Development and Validation of a Screening Tool for Disordered Eating in Athletes

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Abstract

Research suggests that athletes are at greater risk of disordered eating than their non-athletic counterparts. However this literature is limited primarily to female, college-aged populations. The objectives of this study were to develop and validate a screening tool (the Questionnaire of Eating Attitudes and Behaviors, Q-EAB) designed to assess disordered eating attitudes and behaviors in male and female athletes and to estimate the prevalence of disordered eating in a sample of Masters Athletes. A sample of 63 females and 48 males (mean age = 45.4±6.6 years, range=35-65) completed a series of 6 eating questionnaires online as well as three 24 hour dietary and activity recalls. Female and non-elite athletes showed significantly greater disordered eating attitudes and behaviors than male and elite athletes respectively. Results indicated that the Q-EAB correlated to the five standard questionnaires. We conclude that the QEAB may be an effective screening tool for disordered eating in athletes.

Resume

Une abondance de recherches, ont démontré que les athlètes sont plus probable de souffrire de trouble d`alimentation que les non- athlètes. La plupart des présent résultat proviennent de recherches consentrés sur la population fémenine et d`age collegial. L`objective de cette recherche etait : 1) Developer et valider des outils de sélections (le ``Questionnaire of Eating Attitudes and Behaviors, Q-EAB``, développé pour juger les attitudes des troubles d`alimentation et les comportement des athlètes masculin et féminin et 2) pour déterminer l`étendu du trouble d`alimentation dans un échantillon des athètes MAITRE. Un échantillon de 63 femmes et 48 hommes (age moyen= 45.4+6.6 ans, variant de 35-65) completé des series de 6 questionnaires en ligne en plus de three 24 heures de diète et d'activité. Les femmes et les athlètes non-élite demontrent un plus grand désordre dans leur attitudes et comportements alimentaire comparé aux hommes et les athletes élites. Les résultats ont indiqué que le Q-EAB etait en relation avec les items dans les 5 outils standards. Nous concluons que le Q-EAB peut être un outil de sélection efficace pour les signes de désordre dans les attitudes et comportements alimentaire pour les athletes homme et femme.

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List of Tables

Table 1-1 Questionnaire of Eating Attitudes and Behavior (Q-EAB) Abbreviations and Meanings

Abbreviation	Meaning
bestsport	Perfectionism in sport
dsb4	Body dissatisfaction prior to sport involvement
eatrout	Rigidity of eating routine
exavoid	Exercise helps avoid difficult tasks
excontr	Exercise gives feeling of control
exfeel	Exercise helps avoid negative feelings
foodobs	Food obsession
highgoal	Sets high goals in sport
interfer	Priority of eating routine
menttot	Running mental total of intake
missex	Intake dependent on expenditure
morewt	Content with weight gain
obsee	Energy expenditure obsession
ssabil	Satisfaction with overall athletic ability
ssachiev	Satisfaction with athletic achievements to date
Ssappear	Satisfaction with overall physical appearance
ssbf	Satisfaction with body fat
sschest	Satisfaction with size and/or appearance of chest
ssend	Satisfaction with cardiovascular endurance
ssfit	Satisfaction with overall physical fitness
ssshape	Satisfaction with body shape
ssstomac	Satisfaction with size and/or appearance of stomach
ssstreng	Satisfaction with muscular strength
sssucc	Satisfaction with ability to be successful in sport
ssthigh	Satisfaction with size and/or appearance of thighs
stone	Satisfaction with muscle tone and appearance
sswt	Satisfaction with body weight
typeatbh	Restraint in typical eating

weigfrq	Weighing frequency
worrycon	Anxiety regarding losing control of weight/appetite
wtmtn	Difficulty maintaining weight
wtobs	Weight obsession

1.0 Overview

Disordered eating can be thought of as a continuum of pathogenic eating behaviours, spanning from the obsessive dieter who may regularly use fasting, diet pills, binge eating and purging, to the individual with a clinical eating disorder, such as anorexia nervosa and bulimia nervosa (Sundgot-Borgen, 2004). The concept of a disordered eating continuum is important as there are many more individuals with subclinical eating disorders, that is they present disordered eating behaviors without meeting the full diagnostic criteria associated with clinical anorexia or bulimia nervosa (Beals & Manore, 1994; Johnson, Powers & Dick, 1999; Nagel, Black, Leverenz, & Coster, 2000; Sundgot-Borgen, 2004, 1994; Thompson & Sherman, 1993). Nevertheless, these behaviors have deleterious physical as well as psychological effects and can easily develop into a clinical disorder if preventative measures are not implemented (Beals & Manore, 1994; Brownell, Steen & Wilmore, 1987; Carney & Anderson, 1996; Comerci GD, 1990; Sudi, Ottl, Payerl, Baumgartl, Tauschmann & Muller, 2004; Sundgot-Borgen, 1996; Walsh et al, 2000). Beals and Manore (2000) identified and defined eight behavioral, psychological, and physical characteristics of female athletes with subclinical eating disorders: preoccupation with food, distorted body image, undue influence of body on self-evaluation, intense fear of gaining weight, weight control methods, strict dietary rules, menstrual dysfunction and absence of medical illness to explain low weight. For the purposes of the present study, these eight criteria form the basis of our definition of disordered eating.

Athletes may be particularly vulnerable to disordered eating behaviors due to the biological, psychological, and environmental demands of the athletic setting. Many sports impose weight regulations and require routine body composition assessments, which perpetuate weight obsession and dangerous weight control methods (Brownell et al, 1987; Rivaldi, Vannacci, Zucchi et al, 2003; Steen, Opplinger & Brownell, 1988; Thiel, Gottfried & Hesse, 1993; Thompson & Sherman, 1993). Moreover, sports such as gymnastics and figure skating have aesthetic ideals that favour leanness. It is well documented that

many participants of these sports have suboptimal energy intakes and greater prevalence of disordered eating (DePalma, Koszewski, et al, 1993; Rosen, McKeag, Hough & Curley, 1986; Smolak, Murnen & Ruble, 2000; Sundgot-Borgen, 1994; Yates, Edman, Crago, & Crowell, 2001). There are also specific psychological traits common to both athletes and those at risk of eating disorders, such as being driven, independent, relentless, goal oriented, perfectionistic, and possessing a high threshold for pain and discomfort (Brownell, Rodin & Wilmore, 1992; Leon 1991; Thompson & Sherman, 1999). Thus, there is a host of factors that play a role in rendering athletes especially vulnerable to disordered eating.

In recent years, there has been increased interest in the prevalence of disordered eating among athletes. It has been suggested that athletes are at greater risk of disordered eating than their non-athletic counterparts (Black, Larkin, Coster et al, 2003; Garner, Rosen & Barry, 1998; Nagel et al, 2000; Smolak et al, 1999; Sundgot-Borgen, 1994; Sykora, Grlo, Wilfley & Brownell, 1993). Depending on the criteria used to diagnose pathogenic eating, prevalence rates can be as high as 74% in college-aged athletes (Depalma et al, 1993). One study found that 60% of clinically diagnosed eating disorder patients have a history of engaging in competitive sport, while 78% engaged in excessive exercise prior to the onset of the disorder (Davis, Kennedy, Ravelski & Dionne, 1994). Exercise compulsion is also the strongest predictor of relapse in anorexic patients (Strober, 1997). Hence, sport and excessive exercise appear to play an integral role in the development and maintenance of clinical and subclinical eating disorders.

While a fair amount of research has been done on athletic involvement and the development of disordered eating, up until this point most research has been limited to female athletes of college age. This study, to the author's knowledge, represents the first look into disordered eating tendencies in male and female athletes beyond college age. Furthermore, there currently exists no screening tool for subclinical eating disorders that has been validated for use in both male and female athletes. The need for a screening test specific to athletic populations has been voiced by a plethora of researchers (Black et al, 2003; McNulty, Adams, Anderson & Affenito, 2001; Smolak et al, 2000; Yates et al, 2001). Identifying at

risk athletes must go beyond focusing on those who meet formal eating disorder diagnoses to include those with subclinical eating disorders who engage in a myriad of dysfunctional weight control behaviors, such as energy restriction, laxative and diuretic abuse, and self induced vomiting which severely compromise health and performance (Beals & Manore, 1994; Garner at al, 1998; Sundgot-Borgen, 1994; Wilmore, 1991). Since prevention and early detection are important determinants of recovery (Drinkwater, Loucks, Sherman, et al, 2005), it is imperative that a screening tool be established to identify athletes with subclinical eating disorders and a propensity to clinical eating disorder development.

2.0 Literature Review

2.1 Introduction

The preponderance of pathogenic eating among athletes prompted the recent release of a position statement by the International Olympic Committee (IOC) on the Female Athlete Triad (Drinkwater et al, 2005). A primary focus of the document was on the spectrum of disordered eating behaviors seen among athletes and the importance of early detection and intervention. Specifically, it placed responsibility on team physicians to ensure the health and safety of the athletes by: 1) educating athletes, coaches, and parents about the issue, 2) recognizing the symptoms associated with clinical and subclinical eating disorders, 3) preventing activities that place pressure on athletes to lose weight, and 4) providing appropriate treatment for athletes who experience one or more of the Triad conditions. According to the IOC, the main goal of prevention should be early identification of athletes with low energy intake and disordered eating behaviors because prompt identification leads to earlier treatment, and may reduce the health risks for the athlete, as well as thwart progression to a clinical eating disorder. Improving identification involves not only education of individuals who are most likely to be in a position to identify disordered eating, such as coaches, team physicians and athletic trainers, but also the development and use of appropriate screening procedures.

A similar statement was previously released by Canadian Academy of Sport Medicine (CASM) declaring that routine body composition assessment be abandoned for all female athletes and dancers as a strategy to reduce incidence of disordered eating (Carson and Bridges, 2001). It points to the lack of evidence of such assessment improving athletic performance and the rather abundant evidence of such assessments promoting body anxiety which may lead to disordered eating. In addition, the statement proposed a change in the attitude and culture in aesthetic sports such as gymnastics, ice skating, and dancing, such that low body weight is de-emphasized and the focus returned to performance. The health of the athlete should be top priority and form the basis upon which training protocol is

made. CASM suggests that monitoring programs be developed to better identify and support athletes with subclinical eating disorders. It concludes by requesting further research into the precipitators and preventative measures of disordered eating.

2.2 Current Screening Tools

There are several standard screening tools used to identify individuals at risk for disordered eating. Each focuses on different aspects of the condition and has specific strengths and weaknesses. Apart from the Eating Disorder Examination, no tools are able to diagnose presence of clinical eating disorders, they merely serve as screening tools to asses those most at risk who should be referred for further investigation

2.2.1 Diagnostic Tool

Eating Disorder Examination (EDE) (Fairburn & Cooper, 1993): The only currently validated tool capable of diagnosing clinical eating disorders is the EDE, which is an investigator-based interview and is considered the gold standard in eating disorder assessment. The EDE comprehensively assesses severity of dietary restraint and concerns about eating, shape and weight in the preceding 28 days. Questions are rated on a 7 point scale with higher scores representing greater psychopathology. The EDE contains four subscales (Dietary Restraint, Eating Concern, Shape Concern, and Weight Concern) as well as frequency measures of binge eating and compensatory behaviors such as vomiting and laxative use. Good discriminant and concurrent validity, internal consistency coefficients ranging from .68 to .90 for the subscales, and inter-rater reliability ranging from .83 to .99, have been well documented in adults (Anderson, Lundgren, Shapiro et al, 2004; Fairburn & Cooper, 1993). However, since the EDE is time and labour intensive, requires specialized training to administer, and may be subject to under-reporting due to lack of anonymity (Binford, LeGrange, & Jellar, 2005), several self-report questionnaires have been developed for

detecting behavior related to eating disorders. The most common measures are described below.

2.2.2 Self-Report Measures

Eating Disorder Examination (EDE-Q) (Fairburn & Beglin, 1994): The EDE-Q is a 52 item self-report measure adapted from the EDE (Fairburn & Cooper, 1993). Parallel to the EDE, the EDE-Q assesses severity of dietary restraint and concerns about eating, shape, and weight of the preceding 28 days. Questions are presented in 7-point Likert scale and dichotomous format, with higher scores representing greater psychopathology. The EDE-Q evaluates both behavioral and psychological aspects of eating. It contains four subscales (Dietary Restraint, Eating Concern, Shape Concern, and Weight Concern) as well as frequency measures of binge-eating and compensatory behaviors such as diuretic and laxative use, self-induced vomiting, and intense exercise. Testing over a two-week period revealed good test-retest reliability, with Pearson correlations ranging from 0.81 to 0.94 for each of the subscales (Luce & Crowther, 1999). Further, internal consistency was reported to be above 0.80 for all four subscales. A recent comparison study of the EDE-Q with the interview format EDE found the self-report measure to perform well in some areas, but poor in others (Binford et al, 2005). Specifically, the EDE-Q showed good agreement with the EDE for the assessment of self-induced vomiting and laxative misuse, but less precise correspondence when measuring binge eating. Three of the four subscales on the EDE and EDE-Q have been found to be highly correlated but significantly different, namely the Weight Concern, Shape Concern, and Eating Concern subscales (Binford, et al, 2005; Black & Wilson, 1996; Fairburn & Beglin, 1994). It has been posited that these subscales tap concepts that are too complex for participants to rate without the assistance of a skilled interviewer (Binford et al, 2005). Dietary Restraint does not demonstrate significant differences between the interview and self-report format perhaps because the items on this subscale are more concrete and straightforward. Comparison studies of the EDE and EDE-Q

as measures of eating disorder psychopathology have been limited almost exclusively to adult populations with clinical eating disorders (Carter, Aime, & Mills, 2001; Fairburn & Beglin, 1994). One exception is a study done in adolescents with clinical and subclinical eating disorders (Binford et al, 2005). In this study, the EDE-Q showed correlations ranging from 0.71 to 0.94 on all four subscales. Furthermore, these researchers found greater agreement between the EDE and EDE-Q in the subclinical group, and concluded that the EDE-Q may be more reliable in subclinical populations. The use of the EDE-Q in athletic populations has been fairly limited. In a study that employed the EDE-Q in elite female distance runners, those with eating disorders scored significantly higher on all subscales compared to those without eating disorders (Hulley & Hill, 2001). However, in a similar study in female college athletes, the EDE-Q did not consistently differentiate between athletes and non-athletes with eating disorders (McNulty et al, 2003). The athletes with eating disorders scored lower than non-athletes with eating disorders on the Restraint subscale, and higher than non-athletes on the Shape Concern subscale. Regardless of limitations, the good internal consistency, discriminant and concurrent validity, and test-retest reliability estimates for the EDE-Q fully support its use (Binford et al, 2005; Fairburn & Beglin, 1994; Luce & Crowther, 1999). Hulley & Hill (2001) conclude that the EDE-Q is a useful screening device and appears superior to other self-report instruments.

Eating Disorder Inventory (EDI) (Garner, Olmsted, & Polivy, 1983): The Eating Disorder Inventory is designed as a self-report measure of psychological and behavioral traits common in disordered eating. High scores indicate high likelihood of engaging in disordered eating behaviors, such as binge eating, discontentment with body size and shape, and excessive concerns for dieting and preoccupation with weight (Garner et al, 1983). It contains 64 items in 6 point forced choice inventory format that generate eight subscales: Drive for Thinness, Bulimia, Body Dissatisfaction, Ineffectiveness, Perfectionism, Interpersonal

Distrust, Interoceptive Awareness, and Maturity Fears. The EDI was designed for use in females over the age of 12 and has since been used in over 400 studies (Espelage, Mazzeo, Aggen et al, 2003). A strength of the EDI is that it includes both eating and weight related scales as well as scales assessing psychological and personality characteristics associated with disordered eating (Espelage et al, 2003). It was originally developed from a sample of 129 college-aged females with eating disorders and a comparison group of 770 female college students. Internal consistency reliability for the 8 subscales ranged from 0.83 to 0.93 in the eating disorder group and 0.72 to 0.92 in the non-clinical group (Garner et al, 1983). When measured against clinician ratings, interrater agreement correlations ranged from 0.43 to 0.68 on the subscales. All EDI items were able to discriminate between clinical and non-clinical samples as well as between subtypes within subclinical populations (Garner et al, 1983). Discriminative validity was later verified by Espelage et al (2003) who found the EDI to correctly identify 92% of the nonpatient group and 84% of the clinical group. However, in a study of female collegiate athletes (Black et al, 2003), the EDI performed less extraordinarily. It generated a sensitivity of 0.62, a specificity of 0.74, a false positive rate of 0.26, a false negative rate of 0.39, positive predictive power of 0.56, and negative predictive value of 0.80. Beals & Manore (2000) found that several subscales of the EDI failed to generate significant differences between female athletes with eating disorders and those without. Wilmore, Wambsgans, Brenner et al (1992) describe a study that used the EDI in female runners, which identified only 3 as having possible eating disordered behavior. However, seven runners were subsequently diagnosed with a clinical eating disorder. Another drawback of the EDI is that no specific information is given as to which pathogenic behaviors are engaged in and the bulimia subscale includes information about self-induced vomiting only, and not other inappropriate compensatory behaviors such as fasting, laxative abuse, and obsessive exercise (Mintz et al, 1997). A further limitation of the EDI is its clear and obvious intent, such that individuals taking the test can easily ascertain that its purpose is to identify individuals with disordered eating (Black et al, 2003). As discussed later,

this is particularly problematic in athletes who may fear punishment from coaches and disbarment from team participation if they are identified as disordered eaters. Thus, the applicability of the EDI in athletic populations has been questioned (Black et al, 2003; Brownell, 1992; McNulty et al, 2001; Wilmore, 1996)

Eating Attitudes Test (EAT) (Garner, Olmstead, Bohr, & Garfinkel, 1982): The EAT-26 consists of 26 questions and 3 factors (dieting, bulimia and food preoccupation, and oral control) assessing symptoms and concerns that are characteristic of anorexia nervosa. A cut-off of 20 is used to identify those individuals with disturbed eating patterns who may be at risk of receiving a clinical diagnosis of anorexia. To complete the EAT, participants rate their agreement with statements about weight and food. The dieting factor describes avoiding high calorie food and a pre-occupation with being thinner. The factor bulimia and food pre-occupation includes items that reflect thoughts about food and bingeing and purging tendencies. Items on the oral control factor are related to the control of eating and the perceived pressure from others to gain weight. In the original validation study comprised of 160 female anorexia nervosa patients and 140 female university psychology students, internal consistency reliabilities were found to range from 0.79 to 0.94 (Garner & Garfinkel, 1979). A major limitation of the EAT is that no distinctions can be made within the group of individuals scoring in the non-eating disordered range, such that a person scoring just below the cut-off would be considered similar to someone receiving the lowest possible score (Mintz et al, 1997). Furthermore, Wilmore (1996) described a study that used the EAT in 110 elite female athletes. None of the athletes scored in the eating-disordered range, yet 18% received treatment for eating disorders in the subsequent 2-year period. Hence, like the aforementioned EDI, the EAT also appears to be less valid in athletic populations (Brownell et al, 1992; Nagel et al, 2000; Wilmore, 1996).

