<th>Eating Concern (Mean (SD))</th>
<th>Weight Concern (Mean (SD))</th>
<th>Shape Concern (Mean (SD))</th>
<th>Global (Mean (SD))</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Geitz et al. (2015)</td>
<td>U.S female dietetic undergraduates 20-32 years</td>
<td>28</td>
<td>1.85 (0.77)</td>
<td>1.62 (0.61)</td>
<td>2.24 (1.22)</td>
<td>2.45 (1.35)</td>
<td>2.04 (0.9)</td>
</tr>
<tr>
<td>*Quick et al (2013)</td>
<td>U.S Male and Female diverse undergraduate population</td>
<td>1,533</td>
<td>1.35 (1.43)</td>
<td>0.89 (1.09)</td>
<td>1.98 (1.6)</td>
<td>2.39 (1.63)</td>
<td>1.65 (1.3)</td>
</tr>
<tr>
<td>*Luce et al. (2008)</td>
<td>U.S female undergraduates 18-25 years</td>
<td>723</td>
<td>1.62 (1.54)</td>
<td>1.11 (1.11)</td>
<td>1.97 (1.56)</td>
<td>2.27 (1.54)</td>
<td>1.74 (1.3)</td>
</tr>
<tr>
<td>***Mond et al. -2006</td>
<td>Australian female general population Age groups 18-32 years used for comparison</td>
<td>3,300</td>
<td>1.3 (1.39)</td>
<td>0.82 (1.1)</td>
<td>1.89 (1.6)</td>
<td>2.31 (1.65)</td>
<td>1.58 (1.29)</td>
</tr>
</tbody>
</table>

* raw data, does not reflect any adjusted means.
*** used pooled mean across age groups
Did not adjust for sample sizes. Score > 4 is considered clinically significant.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>N</th>
<th>Restraint</th>
<th>Eating Concern</th>
<th>Weight Concern</th>
<th>Shape Concern</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>*GEITZ ET AL. (2015)</td>
<td>28</td>
<td>0.0%</td>
<td>0%</td>
<td>10.7%</td>
<td>14.3%</td>
<td>3.6%</td>
</tr>
<tr>
<td>*QUICK ET AL. (2013)</td>
<td>1,533</td>
<td>5.4%</td>
<td>2.0%</td>
<td>13.0%</td>
<td>18.6%</td>
<td>6.0%</td>
</tr>
<tr>
<td>*LUCE ET AL. (2008)</td>
<td>723</td>
<td>7.9%</td>
<td>2%</td>
<td>10.2%</td>
<td>14.8%</td>
<td>5.6%</td>
</tr>
<tr>
<td>**MOND ET AL. (2006)</td>
<td>3,300</td>
<td>0.0%</td>
<td>0%</td>
<td>11.3%</td>
<td>19.4%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

There was one skeletal site where BMD and eating attitudes were significantly associated in this sample of females. Radius UD Z-score was negatively correlated with MBSRQ appearance orientation score. The majority of females had radius UD Z-scores.
less than -1 (57.1%), indicating below average BMD at the distal radial site. The other measured BMD sites did not significantly correlate with eating attitude scores, and the majority of participants had Z-scores indicating age-appropriate BMD for total body, hip and lumbar spine. Correlations do not insinuate causation, and the low radius UD Z-scores could also be related to other factors such as lack of weight-bearing stimulation at the wrist.\(^{86}\) It is possible that as an individual is more invested in their appearance they may participate in more cardiovascular exercises, such as running or use of an elliptical trainer in which there is no weight applied to the wrist, to maintain or reach what they feel is an acceptable physical appearance. This may help explain the observed below average radius UD BMD.

Our findings also suggest that females with greater body fat percentage aspired to have a smaller body than their current body figure view, implying body-image dissatisfaction. This correlation mirrors the results of Silva et al., which revealed that overweight students had higher body-image dissatisfaction, and 13.7\% of the female participants were dissatisfied with their body-image.\(^{11}\) From our study and based on their silhouette score, 64\% of female participants indicated they would like to be a smaller body-size than they are currently. This comparison must be made with caution as we had few overweight individuals and a smaller sample size.