Bulimia Test-Revised (BULIT-R) (Thelen, Farmer, Wonderlich, & Smith, 1991): The BULIT-R provides scores that reflect the degree of bulimic

symptomatology and a cutoff (>104) to indicate probable presence of bulimia. Based on the DSM-III, the tool contains 36 items in a 5 point Likert scale format measuring attitudes and behaviors associated with bulimia, such as shape and weight preoccupation, and bingeing and purging. The original validation sample included female subjects as young as 16 and it has since been validated for use in college-aged men and adolescent females (Boerner, Spillane, Anderson et al, 2004; McCarthy, Simmons, Smith et al 2002; Welch, Thompson, & Hall, 1993). It has been shown to differentiate bulimics from normal controls and shows good sensitivity (0.62), specificity (0.96), positive predictive power (0.82), and negative predictive power (0.89) in college-aged females (Thelen et al, 1991; Thelen, Mintz, & Vander Wal, 1996). Thelen et al (1991) found its internal consistency reliability to be 0.97. However, in a study of 148 female collegiate athletes (Black et al, 2003), the BULIT-R performed less stellarly. It demonstrated a sensitivity of 0.27, specificity of 0.99, false positive rate of 0.01, false negative rate of 0.73, positive predictive power of 0.93, and negative predictive power of 0.71. Based on the unacceptably low sensitivity and unacceptably high false-negative rate, these researchers concluded that the BULIT-R is not an acceptable screening tool in athletes. Another limitation of the BULIT-R is its inability to discriminate within the non-bulimic group, such that individuals with anorexia or subclinical eating disorders would not be differentiated from those without disordered eating, and as such is only recommended for research on bulimic individuals (Mintz et al, 1997).

While the above tests are commonly used to identify individuals with disordered eating, research that guided their development consisted primarily of college-aged female subjects. In addition, these tools rely on the DSM criteria to directly measure overt eating disordered behaviors, and as such are only capable of identifying individuals who have already developed significant pathological eating tendencies (Slade & Dewey, 1986; Sundgot-Borgen, 2004). Effective prevention and early identification requires the recognition of people who are likely to develop such a problem before the overt symptoms appear. Furthermore,

these tools and their corresponding cutoffs have not been standardized for use in athletic populations (Black et al, 2003; Brownell et al, 1992). For the above reasons, many researchers have concluded that the standard disordered eating screening tools may not accurately assess eating pathology in athletic populations and have called for the development of a tool that is sensitive to the unique needs of athletes (Black et al, 2003; Brownell et al, 1992; McNulty et al, 2001; Nagel et al, 2000; Smolak et al, 2000; Wilmore, 1992).

2.2.3 Athlete-Specific Self-Report Measures

Physiologic Screening Test (Black et al, 2003): The Physiologic Screening Test was designed to detect disordered eating specifically in collegiate female athletes. The test includes 14 self-report interview items and 4 physiologic measurements. The self-report includes items pertaining to present and past weight, hours exercised outside of practice, perception of being overweight, and physical symptoms such as dizziness, abdominal bloating and pain, and menstrual regularity. The physiologic component includes 4 measurements: percentage of body fat, waist:hip ratio, standing diastolic blood pressure, and enlarged parotid glands. The physiologic items were included in an attempt to reduce response bias by being objective in nature and not easily manipulated or distorted by athletes. The Physiologic Screening Test produced higher sensitivity (87%) and specificity (78%) than both the EDI and the BULIT-R in a sample of 148 female collegiate athletes (Black et al, 2003). The major drawbacks of this test are the time and resources required to physically measure each athlete as well as the lack of applicability to male athletes.

Female Athlete Screening Tool (FAST) (McNulty et al, 2001): Recently, a tool was developed for use specifically in female athletes. Since standardized self-report questionnaires are often insensitive to the unique needs of the female athlete, the FAST was developed to accurately measure the reason for engaging in atypical exercise and eating behaviors. The FAST is a 33 item, 4 pt forced choice

self report which screens for atypical eating and exercise behaviors in college aged female athletes. A score above 77 indicates risk of subclinical eating disorders while a score above 94 indicates risk of clinical eating disorders. In the one validation study that employed the tool, the FAST demonstrated high internal consistency (0.87) as well as discriminant validity such that female athletes with eating disorders scored higher than both athletes without eating disorders and non-athletes with eating disorders (McNulty et al, 2001). Concurrent validity of the FAST to the EDE-Q and EDI was established by correlation coefficients ranging from 0.51 to 0.89 for the various subscales.

Although thus far only validated for use in female athletic populations, the Physiologic Screening Test and the FAST represent two of the first tools designed to measure disordered eating in athletes. Despite the overwhelming need, a standardized and norm-referenced instrument has not yet been validated for use in both male and female athletes. Nor has there been investigation into the eating habits of male and female athletes beyond college age.

2.3 Definitions of Disordered Eating

A clarification of the differences between clinically diagnosed eating disorders and the general concept of disordered eating is of importance. Disordered eating is defined as "a wide spectrum of harmful and often ineffective eating behaviors used in attempts to lose weight or achieve a lean appearance" (Otis, Drinkwater, Johnson et al, 1997). Disordered eating can be thought of as a continuum of pathogenic eating behaviours, spanning from obsessive dieting to the use of dangerous weight control behaviors such as fasting, diet pills, binge eating and purging, to a clinical eating disorder, such as anorexia nervosa and bulimia nervosa (Sundgot-Borgen, 2004). Thus an individual suffering form disordered eating can lie at any point along the continuum and include not only those with clinical eating disorders but also those with subclinical eating disorders, that is those who present eating disordered behaviors without meeting the full diagnostic criteria associated with anorexia or bulimia nervosa.

2.3.1 Clinical Eating Disorders

The Diagnostic and Statistical Manual of Mental Disorders 4th edition (DSM-IV) classifies eating disorders as gross disturbances in eating behavior and identifies three types of clinical eating disorders (American Psychiatric Association, 1994). The first, anorexia nervosa, is characterized by self-starvation, maintenance of an unhealthily low body weight with refusal to gain, distorted body image, and amenorrhea (absence of three or more consecutive menstrual cycles). Bulimia nervosa, on the other hand, presents with episodes of binge eating (rapid consumption of large amounts of food in a discrete period of time occurring at least two times per week for three or more months) followed by purging through vomiting, laxative abuse, excessive exercise or other compensatory measures. The DSM-IV includes a third classification of Eating Disorders Not Otherwise Specified (EDNOS) for individuals who meet some, but not all, of the criteria for anorexia nervosa or bulimia nervosa. Examples of eating behaviors that would fit in this category are: (1) For females, all of the criteria for anorexia nervosa are met, except for absence of a menstrual cycle; (2) All of the criteria of anorexia nervosa are met, except that, despite significant weight loss, the individual's weight is in the normal range; (3) All of the criteria of bulimia nervosa are met, except that the binge-eating/purging behaviors occur less than twice a week for three months. Because the diagnostic criteria for EDNOS are not as stringent as those for anorexia nervosa and bulimia nervosa, many more individuals fall into this category.

2.3.2 Subclinical Eating Disorders

Individuals who have significant eating and body image disturbances but do not meet the DSM criteria for anorexia or bulimia nervosa are said to have subclinical eating disorders (Beals, 2000; Garner et al, 1998; Mintz, O'Halloran, Mulholland, & Schneider, 1997; Sundgot-Borgen, 1994). Researchers have identified several subclinical conditions that are described below. While they do not represent distinct disorders, they are syndromes that have been described in

detail in the literature and represent subtle differences in the interpretation of subclinical eating disorders.

Anorexia Athletica: Sundgot-Borgen (1993) described a subclinical form of anorexia nervosa referred to as *anorexia athletica* (AA), which, as the name implies, is specific to athletes. The concept of AA was introduced because the symptoms of EDNOS in athletes may require somewhat different interpretation than in non-athletes due to their unique training, eating patterns and psychological profiles (Sudi et al, 2004; Sundgot-Borgen, 2004). An athlete with AA exhibits intense fear of gaining weight despite being underweight (at least 5% below ideal weight), and uses a variety of pathological weight control methods, such as severe energy restriction (<1200 kcal/d), excessive exercise, self-induced vomiting, and laxative and/or diuretic abuse. Excessive exercise is defined as more than is required to improve performance and is in addition to normal training. Other elements that Sundgot-Borgen used to diagnose AA include menstrual dysfunction, GI complaints, distorted body image, delayed puberty, excessive fear of becoming obese and an absence of medical illness or affective disorder to explain weight reduction.

Subclinical Eating Disorders in Athletes: Despite the specificity to athletic populations, Beals and Manore (2000) believe that AA may not be appropriate for identifying athletes with subclinical eating disorders since some of the features are not well defined (ie no definitions given for distorted body image or excessive exercise) while others are too restrictive (ie defining a maximum energy intake of 1200 kcal/d or a weight loss of greater than 5% of body weight). Instead, these researchers identified and defined eight behavioral, psychological, and physical characteristics of female athletes with subclinical eating disorders (SCEDs): preoccupation with food, distorted body image, undue influence of body on self-evaluation, intense fear of gaining weight, weight control methods, strict dietary rules, menstrual dysfunction and absence of medical illness to explain low weight. These characteristics include possible cut-off scores on routinely administered

tests such as the Eating Disorder Inventory and Body Shape Questionnaire that may indicate the presence of SCEDs. An advantage of the defined characteristics for SCEDs is that they focus more on the athlete's weight control behaviors than on current body weight or composition. These researchers purport that the motives for and methods of weight control are equally as important as maintenance of low body weight in demonstrating significant body image disturbance and pathological weight control behavior. Another advantage of the SCED's characteristics is that they employ relative criteria rather than absolute. Relative criteria help verify existence of the disorder, while absolute criteria must be present in order to confirm diagnosis. Relative criteria may be more appropriate for properly classifying individuals who lie at different points along the disordered eating continuum.

2.3.3 Female Athlete Triad

A medical disorder termed the Female Athlete Triad, comprised of disordered eating, amenorrhea, and osteoporosis was initially described in 1992 by the American College of Sports Medicine (Otis et al, 1997). Amenorrhea is defined as the absence of three or more consecutive menstrual cycles. Similar to disordered eating, menstrual dysfunction can be seen on a continuum with amenorrhea at the extremes and varying degrees of menstrual irregularity falling in between (Beals, Brey & Gonyou, 1999). Menstrual dysfunction is itself a serious medical condition, as menstrual irregularity is associated with bone densities of at least 1 standard deviation below the mean (Khan, Liu-Ambrose, Sran et al, 2002). Menstrual dysfunction is precipitated by the hypoestrogenism which follows energy restriction and obsessive weight control behaviors, and in turn results in decreased bone density and premature osteoporosis (Walsh et al, 2000). Thus disordered eating can initiate a cascade of consequences that lead to a triad disorder, consisting of disordered eating, reproductive and bone dysfunction.

2.4 Prevalence of Disordered Eating in Athletes

Several studies have tried to characterize the prevalence of clinical and subclinical eating disorders in athletes. Since there currently exists no consistently used tool to diagnose either condition in athletes, and since occurrence of disordered eating depends on the athletic population being studied, prevalence rates vary greatly from study to study. However, there are four specific trends concerning disordered eating in athletes that have been validated repeatedly. These are that athletes are at greater risk of disordered eating than their non-athletic counterparts, the prevalence of subclinical eating disorders far outweights that of clinical, female athletes are at greater risk than male, and disordered eating is most common in weight-dependent sports.

2.4.1 Athletes vs Non-Athletes

First and foremost, an abundance of research suggests that prevalence of disordered eating is higher in athletes than non-athletes (Johnson et al, 1999; Sundgot-Borgen, 1993). In fact, athletes appear to be 2 to 3 times more likely than the general population to meet criteria for eating disorders (Burckes-Miller & Black, 1988). Amenorrhea, a component of the Female Athlete Triad, occurs in as many as 66% of athletes, which is in contrast to the prevalence of 2% to 5% in the general population (Vereeke West, 1998). In a ground-breaking study by Sundgot-Borgen and Torstveit (2004), the entire population of elite athletes in Norway was assessed for the incidence of disordered eating. They found that 13.5% of athletes displayed dysfunctional eating, while the same was true for only 4.9% of the non-athlete group. A meta-analysis of 34 studies concerning athletic participation and eating problems concluded that significantly more eating problems are reported among college athletes than among college-aged, non-athlete controls (Smolak et al, 2000).

2.4.2 Clinical vs Subclinical Eating Disorders

A second consistently demonstrated trend is that the prevalence of subclinical eating disorders in athletes far outweighs that of clinical (Beals &

Manore, 1994; Johnson et al, 1999; Nagel et al, 2000; Sundgot-Borgen, 2004, 1994; Thompson & Sherman, 1993). A study of male collegiate lightweight football players found that 9.9% of the sample engaged in behavior that could represent a clinical eating disorder, while 42% of the sample evidenced a pattern of dysfunctional eating (Depalma et al., 1993). Specifically, 74% engaged in binge eating, 66% had fasted, 17% engaged in self-induced vomiting, 4% used laxatives, and 2.5% used diet pills, diuretics or enemas. Twenty percent of athletes reported that their weight control practices significantly interfered with their thoughts and extracurricular activities. A similar study of 148 female collegiate athletes from 12 different sports, including golf, swimming, softball and track, found that clinical eating disorders were evident in 8% of athletes, while 16% exhibited subclinical eating disorder behavior (Black et al, 2003).

2.4.3 Males vs Females

Thirdly, female athletes are at a greater risk for developing disordered eating behaviors than male athletes (Beals & Manore, 1994; Otis et al, 1997; Sudi et al, 2004). A study conducted in collaboration with the NCAA looked at the prevalence of disordered eating and weight reduction practices among 1,445 male and female athletes in eleven Division I schools (Johnson et al, 1999). Binge eating was found to be the most prevalent behavior for both men (11.97%) and women (22.68%). Women with clinically significant problems with bulimia were estimated at 9.2%, versus .01% of men. Purging behavior on a weekly or greater basis was estimated at 5.52% in women and 2.05% in men. During their lifetime, more women than men were shown to use vomiting (23.9%, 5.93%, respectively), diet pills (14.03%, 2.16%, respectively), and laxatives (11.72%, 5.06%, respectively). The only weight loss method where males exceeded women was in sauna/steam use for weight loss (24.26%, 6.59% respectively). Similar results were found by Sykora et al. (1993), who measured eating attitudes, diet patterns, weight fluctuation and methods of weight loss in 162 heavyweight and lightweight rowers. Overall, females were more concerned about eating and weight than males and exhibited more restrictive eating behaviors. Likewise, in a

large sample of elite athletes from 7 different sports, Sundgot-Borgen (2004) found that the criteria for subclinical eating disorders were met by more female (20%) than male (8%) athletes.

2.4.4 Weight-dependent vs Non Weight-dependent Sports

Finally, disordered eating is more common among those competing in leanness-dependent and weight-dependent sports than in other sports (Black et al, 2003; Garner et al, 1998; Otis et al, 1997; Yates et al, 2001). Sports that emphasize low weight for performance (ie distance running), where ratings by judges are influenced by appearance (ie gymnastics, figure skating), or where athletes must conform to weight restrictions (ie wrestling, rowing), have higher incidence of dysfunctional eating (Sykora et al, 1993). Sundgot-Borgen (2004) found that the prevalence of disturbed eating among male athletes was greater in antigravitation sports (22%), such as swimming, than in endurance (9%) and ball game sports (5%). Among female athletes, prevalence was highest among those competing in aesthetic sports (42%) such as figure skating and gymnastics than in endurance (24%), technical (17%), and ball game sports (16%).

Beals and Manore (2002) assessed the prevalence of the Female Athlete Triad in a group of 425 female collegiate athletes. They found that athletes in aesthetic sports scored higher on the Eating Attitudes Test (EAT) to indicate disordered eating and reported more muscle and bone injuries than athletes in endurance or team/anaerobic sports. Similarly, a recent Norwegian national survey found that a higher percentage of athletes competing in sports that emphasize thinness and/or a specific weight reported menstrual dysfunction (24.8%) than athletes competing in sports focusing less on such factors (13.1%) (Torstveit & Sundgot-Borgen, 2005).

As demonstrated above, the prevalence of clinical and subclinical eating disorders in athletes varies greatly across studies and across athletic populations. Regardless of this variance, the prevalence of disordered eating has consistently

been found to be higher in athletes than non-athletes. There are a variety of factors inherent to the athletic setting that place the athlete at increased danger.

2.5 Risk Factors in the Athletic Setting

Although there exists no singular cause of disordered eating, it appears that an interplay of biological, psychological, and environmental factors are responsible (Brownell et al, 1992; Garner et al, 1998; Otis et al, 1997; Sundgot-Borgen, 1994).

2.5.1 Biological Factors

Certain biological factors may have a hand in producing pathogenic eating specific to the athlete. The first involves the body's physiological response to exercise. A hypothesis known as activity-based anorexia proposes that food intake is reduced following strenuous exercise and that, likewise, in the face of food restriction, exercise increases (Davis, Kennedy, Ravelski et al, 1997; Epling & Pierce, 1996; Hebebrand, Exner, Hebebrand et al, 2003). Thus under-eating and over-exercising may be self-perpetuating behaviors, which lead to the development of subclinical and clinical eating disorders. It also appears that age of initiation into sport and physical activity affects risk of disordered eating (Sundgot-Borgen, 1994). Davis, Katzman and Kirsh (1999) found that childhood physical activity predicted excessive exercising in adolescents with eating disorders. Other biological factors have also been implicated in disordered eating development, including altered neurophysiology, early onset of menarche, and gender (Beals, 2000; Garner et al, 1998; Hashimoto, Koizumi, Nakazato et al, 2005; White, 2000).

2.5.2 Psychological Factors

Studies investigating disordered eating have attempted to identify psychological risk factors that can lead to the development of this behavior. Common factors include depression, perfectionism, obsessive-compulsive tendencies, need for control, competitiveness, overconcern with body weight and appearance, and

drive for thinness (Brownell et al, 1992; Geller, Cockell, & Goldner, 2000; Robert-McComb, 2001; White, 2000).

Depression: Depression is the most common comorbid diagnosis in persons with disordered eating (Braun, Sunday, & Halmi, 1994; Fairburn & Cooper, 1984; Grubb, Sellers & Waligroski, 1993; Young, Clopton & Bleckley, 2004). Diehl et al (1998) measured eating disorder symptomatology in female undergraduate students and found that depression predicted anorexic and bulimic symptoms. In another study, women with bulimic tendencies demonstrated significantly higher levels of depression than either obese women or women in a normal comparison group (Williamson, Kelley, Davis, et al, 1985). Lane (2003) found that depressed mood scores showed the strongest relationship with disordered eating scores than other mood states.

Perfectionism: Perfectionism has been consistently linked with disordered eating symptomology (Fairburn, Cooper, Doll, & Welch, 1999; Hewitt, Flett & Ediger, 1995; Joiner et al, 1997; Steiger, Leung, Puentes-Newuman & Gottheil, 1992). It has been proposed that perfectionistic tendencies generate a need on the part of the individual to seek control over some aspect of their life, which is often body and weight control (Slade, 1982). Successful dieting then has a powerful intrinsic reinforcing consequence that precipitates the individual into a downward spiral of increased weight control. Vohs, Voelz, Pettit et al (2001) showed that the combination of perfectionistic attitudes, body dissatisfaction, and low self-esteem were not only predictive of subclinical bulimic behavior but also of depressive symptoms. A study in female athletes found that those with eating disorders scored highest on the perfectionism subscale of the EDI-2 (McNulty et al, 2001).

Other Personality Traits: Many of the psychological risk factors associated with disordered eating are also traits commonly found in athletes. Thompson and Sherman (1999) suggested that certain traits coaches desire in their athletes (referred to as "good athlete" traits) are similar to traits found in individuals with

disordered eating. Specifically, they defined six such pairs of characteristics: mental toughness/asceticism; commitment to training/excessive exercise; pursuit of excellence/perfectionism; coachability/overcompliance; unselfishness/ selflessness; and performance despite pain/denial of discomfort. Leon (1991) further suggested that traits such as high achievement orientation and obsessive-compulsive tendencies are commonly associated with disordered eating and are also expected and usually essential for competing successfully. Brownell et al (1992) further listed several personality characteristics associated with eating problems that might also be descriptive of athletes: competitiveness, concern with performance, compulsive concern with body shape, and perfectionism. Thus there are a variety of psychological conditions that may precipitate disordered eating behavior, and these are traits commonly found in athletes.

2.5.3 Environmental Factors

There are also factors specific to the athletic setting that place athletes at greater risk of developing aberrant eating behavior.

Weight Pressures: There are higher than normal weight and body composition demands placed on athletes. Not only are they subject to regular weighings and body fat measurements, but also they are often pressured to conform to specific aesthetic ideals and weight restrictions of their respective sport. Figure skating (Zeigler et al, 1998), distance running (Hulley & Hill, 2001), ballet (Ravaldi et al, 2003) and gymnastics (Rosen & Hough, 1988) are prime examples of sports that emphasize a small body ideal and it is well documented that many participants of these sports have suboptimal energy intakes and greater prevalence of disordered eating (Garner et al, 1998; Smolak et al, 2000, Sundgot-Borgen, 1994; Yates et al, 2001). Wrestling and rowing often require participants to meet certain weights on game day, and this leads many athletes to resort to dangerous weight loss methods such as severe caloric restriction, dehydration, and laxative and diuretic abuse (Brownell et al, 1987; Depalma et al, 1993; Johnson et al, 1999; Sykora et al, 1993; Thiel et al, 1993). Thiel et al (1993) found that 52% of male rowers and

wrestlers engaged in pathogenic weight control methods. Similarly, DePalma et al (1993) reported that 42% of lightweight football players practiced dysfunctional eating behavior to meet the weight restrictions of their sport. Thus it appears that participants in activities that stress low body weight and a slim shape for professional competence appear to be at greater risk of developing disordered eating behavior.

Coaching Staff: The often unquestioned authority of a coach who places too much emphasis on body size rather than performance may similarly cause athletes to focus exclusively on weight (Nagel et al, 2000; Williamson, Netemeyer, Jackman et al, 1994). Athletes' beliefs regarding nutrition and body weight are often shaped by coaching staff. Depalma et al (1993) found that the "teacher / coach" was most frequently perceived by athletes as the individual who motivated dysfunctional weight control behavior. Sundgot-Borgen (1994) found that 67% of athletes with eating disorders were dieting on the advice of their coach. A study of 42 collegiate women gymnasts found that 67% were told by their coaches that they were too heavy and 75% of these resorted to dangerous weight control methods (Rosen & Hough, 1988). Hence, comments from coaching staff on body size or emphasis of its role in performance may place athletes at risk of developing unhealthy eating practices.

Competitiveness: Researchers have begun to examine the possibility that the level of competition might play a role in the development of pathological eating. Specifically, researchers have found elite athletes to exhibit more disordered eating behaviors than those in lower levels of competition (Smolak et al. 2000; Sudi et al, 2004; Sundgot-Borgen, 1994, 2004). This may be partially attributed to the similarity between personality traits required for success in sport and those found in disordered eating populations (Smolak et al, 2000; Thompson & Sherman, 1999). Another possible explanation is that as the level of competition increases so too does the pressure to improve performance. Subsequently, many athletes turn to reducing body weight as a way to gain an edge on the competition,

which results in increased weight preoccupation and body dissatisfaction and increases the tendency for disordered eating behavior (Sudi et al, 2004). When Picard (1999) examined the differences between athletes at similar Division I and Division III colleges, the results supported the theory that the level of competition increases the prevalence of eating disorders. Athletes at the Division I level were found to have higher subjective levels of competitiveness and pressure to perform than their Division III counterparts. Paralleling the intense feelings of competitiveness, Division I athletes also scored higher on both the EAT and EDI testing measures, indicating a higher prevalence of disordered eating behavior. While the drive for thinness subscale was the strongest drive for both levels, Division I athletes scored highest within this category. Thus it appears that athletes at elite levels of competition have greater prevalence of disordered eating behavior.

Strenuous Training: As mentioned previously, excessive exercise is a strong determinant of subclinical and clinical eating disorder development. In a study of hospitalized eating disorder patients and age-matched controls, Davis et al (1994) found that 60% indicated that they were competitive athletes or dancers prior to the onset of the disorder and excessive exercise was reported by 78% of patients. However, an "excessive" quantity is especially difficult to define in athletes and varies across sports. In the western culture, fitness is heavily promoted and individuals adhering to strict exercise routines are praised for their discipline and commitment, which reinforces the obsessive behavior (Kaminker, 1998). While the benefits of regular exercise are numerous and well documented (Blumenthal, Sherwood, Babyak et al, 2005; Warren & Stiehl, 1999), exercise can easily become excessive in the athletic setting (Kaminker, 1998; McKenzie, 1999; Ogles et al, 1995; Yates, 1991). Several indicators that exercise behavior might be excessive include: preoccupation with thoughts regarding when, where and how much to exercise, avoidance of work and social responsibilities in order to maintain a rigid exercise schedule, exercising when injured or over and above that required for sport, and an inability to exercise for enjoyment or relaxation

(Beumont et al., 1994; Coen & Ogles, 1993; Davis et al, 1994; McNulty et al, 2001). Obsessive exercise exhibits a pattern similar to that of a chronic dieter - the compulsive exerciser arranges his or her life to ensure that rituals and routines are not disturbed (Sherman & Thompson, 1993). When the routine is altered, depression, guilt and anxiety set in. Thus, in the sport setting, where strict training regimens are encouraged, excessive exercise may be placing athletes in jeopardy of disordered eating development.

As illustrated above, there are a variety of biological, psychological, and environmental conditions unique to the athletic setting that place athletes at greater threat of developing disordered eating. In order to accurately identify the athlete with disordered eating, a screening tool must be sensitive to these unique conditions.

2.6 Consequences of Disordered Eating

There are a variety of negative repercussions of disordered eating behaviors on both the physiological health as well as performance of athletes.

2.6.1 Physiological Consequences

The numerous adverse physiological consequences that arise from disordered eating are well documented (Brownell et al, 1987; Carney & Anderson, 1996; Comerci GD, 1990; Sudi et al, 2004; Sundgot-Borgen, 1996; Walsh et al, 2000). Chronic fatigue, muscle weakness, decreased immune function, increased risk of and delayed recovery from injury, anemia, electrolyte imbalances, renal complications, menstrual dysfunction, decreased bone-mineral density, and premature osteoporosis are some of the major medical complications associated with inadequate energy intake. The loss of bone mineral density may be completely irreversible even with resumption of adequate nutrition and menstrual regularity (Nattiv, Agostini, Drinkwater & Yeager, 1994). A study of female athletes with anorexia found that their bone density resembled that of senescent women 3 to 4 times older (Drinkwater, Nilson, Chesnut, et al, 1984). Long-term dieting affects body composition, reduces metabolic rate, increases the

risk for cardiovascular disease, and leads to endocrine abnormalities associated with reproductive function (Brownell et al, 1987; Drinkwater et al, 2005). Steen et al (1988) reported that wrestlers who displayed repeated cycles of weight loss and gain had a 14% lower resting metabolic rate than those without weight fluctuation. Furthermore, purposeful energy restriction and chronic dieting often results in inadequate intakes of energy, protein, carbohydrate and micronutrients such as calcium, vitamin D, and iron, which can result in serious nutrient deficiencies in the long-term (Sundgot-Borgen, 1993a; Zeigler, Khoo, Sherr et al, 1998).

Still more sobering are the consequences inherent to the specific weight control behaviors employed (Beals, 2000; Comerci, 1990; Walsh et al, 2000). Diet pills present side effects such as increased heart rate, anxiety, insomnia, inability to concentrate, and dehydration. Diuretics and laxatives promote dehydration and electrolyte imbalances, as does self-induced vomiting, which can result in arrhythmias and heart failure. Vomitting disrupts gastrointestinal functioning leading to esophageal perforation and ulcers, erosion of tooth enamel, dental caries and swollen salivary glands. Excessive exercise perpetuates increased rigidity and compulsiveness, mood disturbances, altered hormone levels leading to amenorrhea, increased susceptibility to infectious diseases, fatigue, and dehydration, (Coen & Ogles, 1993; Kaminker, 1998; McKenzie, 1999; Yates, 1991). Thus even in athletes without clinical eating disorders, inadequate nutrition and pathogenic weight control behaviors can lead to a host of serious physiological complications.

2.6.2 Performance Consequences

Less perilous but equally significant in the athletic setting is the diminished performance that accompanies inadequate nutrient intakes. Athletes in particular must give careful heed to ensure they are meeting their nutritional requirements, as any change in energy balance or nutritional status will have direct repercussions on athletic performance (Thompson & Sherman, 1999a). Individuals with a high training volume and intensity will clearly require higher

energy and nutrient intakes than sedentary adults in order to achieve energy balance. Energy intakes of at least 45 kcal/kg/day for athletes who train for 90 minutes or more per day are recommended (Economos, Bortz, & Nelson, 1993). In addition, participants of strength/power sports have an even higher recommended dietary protein intake than those engaging in endurance sports (1.7-1.8g/kg vs. 1.2- 1.6g/kg respectively) (Economos et al, 1993; Tarnopolsky, 2004). It has also been recommended that athletes consume a diet rich in vitamins and minerals to maintain micronutrient stores (Economos et al, 1993).

Without adequate intake, athletes cannot achieve optimal physical performance, as their bodies are deprived of the fuel necessary to maintain muscle power and endurance (Nagel et al, 2000). Glycogen and fluid stores will be depleted, protein synthesis will be reduced and stores in muscle and tissue will be broken down for energy, basal metabolic rate will decrease and micronutrients needed for energy metabolism will be lacking (Beals, 2000; Brownell et al, 1987; Steen et al, 1988;). Prolonged calorie restriction and weight loss can have a dramatic negative effect on strength, coordination, oxygen consumption, and energy expenditure during work (Malina, 1992). Low carbohydrate or energy intake increases amino acid oxidation during activity and subsequently, athletes who restrict calories or macronutrient consumption are jeopardizing their protein status which directly affects muscle function (Tarnopolsky, 2004). Decreased energy intake also promotes fluid and electrolyte imbalances, which can lessen endurance, strength, reaction time, speed and ability to concentrate (Vereeke West, 1998). Attempting to train in a dehydrated state may also lead to acute complications such as heat exhaustion and heat stroke (Nagel et al, 2000).

In addition, athletes who over train without adequate rest and nutrition are vulnerable to injury such as stress fractures and torn muscles, ligaments, tendons and cartilage, which can have a long-term and irreversible impact on performance (Kaminker, 1998; Ogles, Masters & Richardson, 1995). Also implicated in increased occurrence of musculoskeletal injuries is amenorrhea (Barrow & Saha, 1988; Drinkwater et al, 2005). In fact, as many as one quarter of female athletes with irregular or absent menses reported incidence of stress fractures in a study by

Lloyd et al (1986). Thus, even moderate malnutrition and disordered eating behaviors can have serious repercussions on athletic performance.

As highlighted above, athletes with disordered eating are at risk of a variety of serious consequences that threaten both their health and performance. As such, it is vital that a screening tool be developed to aid in the early detection of male and female athletes with disordered eating attitudes and behaviors.

3.0 Rationale

Because there is considerable debate about whether currently available instruments are applicable in male and female athletic populations, the Questionnaire of Eating Attitudes and Behaviors (Q-EAB) was developed by the present researchers to identify athletes with disordered eating attitudes and behaviors. In order to detect eating pathology in athletes, a tool must be able to discriminate between behaviors, such as rigorous exercise, which are motivated by a desire to improve performance and those done in an attempt to maintain minimum body weight (McNulty et al, 2001; Sudi et al, 2004; Yates et al, 2001). The use of body mass or related variables in the identification of athletes with disordered eating is questionable, because athletes may have low body mass and fat stores due to intense training, or high body mass due to a large proportion of muscle mass (Sudi et al, 2004). McNulty et al (2001) found that all athletes scoring high on psychometric inventories indicating disordered eating tendencies had normal Body Mass Indices. Thus, an effective tool should focus on eating attitudes and weight control behaviors rather than physical indicators to verify existence of disordered eating.

Effective prevention and early identification requires the recognition of athletes who are at risk of developing pathogenic behavior before overt eating disorders appear. This entails trying to assess pathogenic attitudes and beliefs that occur earlier in the causal chain than eating disordered behavior. For example, measuring the cognitive expectations for eating and the expectancies that accompany a pursuit for thinness may help identify the person with a pathologically high drive for weight control and a propensity to eating disorder development (Holstein, Smith & Atlas, 1998). It has been suggested that factors such as depressive symptoms, dissatisfaction with weight and body, training frequency and intensity and other lifestyle behaviors also be addressed in a screening tool (Nattiv et al, 1994; Rumball & Lebrun, 2004; Slade & Dewey, 1986). In addition, the degree to which the eating behaviors interfere with work,

school, thoughts, personal relationships, and extracurricular activities may indicate likelihood of dysfunctional eating behaviors (Depalma et al, 1993). Garner et al (1998) list several psychological and behavioral symptoms that may indicate existence of disordered eating in athletes, including excessive dieting and exercise, preoccupation with food, frequent weighting, and use of weight-control methods. Beals (2000) reports additional indicators, including undue influence of body on self-evaluation, intense fear of gaining weight, strict dietary rules, and menstrual dysfunction to characterize the athlete with a subclinical eating disorder. These criteria guided development of the Q-EAB, which was designed to capture the various psychological conditions that place an individual at risk of developing subclinical and clinical eating disorders.

Many current screening instruments rely on self-report of eating disorder symptoms and as such are easily appraised by athletes. In fact, some tools use the words "eating disorder" or directly ask if the subject believes they have an eating disorder. Fear of punishment from coaches and dismissal from the team may prompt athletes to omit or distort responses that would indicate a problem (Wilmore, 1991). Yates et al (2001) suggest that in order to gain truthful responses, a screening tool should be based on something other than specific eating disorder symptoms. Furthermore, athletes must be assured that identification of eating problems will not lead to expulsion from team participation (Black et al, 2003; Garner et al, 1998; Nagel et al, 2000; Sundgot-Borgen, 1994). Anonymity of participant responses in the current study was maintained through computer administration of tests and emphasized in the letter of consent to enhance truthfulness of responses.

An effective screening tool will distinguish between individuals with varying degrees of disordered eating. Most of the existing screening tools use diagnostic cut-off scores such that individuals scoring just below the cut-off are considered equivalent to individuals receiving the lowest possible score. Obviously these two sets of individuals display different degrees of psychopathology that is not being captured by these tools. It has been suggested that screening measures instead employ continuous scores to allow for

differentiation among individuals along the disordered eating continuum (Mintz et al, 1997). In addition, low scores should not automatically confirm the absence of disordered eating, but should be taken along with reports from parents, teammates, and coaches to correct for denial and dishonesty (Garner et al, 1998). In accordance with the above recommendations, the Q-EAB uses continuous scores to indicate varying degrees of psychopathology.

Since coaching or training staff are most often responsible for its employment, an efficient screening tool must be inexpensive, require minimal training for administration, and employ simple scoring methods (Black et al, 2003; Garner et al, 1998; Nagel et al, 2000; Yates et al, 2001). Depalma et al (2002) assert that it is seldom viable to screen large numbers of athletes with costly and time intensive clinical interviews, such as the EDE. Self-report instruments are more suitable by being time efficient, inexpensive, descriptive, not requiring a trained clinician, and able to give immediate feedback. Furthermore, with the rise in computer and internet use, computerized administration of tests is becoming a preferable method to collect information from large samples. It offers several advantages over other mediums, including the ability to reach a larger audience, being simple and inexpensive to administer, and decreased scoring error (Schonlau, 2004). In addition, the anonymity of computer administration may elicit more truthful responses since volunteers will be less swayed to offer socially acceptable answers (Kiesler & Sproull, 1986). A limitation of self-report tools is the risk of "response sets" such as agreeing with positive statements and disagreeing with negative statements (Isaac & Michael, 1997), but this can be avoided by varying the format of questions. The Q-EAB was designed as a computer-administered, self-report measure in order to minimize the degree of effort required by the both participant and administrator. This type of research is necessary in order to make coaches and trainers aware of disordered eating issues and thus better prepared to identify at risk athletes. Early detection is crucial for the implementation of appropriate nutritional and psychological interventions to successfully prevent development of clinical eating disorders and long-term health consequences.

3.1 Specific Objectives

Our first objective was to measure the prevalence of disordered eating tendencies in male and female Masters athletes. This study represents the first such attempt in this population and it was expected that there would be lower prevalence of pathogenic weight control behavior than that reported for athletes of college age. Based on the research in athletes of college age (Beals & Manore, 1994; Smolak et al. 2000; Sundgot-Borgen, 1994, 2004), we also expected female and elite athletes to display more disordered eating attitudes and behaviors than male and non-elite respectively.

The second objective was to validate the Q-EAB against 5 standard psychometric tools: Eating Disorder Examination-Questionnaire (EDE-Q), Female Athlete Screening Tool (FAST), Center for Epidemiological Studies Scale –Depression (CES-D), Thinness and Restricting Expectancy Inventory (TREI), and Eating Expectancy Inventory (EEI). Since the Q-EAB was designed to measure subclinical eating disorders, we expected it would show some, but not necessarily high, correlation with the EDE-Q, which was developed to assess clinical eating disorders. Likewise, we expected the Q-EAB to show partial correlation with the FAST, which was designed to assess eating pathology in female college-aged athletes. In addition, we expected the Q-EAB to show partial correlation to the CES-D, TREI, and EEI, which assess conditions related to, but distinct from, disordered eating. Finally, we were interested in looking at the nutritional intake and energy expenditure of athletes to see if those scoring high on the psychometric instruments also exhibited suboptimal energy and nutritional intakes for their respective level of physical activity.

3.2 Research Hypotheses

The present study was designed to test the following hypotheses:

1. There will be a significant difference between male and female Master's athletes in terms of disordered eating attitudes and behaviors as measured by scores on 6 psychometric tools.

2. There will be a significant difference between elite and non-elite Master's athletes in terms of disordered eating attitudes and behaviors as measured by scores on 6 psychometric tools.

3. The Q-EAB will show significant correlation to standard psychometric tools such as the EDE-Q, FAST, CES-D, TREI, and EEI.

4. There will be significant correlation between high scores on the psychometric tools and suboptimal energy and nutritional intake in athletes.