The current findings indicate that dietetic students are likely to be within a normal BMI despite having greater restrictive eating attitudes. There was a small percentage of participants within the NWO classification, as the majority of all participants were considered to be both within a normal BMI category and a normal percent body fat category and no participants were considered underweight based on their BMI. These results align with research by Kassier et al. who found that the majority of their nutrition
student sample had a normal BMI, and further supports that restrictive eating attitudes do not necessarily result in a lower BMI.\textsuperscript{7} It is interesting that although most of the female participants were within both a normal BMI and normal body fat percent, many still wished they had a smaller body-figure. This gives insight that body-dissatisfaction may be more related to a preferred appearance rather than body composition. Dietetic students may feel required to have a certain body-figure that coincides with societal beauty standards to potentially protect their appearance from being scrutinized.\textsuperscript{35,36}

Prior studies in women assessing restrictive eating and RMR found a significant association between greater restrictive eating attitudes and lower RMR.\textsuperscript{58,87,61} The current study also observed significant restrictive eating attitudes in the female dietetic students, but interestingly there was no significant association between RMR and restrictive eating. Our average RMR values are similar to averages in another study that compared RMR difference in gender using a ventilated hood; females had an average RMR of 1,348 \( \pm \) 125 kcal, and males had an average RMR of 1740 \( \pm \) 194 kcal.\textsuperscript{88} This implies that there are differences in the impact that restrictive eating attitudes have on non-dietetic females and dietetic females. A possible explanation would be that dietetic students are extensively trained in the subject of nutrition, and likely much more cognizant of how to maintain a healthy and sufficient diet. It’s plausible that the restrictive eating attitudes are expressed differently between these two groups. The general population could express restraint through a greater degree of caloric restriction, whereas dietetic students may not express restraint to the degree that adversely impacts health. Since the aforementioned studies did not use the EDE-Q in assessing eating attitudes, statistical comparisons cannot be made. Larger caloric restriction could
explain the observed reduction in RMR in association with restrictive eating attitudes in the general female population.

**Limitations**

In interpreting the results of the present study, there are limitations that must be acknowledged. The descriptive nature of this study is a clear limitation. In preceding years, the MD4900 course averaged 75 dietetic students; however, class enrollment for the autumn 2015 semester only consisted of 51 students. Consequently, this unanticipated decrease reduced the recruitment pool and potential sample size. Due to the small sample size, results of this study cannot be easily generalized to the wider dietetic student population. Furthermore, the researchers were known by the students outside the study which may have influenced students’ election to participate and possibly their questionnaire responses. Prolonged IRB approval delayed recruitment from starting at the beginning of the semester. As a result, recruitment began 5 weeks later than intended and participants already took their own in class anthropometric measurements such as height, weight, skin-fold measurements and completed a bioelectrical impedance analysis. Participants may have been sensitized to body-dissatisfaction or disordered eating attitudes after learning how to interpret their anthropometric measurements. Additionally, since the sample was drawn from one university and embodied limited diversity, these results may not reflect eating attitudes among dietetic students in other settings.

The tools utilized had limitations. Accuracy of self-reported data, including the questionnaires, relies on the honesty and introspective capability of participants. Overall, the tools that comprised the questionnaire were subjective in nature, and did not inquire about history of any previously diagnosed eating disorders. Information on
exercise frequency and intensity was not collected; therefore, energy availability could not be calculated. As for the EDE-Q, it is reliant on the subject’s ability to recall their frequency of eating related attitudes and behaviors over the past 28 days. Therefore, responses may not be precise. Male normative data for the EDE-Q is lacking aside from few studies, where one reported that the EDE-Q performs less reliably in males than in females.\textsuperscript{89,90} Exclusion of males for part of the analysis skews the current portrayal of dietetic students’ eating attitudes.

The Korr ReeVue has limitations as well in estimating RMR. First, the machine does not calculate the respiratory quotient for every individual. It automatically assumes a respiratory quotient of .83 because it does not measure expiration of CO\textsubscript{2}. Human error is also a factor to consider. While all participants were instructed to breathe as normal as possible, lack of familiarity with the machine could have inadvertently caused participants to breathe irregularly. Additionally, accuracy could have been affected if participants did not keep a tight seal around the mouthpiece or remain still and relaxed throughout the measurement.