4.0 Methods

4.1 Participants

This study used a convenience sample of male (n=48) and female (n=63) Masters athletes ranging in age from 35 to 65 years who were recruited from an online community (www.trirudy.com) of endurance athletes from Ontario. Canada Masters Athlete Association (CMAA) defines a Masters athlete as male athletes aged 40 and above and female athletes aged 35 and above. Recruitment of athletes was coordinated through the website coordinator, who was contacted separately and given a brief outline of the purpose of the study. Upon receiving his approval, a notice was posted on the website's message board detailing the purpose and participation requirements of the study. The invitation asked for participants interested in completing a study on eating, exercise and personality characteristics of Masters Athletes. As incentive, the first 100 participants to complete the first section of the survey were entered in a draw to receive a full nutritional assessment done by an exercise specialist. All interested athletes were invited to log into a secure website where they could complete the online questionnaires anonymously. Individuals who wanted feedback on their individual diet and activity records provided a contact email address with the primary researcher. Any participant interested in receiving further information contacted the primary researcher directly via email.

4.2 Informed Consent

In order to log into the website, all participants had to read and agree with the consent statement approved by the McGill University Agricultural and Environmental Sciences Ethics Committee. The purpose of the informed consent form was to obtain permission from each of the participants in their willingness to partake in this study. The form indicated exactly what the study demanded, what the participants could expect from the study, the minimal risks and benefits of their participation, and the guarantee of confidentiality. It also stated the

participants' ability to withdraw from the study at any time without penalty and provided the researcher's contact information if any questions, comments, or concerns arose.

4.3 Data Collection

All data was collected online within 12 weeks through a secure website (https://www.hostedware.com/secure/hs/takesurvey.asp?c=TriRudy) moderated by Hosted Survey. Participation in the study was voluntary, anonymous and in accordance with university guidelines for human subjects. Subjects were given an identification number which permitted them to sign in anonymously as many times as needed to complete the questionnaires at their leisure. The website allowed participants to answer only the questions they felt comfortable with, but did not allow them to change their answers once each page had been submitted. Exact procedures for dietary and activity record keeping as well as questionnaire administration were the same for all athletes.

Participation was divided into 3 stages to allow each subject to choose a time commitment that suited their schedule. Tasks involved and estimated time required to complete each stage were stated in the letter of intent so that subjects could make an informed decision of whether to participate. Each stage was completed in the same order and with the knowledge that volunteers could participate as much or as little as they desired. The six instruments were presented in a continuous format beginning with the Questionnaire of Eating Attitudes and Behavior (Q-EAB), followed by the Eating Disorder Examination Questionnaire (EDE-Q), and the Female Athlete Screening Tool (FAST) in the first stage. The second stage consisted of the Thinness and Restricting Expectancy Inventory (TREI), the Eating Expectancy Inventory (EEI), and the Center of Epidemiological Studies Depression Scale (CES-D). The third stage consisted of three 24-hour food and activity recalls for non-consecutive days.

4.4 Psychometric Instrumentation

As mentioned previously, there is much debate on the applicability of the EDI and the EAT in athletic populations. As such, these tools were not used in the present study. Based on discussions with experts and clinicians in the eating disorder field, the following psychometric tools were chosen based on their ability to assess attitudes and behaviors known to be related to disordered eating.

Eating Disorder Examination-Questionnaire (EDE-Q) (Fairburn & Beglin, 1994): The EDE-Q is a 52 item self-report measure adapted from the Eating Disorder Examination (EDE) (Fairburn & Cooper, 1993), an investigator-based interview that is considered the gold standard in eating disorder diagnosis. Questions are presented in one of two formats: Likert scale, or dichotomous (yes/no) with an open-ended follow up question. Likert items are rated on a 7-point scale with higher scores representing more psychopathology and include questions like "How dissatisfied have you felt about your weight?" and "How concerned have you been about other people seeing you eat?" An example of a dichotomous, open-ended follow-up item would be: "Have you exercised hard as a means to control your shape or weight?" (Yes/No); "How many times have you done this over the past four weeks?" The EDE-Q generates behavioral and psychological data on four subscales, which focus on distinct aspects of eating disorder psychopathology. Subscale scores are obtained by summing the scores on each item in a particular subscale and dividing by the number of items. To obtain a global score, which provides a measure of the overall severity of the eating disorder psychopathology, the four subscales scores are summed and the resulting total divided by the number of subscales. The EDE-Q was chosen for this study because it differentiates between those individuals who exhibit many eating disordered symptoms and those who have few or no such symptoms. This type of differentiation is important when investigating disordered eating as a continuum of behaviors (Mintz et al, 1997). Furthermore, it permits global and subscale scores to be obtained if some data are missing, as long as ratings for at least half of the items are available.

Female Athlete Screening Tool (FAST) (McNulty et al, 2001): The FAST was designed to identify pathogenic eating and exercise behaviors in college aged female athletes. It contains 33 questions on a 4 point forced choice self report format. For example, subjects are asked to rate their agreement with 1 being "Strongly agree" and 4 being "Strongly disagree" to statements like, "I do not eat foods that have more than 3 grams of fat." Other questions require an indication of frequency with 1 being "Frequently" and 4 being "Never" to statements like "If I cannot exercise, I find myself worrying that I will gain weight." A total score is obtained by summing the scores on each item, with items 15, 28, and 32 being reverse scored. Total scores then range from zero to 132; a score above 77 indicates risk of subclinical eating disorders while a score above 94 indicates risk of clinical eating disorders. Despite the fact that the FAST has not yet been used on male athletes or athletes beyond college age, it was chosen for its unique sensitivity to athletic populations.

Eating Expectancy Inventory (EEI) (Hohlstein et al, 1998): The EEI is a 34 item Likert format questionnaire designed to assess cognitive expectations for eating. It includes 5 factors that are stable and internally consistent: Eating Helps Manage Negative Affect, Eating is Pleasurable and Useful as a Reward, Eating Leads to Feeling Out of Control, Eating Enhances Cognitive Competence, and Eating Alleviates Boredom. Subjects rate their agreement with 1 being "Completely Disagree" and 7 being "Completely Agree" to statements such as "Eating fills some emotional need," or "Eating helps me deal with my feelings about myself." Subscale scores are obtained by summing the scores on each item in a particular subscale and dividing by the number of items, with items 6, 8, 11, 16, 17, 18, 22, and 33 being reverse scored. Higher subscale scores indicate greater contribution of the given cognitive expectation to eating. A total score is obtained by summing the scores on each item and ranges from zero to 238. Internal consistency reliabilities for the subscales ranged from 0.78 to 0.94 in a sample of college-aged women (Hohlstein et al, 1998). Furthermore, the EEI has

been shown to highly correlate with eating disorder criterion measures such as the Bulimia Test, the Eating Disorder Inventory, and the Three-Factor Eating Questionnaire in adolescents, college students and clinical patients (Hohlstein et al, 1998; Simmons, Smith & Hill, 2002). It also is able to distinguish anorexics from bulimics and separates eating disordered patients from psychiatric and normal controls (Hohlstein et al, 1998). To date, the EEI has only been used in adolescent and college-aged females. The EEI was chosen for its ability to measure the motives for eating, which is especially applicable if pathogenic attitudes toward eating are to be identified.

Thinness and Restricting Expectancy Inventory (TREI) (Hohlstein et al, 1998): The TREI is a 44 item Likert format questionnaire measuring cognitive expectations for consequences of thinness and restricting food intake. It has one global scale that reflects a broad expectation for overgeneralized life improvement from dieting and thinness. Subjects rate their agreement with 1 being "Completely Disagree" and 7 being "Completely Agree" to statements such as "When I limit what I eat I am more attractive," or "My problems would appear less troublesome if I were thin." A total score is found by summing the scores on each of the 44 items and ranges from zero to 308. A higher total score indicates greater expectation for overgeneralized life improvement from dieting and thinness. High internal consistency (alpha = 0.98) and correlation to standard eating disorder measures such as the Eating Disorder Inventory, Bulimia Test, and the Three-Factor Eating Questionnaire were demonstrated in adolescents, college students and clinical patients (Hohlstein et al, 1998; MacBrayer, Smith, McCarthy et al, 2001; Simmons et al, 2002). The TREI correlates with measures of bulimic symptomatology and eating-disordered attitudes and behaviors. Eating disordered patients scored higher on the TREI than psychiatric or normal controls, thus demonstrating the tool's ability to distinguish among anorexics, bulimics, and normal and psychiatric controls (Hohlstein et al, 1998). The concurrent use of both the EEI and TREI appears to have greater sensitivity than the use of one or the other measure separately. When both measures were used 94% of bulimic,

anorexic, and control populations were correctly identified (Hohlstein et al, 1998). Like the EEI, the TREI has thus far only been used in adolescent and college-aged females. It has been proposed that experiences such has being teased about one's weight or having one's mother model negative eating patterns, lead to the formation of maladaptive expectancies for eating and for thinness (MacBrayer et al, 2001). These expectancies then place an individual at risk for disordered eating. Similar to the rationale for using the EEI in the present population, the TREI was chosen due to its ability to assess the expectations for thinness and restriction, which may aid in identifying pathogenic attitudes toward eating and body.

Center for Epidemiological Studies Scale – Depression (Radloff, 1977): The CES-D is a 20-item, 4 point scale self-report which assesses the frequency and severity of symptoms of depression during the past week. The measure has 4 factors: depressive affect, somatic symptoms, positive affect, and interpersonal relations. Individuals are asked to report the frequency (0=<1 day; 3=5-7 days) of how they felt during the previous week on parameters such as crying spells, loneliness, self-esteem, sleep, etc. A total score ranging from zero to 60 is found by summing the scores on each item, with items 5 and 8 being reverse scored. Although not constituting a clinical diagnosis of depression, scores at or above 16 on the CES-D are considered indicative of clinically significant symptoms of depression (McDowell & Newell, 1996). The CES-D has been shown to measure depressive symptoms and not merely general psychological distress. In the original study used to develop the scale, the CES-D showed high internal consistency in the control population (alpha=0.85) and clinically depressed population (alpha=0.90) (Radloff, 1977). The scale demonstrates agreement with more lengthy self-report scales used in clinical studies and with clinician interview ratings (Weissman, Sholomskas, Pottenger et al, 1977). Adequate test-retest reliability, internal consistency, and concurrent validity have been demonstrated in subsequent research (Schoenbach, Kaplan, Wagner et al, 1983; Wells, Klerman, & Deykin, 1987). The CES-D has been validated for use in a

variety of populations including high school students, older adults, ethnic minorities and diseased populations (Brage, Meredith, & Woodward, 1993; Kalichman, Rompa, Cage, 2000; Ng et al, 2004; Radloff, 1991). Since depression has been consistently linked to disordered eating (Braun, Sunday, & Halmi, 1994; Fairburn & Cooper, 1984; Grubb, Sellers & Waligroski, 1993; Young, Clopton & Bleckley, 2004), the CES-D was included to provide a measure of depressive symptoms in the current population.

The following questionnaire was developed by the present researchers to identify male and female athletes with disordered eating attitudes and behaviors.

Questionnaire of Eating Attitudes and Behaviors (Q-EAB): The Q-EAB was developed to assess attitudes and behaviors that exist in disordered eating. It was designed to distinguish between athletes with strict diet and training regimes resulting from a desire to improve performance verses those designed to maintain a minimum body ideal. It contains 48 questions in 4 and 5 point scale format as well as 6 "choose the best answer" questions. Questions are clustered in 7 categories – Dieting Behavior, Restrictive Tendencies, Performance Dissatisfaction, Body Dissatisfaction, Exercise Compulsion, Weight Obsession, and Perfectionism. Since we were interested more in dieting attitudes and weight control behaviors than in actual restriction of intake or weight loss, we chose to measure these specific subscales based on the literature linking them with disordered eating (Beals & Manore, 2000; Brownell et al, 1992; Geller et al, 2000; Robert-McComb, 2001; Sundgot-Borgen, 1993). The Dieting Behavior category gives an indication of the variety and frequency of weight control methods used as well as the degree of weight fluctuation experienced. Restrictive Tendencies assesses obsession with energy intake and the level of restraint typically exerted over eating. For example, while an individual may be preoccupied with limiting energy or macronutrient intake, this may not result in actual energy or macronutrient restriction. However, the obsessive tendency itself, regardless of whether it is accompanied by behavior, is a manifestation of

disordered attitudes toward eating. Performance Dissatisfaction measures degree of dissatisfaction with a variety of parameters related to performance in sport, such as strength, endurance, and athletic ability. Body Dissatisfaction includes constraints such as dissatisfaction with body fat, body shape, and physical appearance. Exercise Compulsion attempts to measure the motives for exercise, such as to deal with negative emotions, to produce feelings of control, to maintain health, or to alter body, as well as the degree to which exercise interferes with normal daily functioning. As mentioned previously, in order to identify the athlete with disordered eating, a tool must distinguish between strenuous training regimes done in an attempt to improve performance and those done in an attempt to maintain minimum body weight. In order to measure obsession with weight, the Q-EAB includes items pertaining to frequency of weighing, anxiety over losing control of weight and/or appetite, and contribution of weight to personal happiness and physical fitness. Finally, two items related to perfectionism in sport are included in the Q-EAB. Although not a diagnostic tool, higher scores on the Q-EAB indicate greater degree of pathogenic eating attitudes and weight control behavior and risk of development of clinical eating disorders. The Q-EAB was designed for use in adult male and female athletes.

Dietary and Activity Records: Interested participants completed 3 non-consecutive 24-hour recalls of dietary intake and activity. Templates were provided online to boost ease of recording food and activity. Food diaries were divided into 6 time periods to enhance accuracy of record keeping: morning, mid-morning, lunch, afternoon, evening, and late evening. Participants were asked to be as specific as possible with serving sizes and types of foods, such as whole wheat bread verses white bread; skim, 1%, 2% or whole milk, dressings, and cream and/or sugar additions to coffee. Exercise sessions were similarly broken down into 4 components: warm-up, cardiovascular activities, strength training, and stretching to enhance accuracy of estimation. Participants were asked to give as much information as possible about all activity, including distances, repetitions, times, approximate intensity and body parts trained each day.

4.5 Statistical Analysis

All responses were directly downloaded from the website database to Statistical Package for Social Sciences (SPSS) Version 11.0 for Windows (11.0.0, Chicago, Ill: SPSS Incorporated; 2001). The only exception was the dietary and activity records, which were first analyzed using the Food Processor software program (version 7.0, 1996; ESHA Research, Salem, Oregon) before being imported to SPSS. Foods listed in the dietary records were matched to those found in the Canadian Nutrient Database within the Food Processor program; for those foods not listed under the Canadian Database, the US Database and codes were then used. Foods not found in either database were manually added by the researchers based on information from nutritional labels and manufacturer's websites. For those participants who did not include sufficient detail of food intake, such as portion sizes or brand names, the standardized portions found on the Canadian Nutrient database were used. Dietary records were analyzed for total daily energy intake (EI), total daily intake of carbohydrate (g), fat (g), protein (g), starch (g), dietary fiber (g), and water (ml), and percent energy from carbohydrate, fat, and protein. Protein requirement was calculated for each participant based on the Recommended Daily Allowance of 0.8 g protein/ kg body weight (Institute of Medicine, 2002). While alcohol intake (grams and percentage of total EI) was calculated, it was not included in the final nutritional analysis as it was deemed irrelevant to our purpose. Dietary analysis was based on the average intake for the number of days recorded. Thus, daily calculated intakes were summed and then divided by the total number of days reported to provide mean daily intake values.

Of the total participants completing at least one 24-hour activity record (n=44), only 35 provided adequate information to analyze. The remaining participants either failed to provide accurate durations of activities, or there was simply not enough detail from which the researchers could draw valid conclusions regarding energy expenditure. For the eligible 35 participants, resting metabolic rate (RMR) was calculated using the following World Health Organization/Food

and Agriculture Organization/United Nations University (FAO/WHO/UNU) equations (FAO/WHO/UNU, 1985):

For males: RMR (kcal/d) = (11.6 x wt (kg) + 879)

For females: RMR (kcal/d) = (8.7 x wt (kg) + 829)

To compute total energy expenditure (TEE), we first had to calculate each individual's energy expenditure from exercise (EE) and add this to their RMR. Exercise energy expenditure was determined by comparing the activity records to the descriptions from the Compendium of Physical Activities (Ainsworth, Haskell, Whitt et al, 2000). The Compendium is a coding scheme that classifies specific physical activities by the rate of energy expenditure and was developed to enhance the comparability of results across studies using self-reports of physical activity. The Compendium coding scheme links a five-digit code that describes physical activities with its intensity, defined as the ratio of work metabolic rate to a standard resting metabolic rate (MET). Energy expenditure (in kilocalories) is then calculated by multiplying the METs for each recorded activity by the duration of the activity (in hours) and the subject's reported weight (in kilograms). This calculation was done for participant's described warm-up, cardiovascular, strength training and flexibility activities. For activities that were not specifically listed in the Compendium, standard MET values were computed based on the description provided in the participant's self-report and the best possible match found in the Compendium. As when calculating energy intake, daily calculated EE was summed and then divided by the total number of days reported to provide a mean daily EE value. Total energy expenditure (TEE) was then calculated for participants as the sum of their mean EE and mean RMR. Energy balance (EB) was computed for each individual as their mean EI minus their mean TEE.

Descriptive features of the population (ie. demographic data, test scores etc) were examined by computing means, frequencies, standard deviations, and distributional plots. Score distributions were first tested for normality with the Kolmogorov-Smirnov statistic. All scores were normally distributed except the

EDE-Q total and subscales, and all items on the Q-EAB. The EDE-Q total and subscale scores were corrected to a normal distribution via a logarithmic transformation (log10) and all subsequent statistical analyses were performed on this transformed score. The Q-EAB items could not be transformed to a normal distribution so non-parametric tests were subsequently used for their analyses.

To find significant differences between two groups (ie male vs female; elite vs non-elite) t-tests for equality of means were performed on all continuous variables (ie anthropometric data, test scores, dietary data). Levene's tests, which are less dependent on normality, were performed to determine equality of variances so that the according significance could be determined as $p \leq 0.05$. Chi square tests were performed to compare groups on the relative percentages of all categorical variables (ie. frequency of weight control methods, reasons for sport involvement). Again, only groups with $p \leq 0.05$ were considered significantly different. One-way analyses of variance were performed to compare differences between 3 or more groups, such as male and female elite and non-elite, on both categorical and continuous variables. Levene's tests were again performed to determine equality of error variances. For groups with unequal variances, the Welch statistic was used to test the equality of the group means rather than the F statistic. Tamhane's T2 post hoc tests, which do not assume equal variances, were performed to identify specific groups with significantly different means. To determine whether scores were being influenced by gender or elite status, we ran a two-way analysis of variance using gender and elite status as factors for totals and subscales of all standard tests as well as for all Q-EAB items.

The Q-EAB was validated against the 5 standard psychometric tools using concurrent validity analysis. Concurrent validity assesses the degree to which a test correlates with similar inventories that measure similar constructs (Portney & Watkins, 1998). Due to the non-symmetric properties of our data, Spearman's rho was used to measure the correlation between each Q-EAB item and each subscale and total score of the standard tools. We chose a critical value of Spearman's rho ≥ 0.5 at significance of $p \leq 0.001$ to indicate significant correlation. Correlation analysis was also performed on dietary and activity characteristics of

participants, such as EI, EE, EB, BMI, percent of ideal body weight, macronutrient intake and their corresponding test scores. Again, a Spearman's correlation coefficient of ≥ 0.05 and significance of $p \leq 0.001$ was used to indicate significant correlation.

5.0 Results

5.1 Sample Characteristics

Table 5-1 displays the characteristics of our sample of Masters athletes. While 111 (male: n=48; female: n=63) athletes enrolled in our study, only 83 (male: n=35; female: n=48) participants completed Stage 1, which included the Q-EAB, EDE-Q, and FAST questionnaires. Fifty-two (male: n=22; female: n=30) participants completed Stage 2, which included the CES-D, TREI, and EEI questionnaires. Thirty-five (male: n=17; female: n=18) participants completed Stage 3, which included three 24-hour food and activity recalls. Thirty eight percent of females and 44% of males ranked themselves as elite, which was defined as typically ranking within the top 10% of their age class. Fifty-three percent of athletes regularly competed in triathlons, with the remaining athletes regularly competing in single endurance sports such as running, cycling, and swimming. There was no significant difference between the number of competitions entered per year by elite and non-elite athletes. The mean age of our population was 45.4±6.6 years with female athletes being significantly younger than male. BMI's of athletes ranged from 16.3 to 38.9 kg/m^2 (with a mean of 24.2±3.5 kg/m^2) with females and elite athletes having significantly lower BMI's and weights than males and non- elite athletes respectively. There was no difference between the lowest weight for present height reported by elite and non-elite athletes. More elite females than non-elite had experienced amenorrheic episodes at some point in their lives.

5.2 Psychological Characteristics

Thirteen percent of all athletes reported prior treatment for a mental disorder including alcoholism, anxiety, or depression (Table 5-2). Five females reported current use of prescription antidepressants. Thirty-seven percent of athletes reported having dieted at some point in their lives and this was more common in females and non-elite athletes. Dieting during the previous year was

reported by 22% of females, 7% of males, 41% of non-elite and 7% of elite athletes. The number of diets followed during the previous year was significantly higher in non-elite athletes than elite. The most frequently reported weight loss method in this population was restrictive dieting (<1000kcal/day), which was used by 13% of the population. Almost 10% of the population had used fasting to induce weight loss. The most popular commercial diets reported were Atkins (8.8%), Weight Watchers (8.0%), and South Beach (8.0%). Two athletes reported using excessive exercise as a means of losing weight. The most common reason for wanting to lose weight was to improve performance, which was reported by 55% of the population, followed by a desire to improve appearance (50%) and to improve health (43%). The most common reasons for sport participation in this population were to have fun (23%), to improve health (22%), and to improve physical fitness (11%). Less than 4% of athletes reported weight control to be the reason for participating in sport.

5.3 Dietary Characteristics

The mean energy intake (EI) in our population was 2340.42±736.35 kcal/d and there were no significant differences between genders and elite status (5-3). Energy expenditure attributed to exercise (EE) was 615.12±414.73 kcal/d for the population. Again, there were no significant differences between groups. Males had significantly higher resting metabolic rates (RMR) than females; no significant differences existed between elite and non-elite athletes. This resulted in significantly higher total energy expenditures (TEE) in males as opposed to females but similar TEE in elite and non-elite groups. Mean energy balance (EB), defined as EI-TEE, was 144.06±956.91kcal/d for the population and there were no significant differences between genders or by elite status. Mean macronutrient intake as a percentage of EI was 55% carbohydrate, 27% fat, and 17% protein in the population. While female and non-elite athletes had slightly lower carbohydrate intake, higher fat, and higher protein intake, there were no significant differences in macronutrient intake between groups either as a percentage of energy intake or in absolute amounts. No athletes had a

carbohydrate consumption lower than the recommended 130g per day (Institute of Medicine, 2002). Mean dietary fiber intake was 25.79±9.31 g/d and there were no significant differences between groups. All females met the daily protein requirement for sedentary individuals of .8g/kg body weight (Institute of Medicine, 2002) while 4 males (elite=2; non-elite=2) fell short of this requirement. However, when using the recommended protein requirement of at least 1.2g/kg/day for endurance athletes (Tarnopolsky, 2004), 15 (43%) of athletes had inadequate protein intake and this was similarly common in both genders and elite and non-elite athletes. Seven (20%) athletes had less than the recommended 20% of total energy intake from fat (Institute of Medicine, 2002) and five (14%) athletes had more than the recommended 35%; this was similarly common in both males and females and elite and non-elite athletes.

5.4 Test Scores

Table 5-4 displays the mean scores of Masters athletes on the five standard screening tools. We compared the scores of our athletes on the EDE-Q to those previously reported by Hully and Hill (2001) for elite female runners with eating disorders. Approximately 5% of Masters athletes had EDE-Q scores comparable to those with eating disorders and this 5% was made up of female non-elite athletes only (Table 5-4). Although females showed a trend towards higher scores than males on all EDE-Q parameters, they scored significantly higher on the Shape Concern and Weight Concern subscales of the EDE-Q ($p<0.05$). In terms of the frequency of eating disordered behavior reported on the EDE-Q, one female reported vomitting an average of 5.3 days per month in the previous 3 months; no other subject reported regular purging behavior. Forty-nine percent of athletes (19 males; 19 females) reported a mean of 2 episodes of binge eating per month in the previous three months. Thirty-three percent of athletes (9 males; 17 females) reported exercising vigorously as a means of controlling weight, shape, body fat, or energy balance for a mean of 13 days per month (males=20.0±17.3 days; females=8.7±8.9 days) in the previous three months. Thirteen percent of subjects scored higher than 77 on the FAST to indicate probable presence of

subclinical eating disorders (McNulty et al, 2001). No subjects scored above 94, which would indicate probability of clinical eating disorders. Thus the FAST, which was developed specifically for athletic populations, identified more than twice as many athletes as potentially suffering from disordered eating than did the EDE-Q. According to the traditional cut-off score of 16 on the CES-D to indicate clinically significant depression (Radloff, 1977), 19% of the population (n=10) had scores indicating probable presence of clinical depression. The scores in our population on the TREI and EEI were consistent with scores previously reported for females without eating disorders (Hohlstein et al, 1998). There is currently no published use of these tools in athletes that would permit a more accurate comparison. There were no significant differences between male and female scores on the FAST, CES-D, TREI or EEI.

Scores for elite athletes differed from non-elite on several items from the 5 standard psychometric tools (Table 5-4). Non-elite athletes had significantly higher scores on the Restraint ($p<0.005$), Eating Concern ($p<0.05$), and Shape Concern ($p<0.05$) subscales of the EDE-Q. Thirty-five percent (n=17) of non-elite athletes and thirty-one percent (n=9) of elite reported exercising vigorously as a means of controlling weight, shape, body fat, or energy balance for a mean of 13 days per month in the previous three months. Non-elite also scored significantly higher on the Pleasure/Reward subscale of the EEI ($p<0.05$). There were no significant differences in scores between the triathletes and the single-sport endurance athletes. There were also no differences by age of starting sport.

5.5 Q-EAB Scores

Table 5-5 displays the scores on the various Q-EAB items for Masters athletes. All items were measured on a 5-point scale with higher scores indicating greater psychopathology, except for 'Restraint in typical eating', which was measured on a 4 point scale. Performance and body dissatisfaction was measured on a 5 point scale, with higher scores indicating greater dissatisfaction. Male and female athletes were similarly satisfied with all parameters related to performance and physical fitness. Male and female athletes also reported similar

satisfaction with all parameters related to body, except for 'size and/or appearance of thighs' for which females reported greater dissatisfaction ($p<0.001$). Females scored significantly higher than males on several Q-EAB items including rigidity in eating routine, anxiety about losing control of weight and/or appetite, and weight obsession ($p<0.05$).

Scores for elite athletes significantly differed from non-elite on several Q-EAB parameters (Table 5-5). Elite and non-elite athletes were similarly satisfied with all factors related to performance and physical fitness. Non-elite athletes reported greater dissatisfaction than elite on parameters related to body such as body fat, body weight, size and/or appearance of stomach, and muscle tone and appearance ($p<0.005$). Non-elite athletes indicated greater dissatisfaction with body prior to sport involvement, greater obsession with energy expenditure, more often keeping a mental running total of the number of calories eaten each day and more frequently weighing themselves (all significant at $p<0.05$). Non-elite athletes also reported greater anxiety over losing control of weight and/or appetite, greater obsession with weight and food, greater restraint in typical eating behavior and finding it more difficult to maintain their in-season weight than elite athletes (all significant at $p<0.001$). Elite athletes reported setting higher goals for their athletic achievement than non-elite ($p<0.05$).

5.6 Interactions of Gender and Elite Status on Test Scores

Two-way analyses of variance using gender and elite status as factors were run for totals and subscales of all standard tests as well as for all Q-EAB items to see if gender, elite status, or a gender*elite status interaction independently affected the group differences reported Table 5-1 and 5-2. Using the cut-off of $p<0.05$, only the items displayed in Table 5-6 were shown to have significant gender, elite status, or gender*elite status interactions.

5.7 Concurrent Validity Analysis

All Q-EAB items were analyzed for concurrent validity with the five standard tools (Table 5-7). Due to the non-normal distribution of our Q-EAB

scores, Spearman rank correlation coefficients were used. Only those items with a correlation coefficient > 0.5 are displayed (See Table 1-1 for complete list of Q-EAB abbreviations). In total, 13 Q-EAB items demonstrated concurrent validity with the EDE-Q, FAST, and EEI: 'Anxiety regarding losing control of weight/appetite' (worrycon), 'Weight obsession' (wtobs), 'Difficulty maintaining weight' (wtmtn), 'Satisfaction with size/appearance of stomach' (ssstomac), 'Satisfaction with body weight' (sswt), 'Satisfaction with body fat' (ssbf), 'Restraint in typical eating' (typeatbh), 'Satisfaction with body shape' (ssshape), 'History of dieting' (everdiet), 'Satisfaction with muscle tone and appearance' (sstone), 'Intake dependent on expenditure' (missex), 'Satisfaction with size/appearance of thighs' (ssthigh), and 'Satisfaction with overall physical appearance' (ssappear). No significant correlations were found between Q-EAB items and the CES-D or TREI. No significant correlations of >0.5 were found among dietary and activity characteristics, such as EI, TEE, EE, EB and macronutrient intake, or between these characteristics and any of the test items or totals.

Additional validation analyses were performed using Cronbach's alpha to measure the degree of correlation between all Q-EAB items and each test total and subscale (See Appendix 8.3). Only those models listed in Appendix 8.3 met the criteria of Cronbach's alpha ≥ 0.85. In total, seven Q-EAB items highly correlated with the EDE-Q (see Table 1-1 for complete list of Q-EAB abbreviations): 'Anxiety regarding losing control of weight/appetite' (worrycon), 'Weight obsession' (wtobs), 'Difficulty maintaining weight' (wtmtn), 'Weighing frequency' (weigfrq), 'Satisfaction with weight' (sswt), 'Satisfaction with body shape' (ssshape), and 'Satisfaction with muscle tone and appearance' (sstone). No significant correlations were found between the Q-EAB items and the remaining psychometric inventories nor among dietary and activity characteristics. These results further validate our findings from the concurrent validity analysis.

6.0 Discussion

The purpose of this study was two-fold. First we wanted to measure the prevalence of disordered eating tendencies in male and female Masters athletes. Second, we wanted to validate a newly developed screening tool for disordered eating in athletes, the Q-EAB, against several existing standard psychometric tools. The current study represents the first attempt to assess eating attitudes and behaviors in this population and it was proposed that similar trends would exist in Masters athletes that have been validated for younger populations. In particular, it was hypothesized that there would be a greater prevalence of disordered eating tendencies in female as opposed to male athletes, and in elite as opposed to non-elite athletes, while the overall prevalence in Masters athletes would be lower than that found in college-aged athletes. This study also hypothesized that the Q-EAB would show partial, but not complete, correlation with standardized tools designed to measure conditions associated with disordered eating. Finally, it was hypothesized that there would be significant correlation between high scores on the psychometric tools and suboptimal energy and nutritional intake in athletes.

6.1 Prevalence of Disordered Eating in Masters Athletes

While no self-report tools are diagnostic of eating disorders, we compared scores on the EDE-Q of Masters Athletes with scores previously reported for elite female runners with eating disorders (Hulley & Hill, 2001). According to these EDE-Q cut-offs, 5 % of Masters athletes demonstrated disordered eating behavior. No athletes that completed the screening tools met the DSM-IV criteria for anorexia of having body weight <85% of ideal or for bulimia of bingeing at least twice per week for three months (American Psychiatric Association, 1994). One athlete reported having a body weight of < 85% of ideal, but did not complete any of the screening tools so no more information on their eating attitudes or behaviors is available for them. As expected, this prevalence is lower than that reported for younger populations. Hulley & Hill (2001) found that 19% of elite female distance runners with a mean age of 28 years had a present or past

clinical eating disorder diagnosis. Sundgot-Borgen (1999) found that 20% of female and 8% of male elite athletes aged 15-40 met the clinical criteria for eating disorders. Johnson et al (1999) found that 9.2% of female and none of male collegiate athletes met the clinical criteria for eating disorders. However when comparing the scores of Masters athletes on the FAST and the Q-EAB, both of which were developed specifically for athletic populations, more than twice as many athletes were identified as potentially suffering from disordered eating than were from the EDE-Q.

According to the suggested cut-offs on the FAST, 13% of the population was identified as being at risk of subclinical eating disorders. Hence, it appears that the EDE-Q, which was designed to identify clinical eating disordered behavior, fails to identify the larger percentage of people with subclinical eating disordered behavior and may be insensitive to the unique factors involved in the athletic setting. Since the prevalence of subclinical eating disorders in athletic populations has been shown to outweigh that of clinical, it is pertinent that a tool such as the Q-EAB be devised that accurately identifies athletes lying at all points along the disordered eating continuum.

One aspect of the EDE-Q that performs well in this population concerns deciphering the motive for exercise. Thirty-three percent of athletes reported exercising vigorously as a means of controlling weight, shape, body fat, or energy balance in the previous 3 months in the EDE-Q. However, when athletes were asked in the Q-EAB to report weight loss methods they had used in the past, only 2% identified exercise. A similar trend was found when using an original diet and sport questionnaire to examine dieting behavior in elite figure skaters (Zeigler et al, 1998). Despite rigorous training schedules, 59% of females and 66.7% of males reported that they rarely or never used intensive exercise as a method of losing weight. In the present study, the EDE-Q appears superior for detecting the motive for exercise. This alludes to the necessity to reword or modify the Q-EAB item in order to facilitate more accurate responses.

The frequency of reported weight control behaviors in our population was somewhat lower than that previously established for younger athletes. Forty-nine

percent of females and 21% of males reported previous dieting for the purpose of weight loss. Zeigler et al (1998) found that 65% of female elite skaters and 26% of males reported a history of dieting. Hulley & Hill (2001) found that 47% of elite female distance runners had previously dieted. A total of 25% of Masters athletes reported prior use of other weight control methods, including fasting (10%), fat burners (5.3%), laxatives (4.4%), diet pills (2.7%) and vomitting (2.7%), which again is slightly lower than that found in other studies (Depalma, 1993; Sykora et al, 1993). A large-scale study of male and female collegiate athletes found that 55% reported episodes of binge-eating, 30% reported episodes of vomitting, 17% used laxatives, and 16% used diet pills (Johnson et al, 1999). Episodes of binge eating within the previous 3 months were reported by 49% of Masters athletes on the EDE-Q. However, it has been shown that this instrument may underestimate the frequency of bingeing due to the subjective assessment of a binge being left up to the test-taker rather than additional clarification being given from an interviewer (Binford et al, 2005; Carter et al, 2001). Nevertheless, the prevalence of binge-eating in our sample was not dissimilar to the range of 43% - 74% found in younger athletic populations (Depalma et al, 1993; Sykora et al, 1993). Thus, as expected, the prevalence of disordered eating tendencies in Masters athletes is slightly lower than that reported for other athletic populations of younger ages.

6.1.1 Effect of Gender

Researchers have consistently found greater frequency of disordered eating behavior in female as opposed to male athletes (Johnson et al, 1999; Otis et al, 1997; Sudi et al, 2004; Sundgot-Borgen, 2004; Sykora et al, 1993). The current study is no exception. In particular, female athletes in our study reported greater frequency of dieting, increased shape and weight concern, body dissatisfaction, and anxiety over losing control of weight and/or appetite. More females than males also reported exercising vigorously to control shape or weight. It has been demonstrated that motives for exercise differ by gender, such that women tend to use exercise as a form of weight-control (Thome & Espelage,

2004). While men are likely to view exercise as a fun, competitive, social activity, women are much more apt to engage in physical activity specifically to control their weight. Consequently, female athletes in our population may be engaging in sport in an attempt to control weight and as such display greater degrees of disturbed eating attitudes and behavior. In general, Masters athletes display the same trend established in college-aged athletes of females being at greater risk of pathogenic eating than males.

6.1.2 Effect of Elite Status

Based on the literature to date, we expected to see a greater prevalence of disordered eating attitudes and behavior in elite athletes than non-elite (Picard, 1999; Smolak et al. 2000; Sudi et al, 2004; Sundgot-Borgen, 1994, 2004). However, this was not the case. On the contrary, we consistently found greater eating and body image disturbances in non-elite athletes. Since previous research is based on younger populations, the present study provides credence for the possibility that there appears to be a shift after college-age where elite athletes with disordered eating tendencies are either unable to maintain their elite status or realize that in order to preserve performance they must improve their nutritional habits. In the same vane, non-elite athletes may blame their body size for their lack of success in sport and believe that altering their weight and shape is the best way to improve performance. Many athletes subscribe to the belief that a lowered weight will automatically equate to enhanced performance, and this myth has been implicated in increased weight preoccupation and body dissatisfaction and the subsequent tendency for disordered eating behavior in athletes (Carson & Bridges, 2001; Nagel et al, 2000; Sudi et al, 2004; Williamson et al, 1994).

Another possibility is that the non-elite population may be comprised of a greater number of individuals who use sport as a weight control method as opposed to those with a desire to excel. Sundgot-Borgen (1994) suggests that sport may attract people with disordered eating because it provides a setting to expend extra calories and mask abnormal eating behaviors. Body dissatisfaction and disordered eating tendencies may have existed in these non-elite athletes prior

to their sport involvement, and sport merely serves as a socially acceptable way of maintaining rigid eating and activity patterns.

Interestingly, non-elite athletes scored highest on the 'Eating is Pleasurable and Useful as a Reward' subscale of the EEI. They also exhibited greater obsession with weight, food, and energy expenditure as well as more often keeping a mental running total of the number of calories eaten each day. This suggests that non-elite athletes may be "exercising to eat" and not "eating to exercise", such that their food intake depends largely on the amount and type of physical activity they do. Food is used to reward their exercise energy expenditure as opposed to fueling their body to support activity. This mentality existed in non-elite athletes despite no significant differences in energy balance between elite and non-elite athletes, suggesting that while the eating behavior is not dissimilar between elite and non-elite athletes, the attitudes motivating the behavior are.