There is a paucity of data on the relationships between restrictive eating attitudes and body composition measured by iDXA as well as limited reports on restrictive eating attitudes and RMR in this specific population; therefore, there is no reference data. There is also a scarcity of data examining restrictive eating attitudes using the EDE-Q in dietetic students. When reviewing the current results and comparisons, it is important to consider that previous studies used tools other than the EDE-Q to assess restrictive eating attitudes in dietetic students (see Appendix B). Consequently, previous research and the current results may not be of equal comparison due to the different methods of assessment. There are three sources of normative data for the EDE-Q in females; two
examined an undergraduate population in the U.S, and one examined a community sample from Australia.\textsuperscript{1,85} Use of more questionnaires may have allowed for wider comparisons, but would also have resulted in more subject burden.

Despite the limitations of this study, the current results provide further insight to literature surrounding this topic. Mond et al. concluded that the degree of eating psychopathology may differ among countries.\textsuperscript{1} Continued research should compare restrictive eating attitudes and body composition of dietetic students from different U.S universities to identify if results vary by geographical location or possibly university type. It is possible that cultural differences could impact research results as the studies that have examined this population were conducted in different countries. Future studies examining energy availability in this population would be useful to better determine whether dietetic students adequately meet their caloric needs despite having restrictive eating attitudes. Finally, to expand the available tools in assessing eating attitudes for males, an EDE-Q version should be created that is as reliable as what has been demonstrated in females.

\textbf{Conclusions}

This study examined the relationship between restrictive eating attitudes, bone mineral density, body composition, and resting metabolic rate in undergraduate male and female dietetic students. This population is of concern because it has previously been shown to have greater restrictive eating attitudes than non-dietetic students, potentially leading to low energy availability, which could affect bone health. While female dietetic students did have greater restrictive eating attitudes than a female general population, it did not significantly reflect in RMR or bone density. The majority of all participants were within a normal BMI, normal percent body fat, and had an average
BMD Z-score at various sites with the exception of the majority of females having lower BMD in the ultra-distal radius. Having greater restrictive eating attitudes does not necessarily translate to an underweight BMI, below normal body fat percentage, or below average bone mineral density in dietetic students. Taken together, this group of young pre-professionals would benefit from receiving a DXA scan during their undergraduate studies to identify and potentially improve low bone mineral density. Incorporating an educational course to their curriculum that incorporates a healthier understanding of eating psychopathology to better grow and serve as role models in their prospective health careers could also be helpful for this group. Future collaborative research is needed to assess restrictive eating attitudes, energy availability and body composition in dietetic undergraduates across the country amongst different universities and in other countries.
References


50. The presence of both an energy deficiency and estrogen deficiency exacerbate alterations of bone metabolism in exercising women.


Appendix A: Study Questionnaire
What is your subject number in the study?

This study must exclude subjects with issues that affect bone health. Have you ever had a physician tell you that you have...

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic bone disease</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>thyroid abnormalities</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>adrenal abnormalities</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

What is your gender?

- Female
- Male
**MENSTRUAL CYCLE HISTORY**

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

1. Have you missed any periods in the last three to four months?
   - Yes
   - No

2. Have you been on medicine for birth control or contraceptives the past 3-4 months?
   - Yes
   - No

3. What sort of contraceptive have you been using?
   - Oral contraceptive pills
   - "Depo"
   - Other

4. Which of the following best describes your parity status?
   - I have not given birth to a child.
   - I have given birth to one child.
   - I have given birth to two children.
   - I have given birth to three or more children.

5. How many years ago was your most recent child born?

6. If you answered that you have children, did you breast feed the most recent child born?
   - Yes
   - No
BEGIN APPEARANCE EVALUATION SUBSCALE:

My body is sexually appealing.
- 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

Most people would consider me good looking.
- Definitely Disagree
- Mostly Disagree
- Neither Agree nor Disagree
- Mostly Agree
- Definitely Agree
I like the way I look with my clothes on.

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

I like the way my clothes fit.