We cannot overlook the possibility of denial of disordered eating symptoms in elite athletes. Sundgot Borgen (2004) suggests that clinical interviews are required to get a true estimation of disordered eating prevalence because of the tendency for elite athletes in particular to under report disturbed eating behaviors and attitudes. In a two-tiered study design, this researcher found that self-report surveys resulted in significant underestimates of the extent of pathogenic weight control behaviors in elite athletes compared to the follow up interview. For example, 10% of female athletes reported vomiting in the interview phase, while only 3% indicated the same on the self-report screening phase. Thus, the prevalence of disordered eating attitudes and behaviors may under-estimated in our elite athletes. Furthermore, responders may be less forthcoming with their actual behavior due to recognizing this activity as more morbid for an eating disorder and not wanting to identify themselves with those with eating disorders (Anstine & Grinenko, 2000). Despite potential under-reporting within the current study, non-elite Masters athletes consistently exhibited a greater degree of pathogenic eating attitudes and behaviors, which is

contrary to the trend found in younger athletes, and which highlights the need for closer monitoring of this population.

While elite athletes appear to have better psychological adjustment in terms of disordered eating attitudes and behavior, they were at greater risk of depression than non-elite. Twice as many elite athletes as non-elite scored above the cut-off on the CES-D to indicate significant risk of clinical depression. It is surprising that these athletes are able to maintain their high level of training while suffering depressive symptoms, since depression has been found to be negatively associated with participation in health promoting activities such as exercise (Fulkerson, Sherwood, Perry et al, 2004). Although there is no clear explanation from our data, one possiblility is that these individuals are "neurotic perfectionists" as described by Yates et al (2001), who tend to be less satisfied with themselves overall. Consequently, they push themselves harder than most and are not happy unless they achieve their high goals, both in sport and in life. This is supported by the fact that elite athletes reported setting extremely high goals for their athletic achievements. It is also possible that these individuals use exercise as a coping mechanism for psychological stress to the point that they have become top performers in their sport. Research shows that exercise is becoming a popular means of managing stress and promoting psychological health (Ingledew & McDonagh, 1998). While these two explanations are commonsensical, the contribution of overtraining cannot be disregarded. The overtraining syndrome (OTS), which is common in competitive endurance athletes, occurs when prolonged, excessive training stresses are applied concurrent with inadequate recovery (Armstrong & Vanheest, 2002). A major symptom of OTS is depression (Clow & Hucklebridge, 2001; Puffer & McShane, 1992) and this may explain the higher scores on the CES-D of our elite athletes. Regardless of the cause, elite Masters athletes reported a greater degree of depressive symptoms, which was not only unexpected, but also calls for improved awareness by clinicians and coaching staff.

A second domain in which elite athletes appeared in greater jeopardy of ill health consequences concerns the prevalence of amenorrhea. Almost half of the

elite females reported previous and/or current amenorrheic episodes. Given the high training volume of elite athletes, this finding is not surprising as energy balance is a prime determinant of menstrual function (Drinkwater et al, 2005; Stafford, 2005). While amenorrhea is not uncommon in highly trained athletes, it brings a cascade of negative, and sometimes irreversible, health consequences to the individual (Barrow & Saha, 1988; Lloyd et al, 1986; Nattiv et al, 1994; Vereeke West, 1998). In fact, loss of bone density to the point of osteoporosis may occur within one year after amenorrhea develops (Bachrach, Guido, Katzman et al, 1990). In addition, it is a key component of the Female Athlete Triad, which has become such a serious cause for concern in female athletes that organizations such as the International Olympic Committee are making efforts to decrease its incidence (Drinkwater et al, 2005). As evidenced in the present study, elite Masters Athletes appear to be better off than non-elite in terms of disordered eating attitudes and behaviors, but suffer greater depressive symptoms and menstrual dysfunction.

6.1.3 Effect of Psychological Risk Factors

Perfectionism and depression are two psychological risk factors that have been repeatedly associated with disordered eating (Braun et al, 1994; Fairburn et al, 1999; Grubb et al, 1993; Hewitt et al, 1995; Joiner et al, 1997; Steiger et al, 1992; Young et al, 2004). We expected Masters athletes with high levels of perfectionistic and depressive tendencies to present with more disturbed eating practices. However, athletes scoring high on the perfectionism domain of the Q-EAB did not consistently demonstrate higher scores on the remaining psychometric inventories. Nor did scores indicating depression on the CES-D correlate with high scores on the remaining psychometric inventories. Interestingly, elite athletes demonstrated the highest degree of depression and perfectionism while simultaneously evidencing lesser disturbed eating attitudes and behaviors. Perhaps in these athletes, dissatisfaction with life and self prompts them to consistently set high goals for themselves and perfectionistic tendencies

provide the drive to meet these goals. This interdependency appears to be unrelated to eating and body concerns in Masters athletes.

6.1.4 Effect of Sport-Related Risk Factors

A variety of risk factors inherent to the athletic setting have been implicated in disordered eating development and items were included on the Q-EAB to observe their effect in Masters Athletes. Researchers have suggested that age of starting sport is a risk factor for precipitation of pathological eating (Smolak et al, 2000; Sundgot-Borgen, 1994). Specifically, it has been proposed that early and frequent exercise induces eating problems (Davis et al, 1999). However, we did not find any significant differences between scores on the 6 psychometric tools and the age of initiation into sport. A similar assertion by researchers is that dieting from a very early age triggers disordered eating development in athletes (Smolak et al, 2000; Sundgot-Borgen, 1994). But again no relation was found between age of first diet and presence of pathological eating attitudes and behavior.

Weight-related pressures in sport have also been identified as triggers for disordered eating in athletes (Garner et al, 1998; Smolak et al, 1999, Sundgot-Borgen, 1994; Yates et al, 2001). More than 10% of athletes reported in the Q-EAB that a desire for weight loss was prompted by a need to meet a lower weight category or encouraged by coaching staff. This is lower than that previously reported in younger populations. Studies in sports that require participants to meet certain weight restrictions, such as wrestling, rowing, and lightweight football, have typically found that as many as 67% of participants employ pathogenic weight control methods, and most do so on the advice of their coach (Depalma et al, 1993; Nagel et al, 2000; Rosen & Hough, 1988; Sundgot-Borgen, 1994; Thiel et al, 1993; Williamson et al, 1994). The fact that our athletes hailed from endurance sports such as cycling, running, and swimming which typically do not impose weight regulations, and many did not train with an official coach, may account for the diminished contribution of these two factors in their desire to lose weight. Interestingly, over half of Masters athletes cited a desire to improve

performance as motivating weight loss attempts. As voiced by the Canadian Academy of Sport Medicine's position statement (Carson & Bridges, 2001), the link between performance and body composition is weak at best, but the effect of weight and body obsession on disordered eating development is ample. Hence, the need for greater education regarding optimal nutrition for performance in this population is exemplified.

As illustrated above, there appear to be a variety of factors that put Masters athletes at increased risk of disordered eating, and these manifest themselves somewhat differently than in younger athletic populations. Gender, non-elite status, and a belief in low body weight improving performance, are the main issues identified in the present study as affecting the prevalence of disordered eating attitudes and behaviors in Masters Athletes.

6.2 Validation of the Q-EAB

In order to validate a novel screening tool, it must demonstrate high correlation with similar measures (Messick, 1995). Since there is no gold standard screening tool for disordered eating in athletes, the Q-EAB was validated against five psychometric tools that assess conditions known to be related to disordered eating. Concurrent validity indicates the extent to which items in the Q-EAB correlate with similar inventories that measure similar constructs. It was found that scores on several Q-EAB items were consistently and highly correlated to the EDE-Q total and subscale scores. However, the Q-EAB showed only moderate correlation to the FAST and EEI, and no significant correlation to the CES-D or TREI. It is not surprising that the Q-EAB did not highly correlate to the FAST, which was designed specifically for female, college-aged athletes. The FAST is based on overt disordered eating symptoms and as such, its intent is readily apparent. It even includes a question assessing agreement with the statement, "I believe that most female athletes have some form of disordered eating habits." It has been suggested that tools with an intent easily appraised by athletes will generate false-negative responses due to the fear of negative repercussions from coaches, peers and media (Wilmore, 1991; Yates et al, 2001).

Consequently, participants may have been less honest in responding to the FAST than to the Q-EAB, which did not rely solely on self-report of specific disordered eating symptoms. Since the intent of the Q-EAB is not readily apparent, it was the first inventory administered to athletes in order to improve accuracy of responses. While the CES-D, TREI, and EEI assess conditions known to be related to disordered eating, they measure specific constructs that are distinct from disordered eating. It is not unexpected then that these measures would not highly correlate with the Q-EAB, which was developed to comprehensively assess a variety of features associated with disordered eating. Concurrent validity analysis demonstrated some association between the Q-EAB and some items on the EEI, namely Eating Helps Manage Negative Affect, Eating is Pleasurable and Useful as a Reward, and Eating Leads to Feeling out of Control. This indicates that these specific constructs represent intrinsic features of eating attitudes and behaviors that are captured by the Q-EAB. The inventory most similar to the Q-EAB was the EDE-Q, which is designed to measure attitudes and behavior specifically related clinical eating disorders, and it is not surprising that these two inventories showed the highest correlation.

Based on the results from our validity analyses and from the ability to distinguish between genders and elite and non-elite athletes, there are specific Q-EAB items that consistently perform well. Specifically, the following Q-EAB items repeatedly correlated with criterion measures:

- Anxiety regarding losing control of weight/appetite
- Weight obsession
- Difficulty maintaining weight
- Frequency of weighing
- Food obsession
- Restraint in typical eating
- Intake dependent on expenditure
- History of dieting
- Satisfaction with size/appearance of stomach
- Satisfaction with body weight

- Satisfaction with body fat
- Satisfaction with body shape
- Satisfaction with muscle tone and appearance
- Satisfaction with size/appearance of thighs
- Satisfaction with overall physical appearance

Further, 'Running mental total of intake,' 'Body dissatisfaction prior to sport involvement' and 'Energy expenditure obsession' showed significant differences between elite and non-elite athletes. While elite athletes reported higher scores on one of two items designed to measure perfectionism, 'Sets high goals in sport,' perfectionism did not appear to play a role in disordered eating attitudes and behavior in the present population. However, since perfectionism has been consistently linked to disordered eating in previous research (Fairburn et al, 1999; Hewitt et al, 1995; Joiner et al, 1997; Steiger et al, 1992), we suggest that both items remain in the Q-EAB for further investigation. In total, 21 Q-EAB items appear to be valid and useful indicators in a screening tool for disordered eating in athletes.

Certain Q-EAB items showed no association with disordered eating symptoms, namely 'Satisfaction with size/appearance of chest,' 'Content with weight gain,' 'Rigidity of eating routine,' 'Priority of eating routine,' 'Exercise gives feeling of control' 'Exercise helps avoid difficult tasks' and 'Exercise helps avoid negative feelings.' The latter 5 items were included based on the research showing that several indicators of obsessive dieting and exercise include: preoccupation with thoughts about when, where, and what to eat or exercise, avoidance of other duties and activities to maintain a rigid eating and exercise schedule, exercising when injured or more than required for sport, and an inability to derive enjoyment or relaxation from exercise (Beumont et al., 1994; Coen & Ogles, 1993; Davis et al, 1994; McNulty et al, 2001; Sherman & Thompson, 1990). While the majority of Master's athletes reported on the Q-EAB that a desire to maintain overall health and to have fun were the prime motivators of sport participation, a third of athletes reported using exercise as a weight control

method on the EDE-Q. Hence, rather than concluding that Masters athletes did not use exercise to control weight, it can be assumed that the Q-EAB items simply failed to identify these athletes. This suggests that these items should be modified or removed from the Q-EAB because they do not aid in identifying athletes with pathological diet and exercise attitudes. Furthermore, since four of these five items comprised the exercise compulsion domain of the Q-EAB, our questionnaire requires reworking if it is to accurately assess this construct. The remaining two items, sschest and morewt, were components of the body dissatisfaction and weight obsession domains respectively. Since they showed no correspondence to disordered eating symptoms, we suggest that they be eliminated from the Q-EAB. In summary, 21 items from the Q-EAB demonstrated competency as indicators of disordered eating in athletes and the potential to be included in a screening tool, while 7 items did not.

6.3 Correlation of Tests Scores to Dietary Intake and Energy Expenditure

We were interested in assessing whether athletes with high scores on the psychometric inventories also demonstrated significant differences in dietary intake or energy expenditure. We found no correlations between energy or macronutrient intake, energy expenditure and scores on any of the inventories. This would seem to indicate that those individuals with high test scores did not present with suboptimal nutritional intake or higher energy expenditure. There were also no significant differences in intake or expenditure between elite and non-elite or male and female athletes. Thus, despite evidence of pathological eating and body attitudes in non-elite and female athletes, no significant changes in energy balance resulted. Likewise, there was no correlation between low BMI's and high scores on the tests. This was paralleled in previous research by McNulty et al (2001), who found that female athletes with disordered eating all had normal BMI's and pathology was evident only by increased scores on standard psychometric inventories. This suggests that all of our psychometric inventories assess, to some degree, disturbed eating attitudes and behaviors that may precede overt eating disorder symptoms. However, for reasons mentioned

earlier, the FAST and Q-EAB appear superior to the EDE-Q in their ability to identify disordered eating in athletic populations.

Almost half of athletes had protein intakes less than that recommended for highly active persons. Since there was no association between low protein intake and high scores on the psychometric inventories, it can be assumed that low protein intake was not purposeful. However, regardless of the lack of pathological intent, a low protein intake is detrimental to an athlete's health and performance (Brownell et al, 1987; Economos et al, 1993; Tarnopolsky, 2004). This highlights the need for nutritional education in athletes that teaches them how to adequately fuel their bodies to support an athletic lifestyle.

6.4 Limitations

As is true of most survey research, this study has a number of limitations that should be noted. First and foremost is the self-report nature of data collection. The internal validity of the study might be questioned if participants were not truthful in their responses. Athletes in particular tend to be less forthcoming in reporting eating problems for fear of negative repercussions from coaches and team-mates and for fear of further damaging sports image (Black et al, 2003; Garner et al, 1998; Johnson et al, 1999; Nagel et al, 2000; Sundgot-Borgen, 1994; Yates et al, 2000; Wilmore, 1991). There may have been several behaviors, such vomiting and diuretic abuse, that participants were reluctant to admit to engaging in due to the sensitive nature of the behaviors. Furthermore, there is a possibility of responses being influenced by the participant's desire to present themselves in a socially desirable way to the researcher, and thus denying eating pathology. Several measures were taken to encourage truthful responding in the present study. All information was collected online in an attempt to minimize the effect of the researcher on participants. Since researchers suggest that ensuring participants' confidentiality will do much to reduce denial of eating problems (Garner et al, 1998; Johnson et al, 1999; Sundgot-Borgen, 1994; Wilmore, 1991), our data was collected in an anonymous fashion to minimize self-report bias. In addition, the Q-EAB was administered before the remaining

psychometric tools to curtail appraisal of the test's intent by responders, since questionnaires measuring eating pathology tend to render false-positive and false-negative diagnoses due to easily ascertained face validity (Fairburn & Beglin, 1994). The fact that questionnaire administration was not randomized is a further limitation. However for our purposes, it was more essential to guard against false responses in our population.

On the other hand, a selection bias may have occurred if participants with eating and body issues chose to partake less extensively in the study than those without such issues. A selective participation could have caused potential underestimates of pathogenic eating attitudes and behaviors in our population. Since we did not ask participants if they had ever been diagnosed with or treated for an eating disorder, there is no way of knowing if a differential response rate occurred between participants with and without a disordered eating history. Consequently, future investigations into the disordered eating tendencies in this population are warranted in order to get a better estimate of disordered eating prevalence.

A similar issue pertains to the limitations of self-reported diet and activity records. Of noteworthy mention is the potential for under-reporting food intake. Although we cannot discount its contribution, the fact that no significant differences in energy balance by gender or elite status were found implies that if under-reporting was present, it was so to the same extent in all groups. Further drawbacks include the inaccuracy of activity diaries and generic equations used to derive energy expenditure values. For example, when determining the METS for the various activities reported by participants, the most recent Compendium of Physical Activities (Ainsworth et al, 2000) was used. However, this edition does not include many of the activities currently performed by athletes such as Pilates, strength training exercises using massage balls, and plyometric exercises. Researchers were forced to modify existing activity codes to estimate energy expenditure of these exercises. Measures were taken to enhance accuracy of diet and activity records, including detailed instructions and templates for record keeping. Since the study's focus was less concerned with actual energy balance

and more on eating attitudes and behaviors of athletes, self-report data collection was the most feasible for our purposes. Other more costly and intrusive methods such as metabolic analysis may be considered in future studies of this nature.

A further drawback is the fact that only 35 individuals completed the dietary and activity records. This small sample size limits the statistical interpretation of records and may explain the lack of significant differences observed between groups. Furthermore, there was a large standard deviation on the mean energy intakes and expenditures which suggest that athletes differ substantially in their nutritional intake and energy output. But again, since dietary and activity characteristics were secondary to the study's purpose, the small sample size and large variance does not diminish our major findings

Finally, the lack of a control group is problematic because it is difficult to draw conclusions on the risk factors in athletes if we do not have corresponding information on non-athletes of similar age with which to compare to. One way of establishing risk for disordered eating is to contrast the presence of syndromes across samples. However, comparative general population figures are not available for this age group. It would have been helpful to have paired case-controls of athletes and non-athletes with which to compare scores on the various measures. Furthermore, there is no "gold standard" for detecting disordered eating in athletes, so it is impossible to know for certain that the high risk group identified actually possesses the disorder and makes validation of the Q-EAB difficult.

6.5 Implications

Despite these limitations, the implications of the present study for both future research and clinicians are numerous.

6.5.1 Future Research

The psychometric properties of Q-EAB should be examined using a larger sample of athletes from a variety of sports, including technical, aesthetic, ball, power, and antigravitational to name a few. This would provide a better estimate

of the applicability of the instrument to athletic populations. It may also be interesting to compare performance of the Q-EAB to other existing eating disorder inventories, such as the EDI, EAT, and BULIT-R. In addition, it may be helpful to employ a two stage study design where participants first complete the Q-EAB and then are given a follow-up interview to assess the sensitivity of the questionnaire. Development of a standardized tool valid in athletic populations would allow for better comparison and greater consistency between studies. More precise estimates of prevalence rates and risk factors would also allow for appropriate intervention and prevention measures to be implemented. More extensive use of the Q-EAB in diverse athletic populations would permit the establishment of norms which would provide greater utility to researchers and clinicians. Because of the paucity of research on disordered eating behavior in Masters athletes, more studies must focus on this population in order to get an accurate estimation of the magnitude of the condition. Additional research may also form a basis for modifying regulations in sports such that an emphasis on low body weight for athletic competence is removed.

6.5.2 Clinicians

The results of this study have several practical implications for health care professionals and clinicians working with athletic populations. The Q-EAB appears to be a valid instrument that could be used by coaching staff and sports physicians to identify athletes at risk of disordered eating who would benefit from appropriate therapy and outreach programs. Due to its simple, convenient administration it could easily be incorporated into a pre-participation physical evaluation. The tool could also be given to large groups of athletes to determine the need for preventative efforts aimed at specific segments of the sporting community.

In addition, Masters athletes would benefit from education about the impact of inadequate nutritional intake and disordered eating practices on athletic performance and health. It must be stressed to athletes that by engaging in dangerous weight control behaviors, they are not only making themselves weaker

and less competitive, but are putting their health in serious jeopardy. Female athletes in particular must be educated about the potentially deleterious effects of menstrual dysfunction on risk of osteoporosis and musculoskeletal injury. At risk athletes must be given appropriate nutritional and medical intervention. During times of high intensity or volume of training, the guidance of a sports dietician would assist in ensuring energy needs are met to avoid problems with menstrual dysfunction. Athletic staff must be aware of the effect of implicating body size and shape in enhancing performance, since their comments and opinions can strongly influence the development of weight obsession and disturbed weight control practices. Ultimately, coaches and athletic trainers must maintain a high index of suspicion for pathogenic eating behavior, particularly in female and non-elite athletes.

6.6 Conclusion

The present study represents one of the first investigations into eating attitudes and behaviors of athletes beyond college age. The results suggest that: 1) athletes beyond college age are afflicted by disordered eating, 2) female Masters athletes are at greater risk than male, 3) non-elite Masters athletes are at greater risk than elite, 4) the Q-EAB is a valid and superior screening instrument to detect disordered eating in athletes. Awareness and early identification of pathological eating attitudes and behavior is vital to prevent serious health complications and development of clinical eating disorders in athletes. It is our hope that the Q-EAB will prove useful to researchers, health care professionals, and athletic staff in identifying athletes at risk of disordered eating.

6.7 Tables

Table 5-1 Sample Characteristics of Masters Athletes

Variable	Male Athletes (n=48)	Female Athletes (n=63)	Elite Athletes (n=41)_	Non-elite Athletes (n=63)
Age (years)[a]	47.8±6.9	42.8±6.5[b]	45.9±6.8	43.9±7.1
Body Mass Index (kg/m^2)[a]	25.8±3.2	23.2±3.4[b]	23.4±2.9	24.8±3.8[c]
Amenorrheic Episodes (%)	n/a	(63)29.0	47.8	18.4[c]

[a] Means ± SD
[b] Female athletes are significantly different from male athletes, $p< 0.001$
[c] Elite athletes are significantly different from non-elite athletes, $p<0.05$

Table 5-2 Psychological Characteristics of Masters Athletes

Variable	Male Athletes (n=48)	Female Athletes (n=63)	Elite Athletes (n=41)	Non-elite Athletes (n=63)
History of mental disorder (%)	10.4	14.3	7.3	17.5
Current antidepressant use (%)	0	7.9[b]	2.4	6.3
History of dieting (%)	20.8	49.2[c]	9	33[d]
Number of diets in past year[a]	1.0±0.5	1.2±0.6	0.6±0.5	1.2±0.5[e]

[a] Means ± SD
[b] Female athletes are significantly different from male athletes, $p< 0.05$
[c] Female athletes are significantly different from male athletes, $p< 0.005$
[d] Elite athletes are significantly different from non-elite athletes, $p< 0.005$
[e] Elite athletes are significantly different from non-elite athletes, $p<0.05$

Table 5-3 Dietary Characteristics of Masters Athletes (Means±SD)

Variable	Male Athletes (n=17)	Female Athletes (n=18)	Elite Athletes (n=13)	Non-elite Athletes (n=22)
Energy Intake (EI) (kcal/d)	2380.6±768.7	2302.4±724.7	2137.6±729.5	2460.2±730.3
Exercise Expenditure (EE) (kcal/d)	617.5±443.9	612.9±398.1	715.7±479.4	555.7±370.4
Resting Metabolic Rate (REE) (kcal/d)	1796.8±175.9	1377.7±87.7[a]	1539.6±206.4	1605.9±277.3
Total Energy Expenditure (TEE) (kcal/d)	2414.3±498.5	1990.5±416.3[a]	2255.3±574.4	2161.5±460.9
Energy Balance (EB) (kcal/d)	-33.6±1055.3	311.9±849.6	-117.7±968.0	298.7±937.5
Carbohydrate Intake (% of total EI)	56.0±8.4	53.4±7.6	58.1±9.6	52.6±6.2
Fat Intake (% of total EI)	24.8±7.9	28.1±9.3	23.3±8.5	28.4±8.4
Protein Intake (% of total EI)	16.3±3.0	18.4±12.4	15.3±4.5	18.6±10.8

[a] Female athletes are significantly different from male athletes, $p < 0.001$

Table 5 -4 Scores for Masters Athletes on the Eating Disorder Examination-Questionnaire (EDE-Q), Female Athlete Screening Tool (FAST), Center for Epidemiological Studies Scale – Depression (CES-D), Thinness and Restricting Expectancy Inventory (TREI), and Eating Expectancy Inventory (EEI) (Means±SD)

Test	Male Athletes	Female Athletes	Elite Athletes	Non-elite Athletes
EDE-Q: Total	0.8±0.8 (35)*	1.1±1.1 (48)*	0.8±0.8 (33)*	1.1±1.1(50)*
Restraint	0.9±1.2	1.4±1.4	0.7±0.9	1.6±1.5[a]
Eating Concern	0.3±0.5	0.6±1.1	0.2±0.5	0.6±1.0[b]
Shape Concern	1.0±1.2	1.8±1.6[c]	1.0±1.1	1.8±1.6[b]
Weight Concern	0.9±0.9	1.6±1.6[c]	1.0±1.0	1.5±1.5
FAST: Total	61.4±9.8 (35)*	66.0±13.0 (48)*	63.0±11.5 (33)*	65.1±12.0 (50)*
CES-D: Total	7.6±6.1 (22)	10.8±10.2 (30)*	10.6±9.7(22)*	8.8±8.3(30)*
TREI: Total	135.3±61.1 (22)*	134.3±70.5 (30)*	145.5± 58.3(22)*	126.7± 71.6(30)*
EEI: Total	104.8±32.5 (22)*	102.1±40.9 (30)*	100.4± 33.1(22)*	106.4± 40.4(30)*
Negative Affect	2.5±1.1	2.4±1.4	2.5±1.1	2.4±1.4
Pleasure/Reward	4.8±1.2	4.4±1.0	4.2±1.1	4.9±1.0[b]
Out of Control	2.7±1.2	2.8±1.9	2.7±1.5	2.8±1.7
Cognitive Competence	3.6±1.9	4.2±1.9	3.8±1.8	4.1±2.0
Alleviate Boredom	3.2±1.5	3.1±1.5	3.1±1.4	3.2±1.6

[a] Elite athletes are significantly different from non-elite athletes, $p < 0.005$
[b] Elite athletes are significantly different from non-elite athletes, $p < 0.05$
[c] Female athletes are significantly different from male athletes, $p < 0.05$
* (n) =Total number of participants completing questionnaire

Table 5-5 Scores for Masters Athletes on the Questionnaire of Eating Attitudes and Behaviors (Q-EAB) Items (Means±SD)

Q-EAB Item	Male Athletes	Female Athletes	Elite Athletes	Non-elite Athletes
Performance Dissatisfaction				
Ability to be successful in sport	(35)1.8±0.8	(50)2.1±0.9	(34)1.8±0.8	(50)2.1±0.9
Overall athletic ability	(35)1.8±0.7	(50)2.1±0.8	(34)1.9±0.8	(50)2.0±0.8
Athletic achievements to date	(35)1.6±0.7	(50)1.9±0.8	(34)1.7±0.7	(50)1.9±0.8
Muscular strength	(35)2.1±0.9	(50)2.1±0.9	(34)2.2±1.0	(50)2.1±0.9
Cardiovascular endurance	(35)1.7±0.7	(50)1.8±0.9	(34)1.8±0.7	(50)1.8±0.9
Overall physical fitness	(35)1.7±0.8	(50)1.8±0.8	(34)1.6±0.6	(50)1.8±0.9
Body Dissatisfaction				
Body fat	(35)2.5±1.2	(50)2.6±1.3	(34)2.5±1.0	(50)2.9±1.4[d]
Body weight	(35)2.4±1.1	(50)2.5±1.2	(34)2.1±1.0	(50)2.8±1.3[d]
Body shape	(35)2.1±1.0	(50)2.4±1.2	(34)2.0±1.0	(50)2.5±1.2
Size and/or appearance of thighs	(35)1.7±0.7	(50)2.8±1.3[b]	(34)2.2±1.0	(50)2.5±1.3
Size and/or appearance of stomach	(35)2.7±1.5	(50)2.8±1.5	(34)2.1±1.1	(50)3.2±1.5[d]
Size and/or appearance of chest	(35)2.1±1.0	(50)2.5±1.2	(34)2.2±1.2	(50)2.4±1.1
Muscle tone and appearance	(35)2.1±1.0	(50)2.2±1.0	(34)1.8±0.8	(50)2.4±1.1[d]
Overall physical appearance	(35)2.1±0.9	(50)2.1±0.9	(34)1.9±0.8	(50)2.3±0.9[c]
Subscale Names				
Rigidity of eating routine	(36)2.6±1.1	(50)3.3±1.1	(35)2.9±1.1	(50)3.1±1.1
Priority of eating routine	(34)2.2±0.8	(48)2.4±0.8[a]	(31)2.3±0.8	(50)2.4±0.8
Body dissatisfaction prior to sport involvement	(35)2.3±1.1	(50)2.5±1.1	(34)2.1±1.0	(50)2.6±1.1[c]
Exercise gives feeling of control	(34)3.4±0.8	(50)3.3±0.8	(33)3.4±0.9	(50)3.4±0.8
Exercise helps avoid difficult tasks	(35)1.7±0.9	(50)1.7±0.8	(34)1.9±1.0	(50)1.6±0.7
Exercise helps avoid negative feelings	(35)3.0±0.9	(49)3.0±1.1	(33)3.0±1.0	(50)2.9±1.0
Anxiety regarding losing control of weight/appetite	(35)1.9±0.9	(48)2.4±1.2[a]	(33)1.9±0.8	(49)2.5±1.2[d]
Weight obsession	(35)2.6±0.8	(49)3.1±1.1[a]	(33)2.4±0.7	(50)3.3±1.0[e]
Sets high goals in sport	(35)2.3±1.0	(49)2.1±0.9	(33)2.6±1.0	(50)2.0±0.8[c]
Perfectionism in sport	(35)2.0±0.9	(49)1.9±0.9	(33)2.2±1.0	(50)1.8±0.8
Difficulty maintaining weight	(41)1.8±0.8	(61)2.1±0.9	(40)1.7±0.7	(62)2.2±0.9[d]
Food obsession	(35)3.0±1.2	(50)3.1±1.0	(35)2.7±1.1	(50)3.3±1.0[d]
Restraint in typical eating	(35)1.8±1.1	(50)2.0±1.1	(35)1.6±0.9	(50)2.3±1.1[e]
Energy expenditure obsession	(35)2.1±1.1	(49)2.5±1.1	(33)2.0±1.1	(50)2.6±1.1[c]
Weighing frequency	(34)2.3±1.1	(48)2.1±1.1	(33)1.8±1.0	(49)2.5±1.1[c]
Intake dependent on expenditure	(35)2.1±0.9	(49)2.5±1.1	(33)2.2±0.9	(50)2.4±1.1
Content with weight gain	(35)3.9±1.1	(49)4.1±0.8	(33)4.2±0.7	(50)3.8±1.1
Running mental total of intake	(35)1.9±1.2	(50)2.2±1.2	(35)1.7±0.9	(50)2.4±1.4[c]

[a] Female athletes are significantly different from male athletes, $p<0.05$
[b] Female athletes are significantly different from male athletes, $p<0.001$
[c] Elite athletes are significantly different from non-elite athletes, $p< 0.05$
[d] Elite athletes are significantly different from non-elite athletes, $p< 0.005$
[e] Elite athletes are significantly different from non-elite athletes, $p< 0.001$

Table 5-6 Significant Interactions of Gender, Elite Status, and Gender*Elite Status on Test Scores [a] [b]

Variable	Gender	Elite Status	Gender*Elite Status
EDEQ-WC	0.018		
EDEQ-SC	0.03		
EDEQ-R		0.041	
BMI	0.001	0.040	
Rigidity of eating routine	0.01		
Anxiety regarding losing control of weight/appetite	0.039		
Weight obsession	0.025	0.001	
Food obsession		0.043	
Difficulty maintaining weight		0.040	
Weighing frequency		0.046	
Restraint in typical eating		0.006	
Energy expenditure obsession		0.024	
Content with weight gain		0.027	
Sets high goals in sport		0.005	
Body dissatisfaction prior to sport involvement			0.039
Priority of eating routine			0.019

[a] All values are p values

[b] Only interactions with $p<0.05$ are displayed in this table.

Table 5-7 Concurrent Validity of the Questionnaire of Eating Attitudes and Behavior (Q-EAB)

Criterion Tool	Q-EAB Item	Spearman's Correlation Coefficient [a]
EDE-Q Total	Worrycon	0.735
	Wtobs	0.727
	Ssstomach	0.606
	Sswt	0.601
	Ssbf	0.590
	Typeatbh	0.585
	Ssshape	0.550
	Everdiet	0.536
	Sstone	0.532
	Missex	0.503
	Ssthigh	0.500
	Ssappear	0.500
EDE-Q Restraint	Wtobs	0.657
	Worrycon	0.644
	Typeatbh	0.571
	Wtmtn	0.501
EDE-Q Weight Concern	Worrycon	0.656
	Wtobs	0.616
	Sswt	0.610
	Ssbf	0.601
	Ssstomac	0.574
	Ssshape	0.551
	Typeatbh	0.541
	Sstone	0.534
	Ssappear	0.515
	Everdiet	0.510
	Ssthigh	0.505
EDE-Q Eating Concern	Wtobs	0.749
	Worrycon	0.705
	Ssstomac	0.578
	Everdiet	0.566
	Wtmtn	0.524
	Typeatbh	0.500
EDE-Q Shape Concern	Wtobs	0.732
	Worrycon	0.716
	Ssstomac	0.678
	Ssshape	0.619
	Sswt	0.614
	Ssbf	0.612
	Sstone	0.582
	Ssappear	0.574
	Typeatbh	0.565
	Foodobs	0.523
	Ssthigh	0.504
FAST Total	Worrycon	0.681
	Wtobs	0.668
	Typeatbh	0.530
	Missex	0.519
	Everdiet	0.512
EEI Negative Affect	Ssstomac	0.511
	Ssshape	0.507

	Sstone	0.501
EEI Pleasure	Wtmtn	0.525
EEI Out of Control	Wtobs	0.591
	Worrycon	0.590
	Ssshape	0.521

[a] All correlations are significant at the 0.001 level

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Appendices

Appendix 8.1
Questionnaire of Eating Attitudes and Behaviors
(Q-EAB)

Health History

1. **What is your age?** _____years

2. **What is your height?** ____ft ____in

3. **What is your current weight?** ____lbs or ____kg

4. **What is your usual weight?** ____lbs or ____kg

5. **What was your lowest weight at this height?** ____lbs or ____kg

6. **How many years ago were you at your lowest weight for present height?**
____1 year or less ____1 -3 years ____3 – 5 years ____5+ years

7. **Please state your gender:**
____Male (Please proceed to question 11)
____Female (Please proceed to question 8)

8. **At what age did you begin menstruating?**
_____

9. **Have you ever missed at least 3 consecutive menstrual cycles (other than during pregnancy)?**
____Yes ____No

10. **Are you currently taking oral contraceptives?**
_____Yes _____ No

11. **Have you ever been treated for a mental disorder including anxiety, depression, or alcoholism?**
_____Yes ____No

Sport History

12. **At what age did you start participating / training in sports regularly?**
____10 or younger ____11-15 ____16-20
____Older than 20 yrs

13. **Please list all sports you engage in during the following seasons?**
Fall:

Winter:
Spring:
Summer:

14. Which, if any, of the sports listed in question 13 do you compete in?

Fall:
Winter:
Spring:
Summer:

15. How many competitions do you normally enter per year?

_____

16. How long ago was your last competition?

____Less than a month ago ____1-2 months ago ____3-6 months ago ____6+ months ago

17. When is your next competition?

____Less than a month ____1-2 months ____3-6 months ____6+ months

18. Where do you typically rank within your age class?

____Bottom 75% ____Top 25% ____Top 10%

Dieting Behavior

19. Have you ever been on a diet?

_____Yes (Proceed to Question 20) _____No (Proceed to Question 23)

20. How many diets have you been on in the past year?

_____

21. Please check all diets that you have followed in the past 5 years.

____Atkins (or other low carbohydrate)
____The Zone
____Suzanne Somers
____Eat Right for your Blood Type
____Weight Watchers/Jenny Craig etc
____Fit For Life
____Ornish (or vegetarian)
____South Beach Diet
____Other (please specify):

22. How old were you when you started your first diet?

____Younger than 12yrs ____12-15 yrs ____16-20 yrs

___Older than 20 yrs

23. Have you ever used any of the following methods for weight loss? Please check all that apply.

___Laxatives, suppositories
___Vomitting
___Fasting
___Diuretics
___Diet Pills
___Fat burners (ie. Xenadrine, Metabolife, Trim Spa)
___Restrictive Dieting (< 1000kcal/day)
___Excessive Exercise
___Other (please specify):

24. What has been the greatest fluctuation in weight that you have experienced in a 3 month period?

___0-5 lbs ___5-10 lbs ___10-15 lbs ___15+ lbs

25. How easy is it for you to maintain your in-season weight?

a. _____ Very easy
b. _____ Somewhat easy
c. _____ Somewhat difficult
d. _____ Very difficult

Restrictive Tendencies

26. What reasons motivated your desire to lose weight? Please check all that apply.

___To meet lower weight category.
___Weight loss was encouraged by coach/trainer.
___To improve performance.
___To look better.
___To be healthier.
___I have a family history of weight problems.
___I have never had a desire to lose weight.
___Other (Please specify)

27. Do you keep a mental running total of the number of calories you eat in a day?

___Always ___Usually ___Sometimes ___Rarely ___Never

28. How often do you think about food, eating or calories between meals?

___Always ___Usually ___Sometimes ___Rarely ___Never

29. Do you get uncomfortable when your usual eating routine is disrupted?

___Always ___Usually ___Sometimes ___Rarely ___Never

30. Check the statement that best describes your typical eating behaviour.

_____ I often eat whatever I want, whenever I want.

_____ I only sometimes eat whatever I want, whenever I want.

_____ I often refrain from eating what I want but often "give in" and eat it anyway.

_____ I often refrain from eating what I want and rarely "give in" and eat it anyway.

Performance Satisfaction

31. Please rate your satisfaction with the following factors:

	Very Satisfied	***Somewhat Satisfied***	***Neutral***	***Somewhat Dissatisfied***	***Very Dissatisfied***
Your muscular strength					
Your cardiovascular endurance					
Your overall physical fitness					
Your ability to be successful in your sport					
Your overall athletic ability					
Your athletic achievements to date					

Body Satisfaction

Your body fat percentage					
Your body weight					
Your body shape					
The size/appearance of your thighs					
The size/appearance of					

your stomach
The size/appearance of your chest and/or shoulders
Your muscle tone and appearance
Your overall physical appearance

32. Which of the following summarize your personal goals for body composition?

Please check all that apply.