- 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

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree
BEGIN APPEARANCE ORIENTATION SUBSCALE:

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

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly 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

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
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 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 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 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
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
TENDENCY TO DIET SCALE

How difficult or easy is it for you to gain weight?
- Very Difficult
- Difficult
- Neutral
- Easy
- Very Easy

How difficult or easy is it for you to lose weight?
- Very Difficult
- Difficult
- Neutral
- Easy
- Very Easy

How much harder or easier is it for you to lose weight now than it was in the past?
- Much Harder
- Somewhat Harder
- Neutral
- Somewhat Easier
- Much Easier

How often are you dieting to lose weight?
- Never
- Sometimes
- Often
- Always
How often do you use fasting or starving as a method to lose weight?

- Never
- Sometimes
- Often
- Always

How often do you use laxatives or purgatives as a method to lose weight?

- Never
- Sometimes
- Often
- Always

If an extremely sad event happens in your life (such as divorce, death, separation, loss of job, etc.), what is likely to happen to your weight?

- Gain Weight
- Stay the Same
- Lose Weight

If an extremely happy event happens in your life what is likely to happen to your weight?

- Gain Weight
- Stay the Same
- Lose Weight

How often are you preoccupied with losing weight?

- Never
- Sometimes
- Often
- Always
How often are you preoccupied with food?

- Never
- Sometimes
- Often
- Always

How much of a difference would it make in your life if you gained 5 pounds?

- Large Difference
- Moderate Difference
- Small Difference
- No Difference

How much of a difference would it make in your life if you gained 10 pounds?

- Large Difference
- Moderate Difference
- Small Difference
- No Difference

How much of a difference would it make in your life if you lost 5 pounds?

- Large Difference
- Moderate Difference
- Small Difference
- No Difference

How much of a difference would it make in your life if you lost 10 pounds?

- Large Difference
- Moderate Difference
- Small Difference
- No Difference
How important is your weight to your self concept?

- Not at all Important
- Mildly Unimportant
- Moderately Important
- Extremely Important
Subscale indicators:

R = Restraint Subscale
E = Eating Concern Subscale
W = Weight Concern Subscale
S = Shape Concern Subscale
On how many of the past 28 days...

R: 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
- Every day

R: 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
- Every day

R: 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
- Every day
R: 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
- Every day

R: 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
- Every day

S: 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
- Every day

E: 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?)
S & W: 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
- Every day

E: 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
- Every day

S: 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
Every day

S: Have you felt fat?

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

W: 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
- Every day

- 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.
E: 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
- Every day

E: 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 times
- Every time

E: 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
- Every time
**W:** 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
- Every time

**S:** 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
- Every time

**W:** 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
- Every time


**W:** 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
- Every time

**S:** 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
- Every time

**S:** 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
- Every time
S: 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
☐ Every time
Appendix B: Comparison of Eating Attitude Assessment Tools Used in Current Restrictive Eating Literature
<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Intended Population</th>
<th>Subscales</th>
<th>Validity, Reliability Supportive Studies</th>
<th>Purpose</th>
<th>Original Author</th>
</tr>
</thead>
</table>
| EDE-Q (Eating Disorder Examination Questionnaire) | Clinical and community                  | 1. Eating Concern  
2. Shape Concern  
3. Weight Concern  
C.A. .81-.92  
2 Aardom et al.  
2. Disinhibition: overeating  
C.A. .91  
2. Cappelleri et al. (2009)  
| DEB-Q (Dutch Eating Behavior Questionnaire) | Young Dutch Adults, now disseminating in Europe to identify validity in different countries (Spain, Italy, France) | 1. Emotional Eating  
2. External Eating  
| EDI (Eating Disorder Index)            | Shown in both clinical and non-clinical, but non-clinical less consistent | 1.Drive for thinness  
2. Bulimia  
3. Body Dissatisfaction  
4.Ineffectiveness  
5. Perfectionism  
6. Interoceptive Awareness  
7.Maturity Fears  
| EAT (Eating Attitudes Test)            | High-school, college, athletes. Screen for ED | 1. Dieting scale  
2. Bulimia  
3. Food preoccupation  