_____ Decrease body fat
_____ Lose weight
_____ Maintain current body composition
_____ Gain lean mass/weight

Exercise Compulsion

33. My exercise and/or eating habits interfere with important things such as socializing with friends and family.

____Often ____Usually ____Sometimes ____Rarely ____Never

34. I was unhappy with my body before I began to exercise.

____Strongly Agree ____Somewhat Agree ____Somewhat Disagree
____Strongly Disagree

35. Exercise gives me a feeling of control.

____Strongly Agree ____Somewhat Agree ____Somewhat Disagree
____Strongly Disagree

36. Exercise helps me avoid dealing with difficult tasks.

____Strongly Agree ____Somewhat Agree ____Somewhat Disagree
____Strongly Disagree

37. Exercise helps me block out negative feelings, such as depression, loneliness, or fear.

____Strongly Agree ____Somewhat Agree ____Somewhat Disagree
____Strongly Disagree

38. Below are some possible reasons for participating in sports. Please choose the most important reason to you.

____To gain muscle/tone body
____To improve mental health (ie stress reduction)
____To improve overall appearance
____To improve physical fitness
____To lose weight/body fat
____To socialize
____To improve overall health.
____For fun

Weight Obsession

39. I worry that I will lose control over my weight and/or appetite.

____Always ____Usually ____Sometimes ____Rarely ____Never

40. How often do you think about your weight or body size?

____Always ____Usually ____Sometimes ____Rarely ____Never

41. How often, on average, do you weigh yourself?

____1+ times per day ____Several times weekly ____Once weekly
____Monthly or less

42. Are you aware of the number of calories you burn during each exercise session?

____Always ____Usually ____Sometimes ____Rarely ____Never

43. If you miss a training session, do you consume less food later to compensate?

____Always ____Usually ____Sometimes ____Rarely ____Never

44. What would make you the most happy?

____Spending time with friends and family
____Losing weight
____Getting a promotion at work
____Placing in the top tenth percentile of your sport

45. How much more could you weigh and still be content with your body?

____0 lbs ____less than 5 lbs ____less than 10 lbs ____up to 15 lbs
____Gaining weight would not bother me

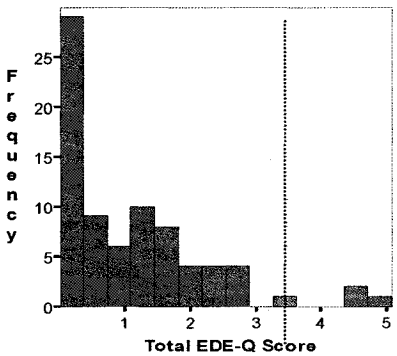
46. What do you think is the best indicator of your physical fitness?

____Looking at your body in the mirror
____The way your clothes fit
____Your weight
____Your performance
____Your energy level

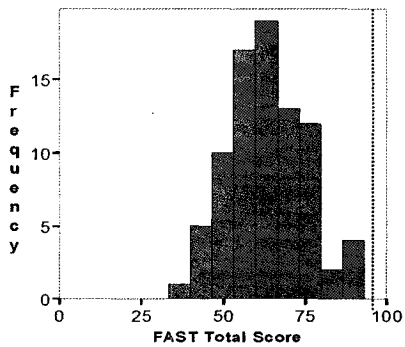
47. I hate being less than best in my sport.
____Extremely True ____Very True ____Slightly True ____Not at all True

48. I set extremely high goals for my athletic achievements.
____Extremely True ____Very True ____Slightly True ____Not at all True

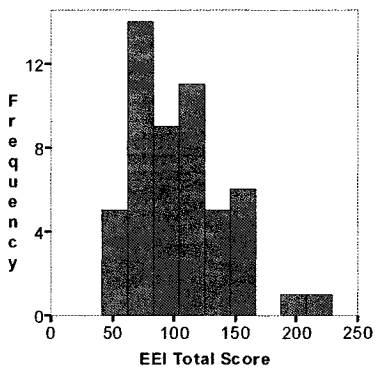
Appendix 8.2
Score Distributions for Each Psychometric Tool

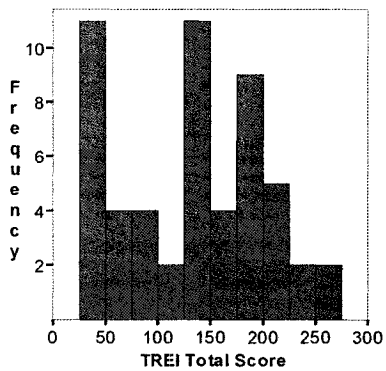


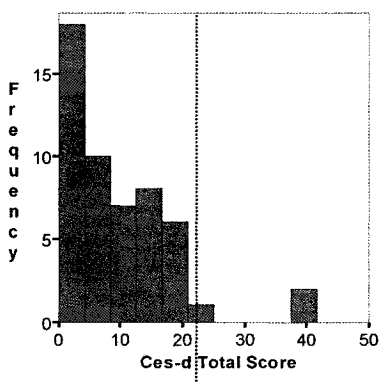
[a] Hulley & Hill, 2001

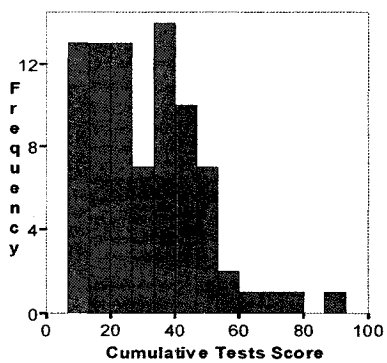


[a] McNulty et al, 2001



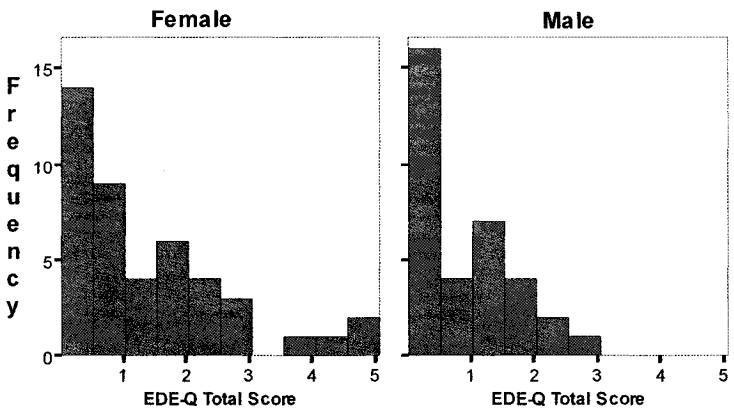


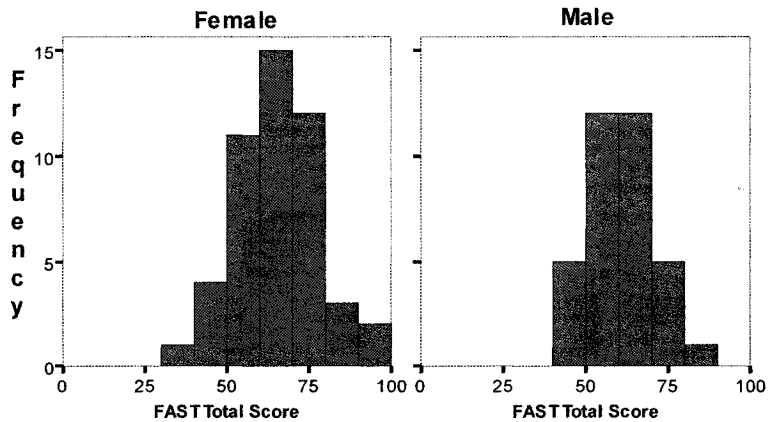


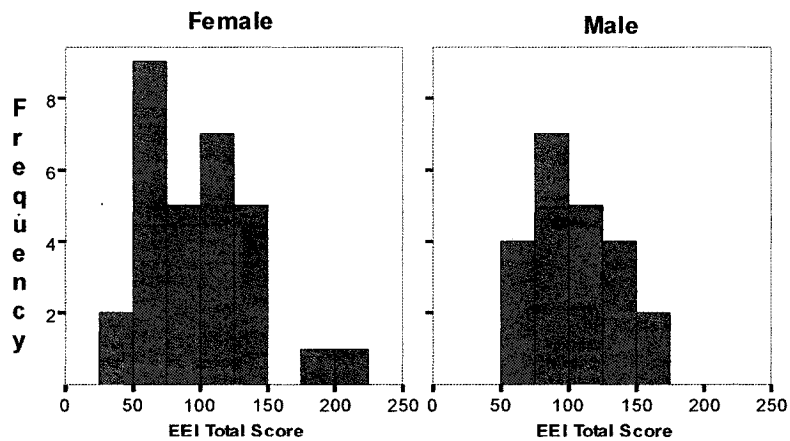


[a] McDowell et al, 1996

Figure 1. Distribution of Scores on EDE-Q, FAST(*), TREI, EEI, CES-D (*) and Cumulative Test Scores in Masters Athletes


Female
Male
Frequency
15
10
5
0
1
2
3
4
5
EDE-Q Total Score
EDE-Q Total Score


Female
Male
Frequency
15
10
5
0
0
25
50
75
100
FAST Total Score
FAST Total Score


Female
Male
Frequency
8
6
4
2
0
50
100
150
200
250
EEI Total Score
EEI Total Score

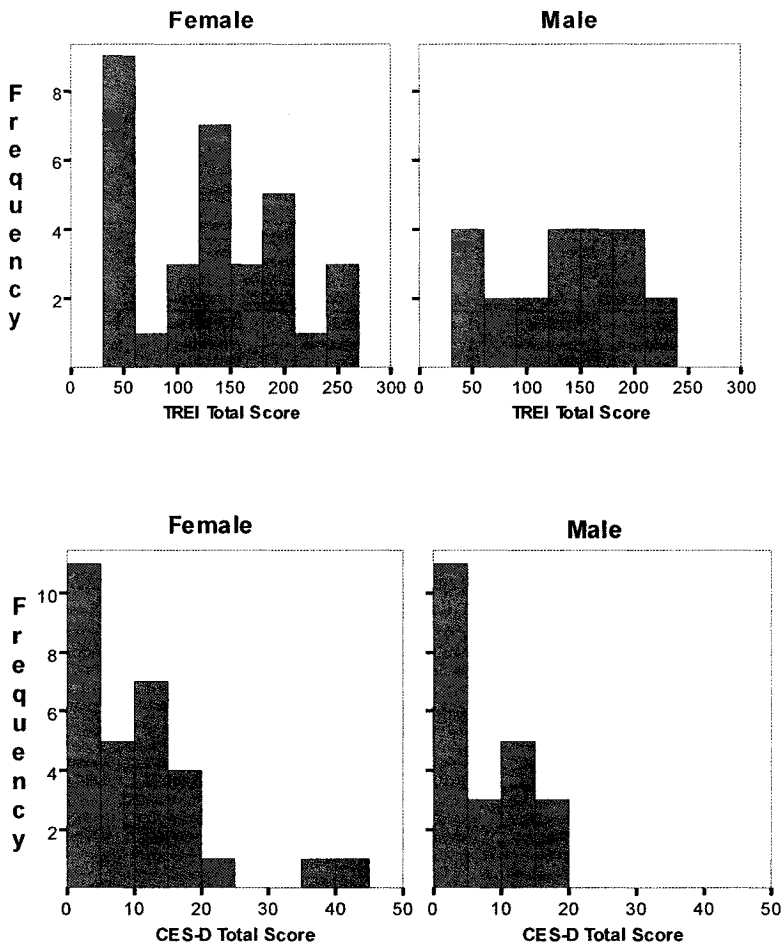
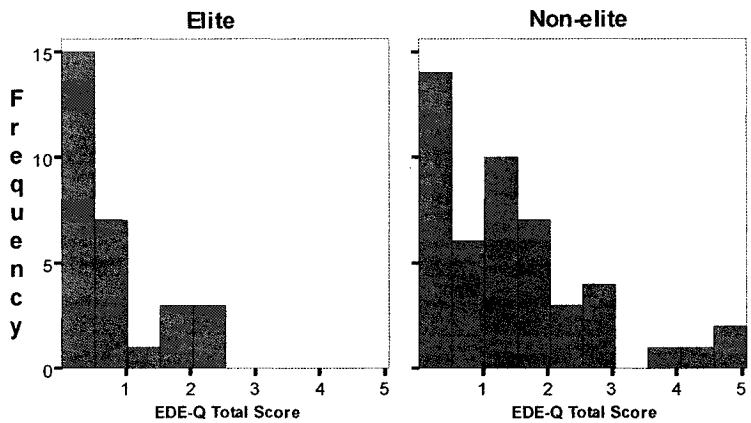
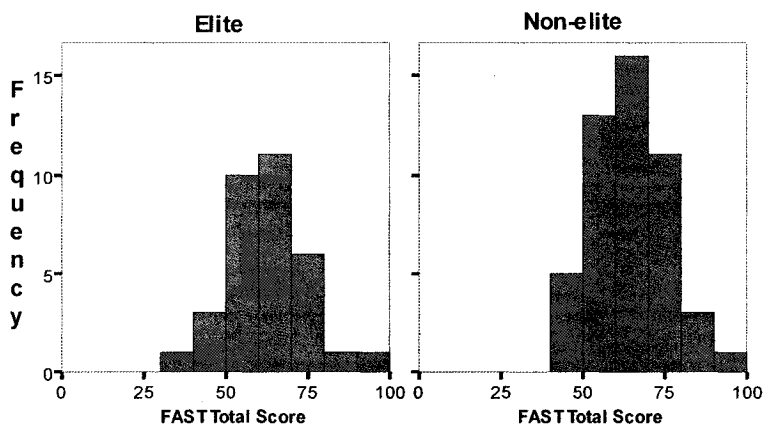
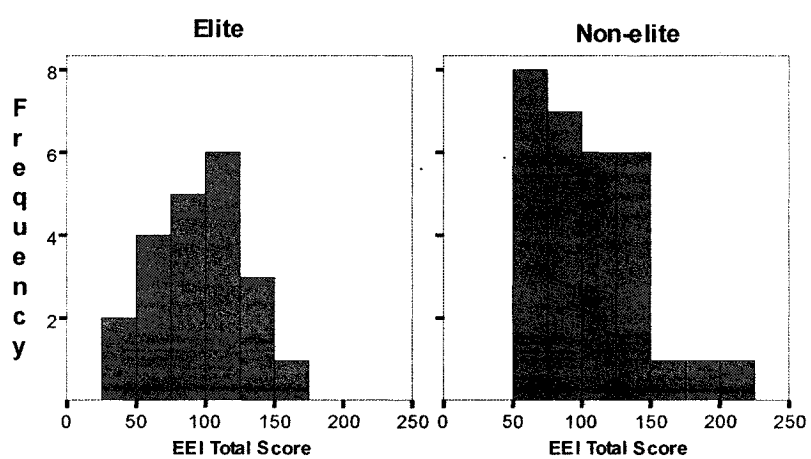


Figure 2. Distribution of Scores on EDE-Q, FAST(*), TREI, EEI, and CES-D (*) in Male and Female Masters Athletes


Elite
Non-elite
Frequency
15
10
5
0
1
2
3
4
5
EDE-Q Total Score


Elite
Non-elite
Frequency
15
10
5
0
0
25
50
75
100
FAST Total Score


Elite
Non-elite
Frequency
8
6
4
2
0
50
100
150
200
250
EEI Total Score

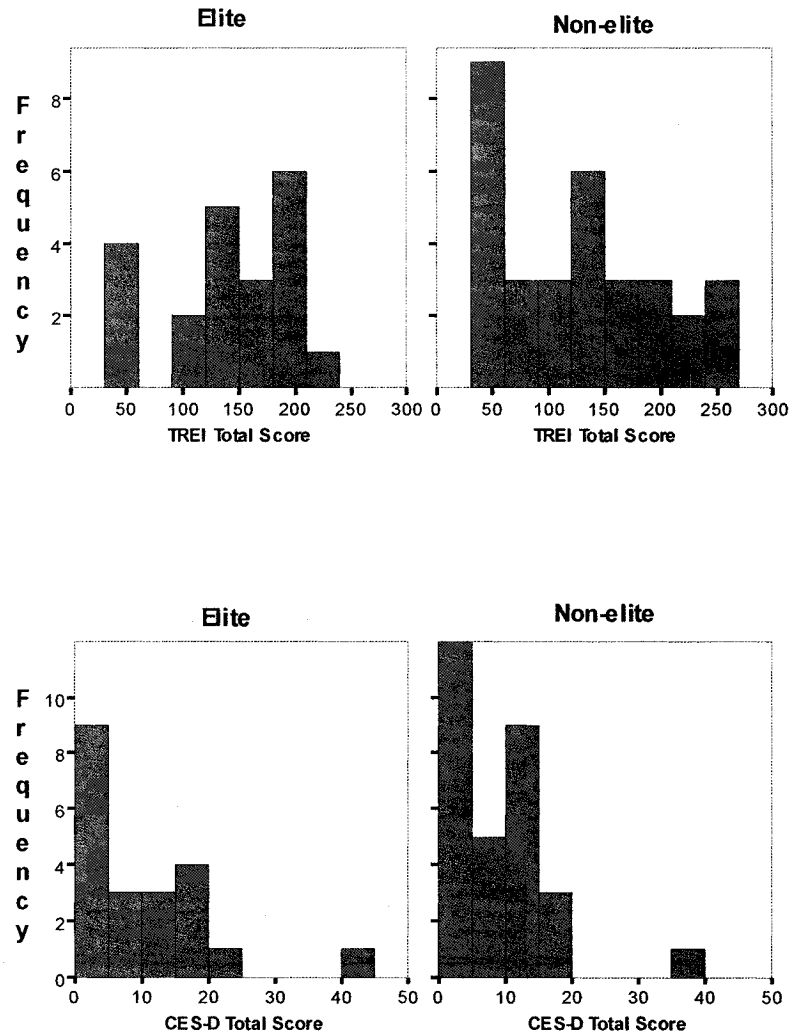


Figure 3. Distribution of Scores on EDE-Q, FAST(*), TREI, EEI, and CES-D (*) in Elite and Non-elite Masters Athletes

* denotes normal distribution

Appendix 8.3
Additional Q-EAB Validation

Table 1 Correlations (Cronbach's Alpha) Between the Standard Psychometric Tools and the Questionnaire of Eating Attitudes and Behavior (Q-EAB) [a]

EDE-Q	Q-EAB Items	α value
EDE-Q Total	worrycon, wtobs	0.9017
EDE-Q Restraint	worrycon, wtobs	0.8540
EDE-Q Weight Concern	worrycon, wtobs, wtmtn, weigfrq, sswt, ssshape, sstone	0.8643
EDE-Q Eating Concern	worrycon, wtobs, wtmtn, ssshape, sstone	0.8633
EDE-Q Shape Concern	worrycon, wtobs, wtmtn, weigfrq, sswt, ssshape, sstone,	0.8705
FAST Total	NSM[b]	
CES-D Total	NSM[b]	
EEI Total	NSM[b]	
TREI Total	NSM[b]	

[a] Only models that produced a Cronbach's alpha ≥0.85 are listed in this table
[b] No Significant Model