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# Disordered eating attitudes and Orthorexia Nervosa in Canadian elite athlete populations

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Disordered Eating Attitudes and Orthorexia Nervosa in Canadian Elite Athlete Populations

by

Georgia Ens

A THESIS

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## ABSTRACT

**Background:** Disordered eating attitudes (DEAs) refer to a continuum of abnormal feeding and eating behaviours (Sundgot-Borgen & Torstviet, 2010). The prevalence of DEAs in elite athletes is greater than that of non-athletes, due in part to sport performance demands. A newly recognized DEA, orthorexia nervosa (ON), may reflect the eating behaviours of some elite athletes (Haman, Barker-Ruchti, Patriksson, & Lindgren, 2015).

**Objective:** The research aims to determine the prevalence of DEAs and ON in Canadian elite athlete populations. In addition, an exploratory factor analysis was performed to understand the validity of the ORTO-15.

**Methods:** 72 male and female athletes were recruited from Canadian Sport Institutes and National Sport Organizations. A demographic survey and two questionnaires, the EAT-26 and the ORTO-15, were completed online via SimpleSurvey.

**Results:** The study found the prevalence of DEAs and ON to be 13.9% and 75% respectively.

**Conclusion:** The prevalence of DEAs and ON in the study is considerably high. Findings can be presented to key stakeholders to educate them on the topic. Developing prevention and treatment protocol for DEAs and ON will contribute to the health and performance of Canada's elite athletes.

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## **Chapter One: Introduction**

### **Background:**

#### **Elite Athlete**

Elite athletes are defined as those actively competing at a national or international level, these athletes must be training on a national development, national, or Olympic team.

Researchers find this group of individuals particularly fascinating. Not only are they able to push their bodies to the brink of what is physically possible day after day, they exhibit phenomenal personality and psychological qualities. The life of an elite athlete is not glamorous. They spend endless hours training, honing their skills and competing with their sport. Early morning gym sessions and late night team meetings make for an exhausting life style.

However, an athlete's day to day is not limited to participating in their sport. Some athletes are required to travel extensively for training and competitions. For example, the 2017/2018 season for moguls skiing consisted of six world cups in five different countries over a four-month times span; this excludes any travel for training camps and the Olympic games in South Korea (FIS, 2017). Athletes may be in charge of their own travel arrangements at times, adding another stressor to their list of tasks. With extensive travel comes adjustment to different time zones, living out of suitcase, and constant familiarization with new countries, cultures, and customs. Athletes must learn how to adapt to the demands of travel while still maintaining the energy to train and compete and the level of elite sport.

Amateur elite sport is rarely funded at the same level as professional sport. The government does provide some athletes with monthly stipends to cover living expenses. Senior level athletes are eligible for \$1500 a month, while development athletes may receive \$900 (AthletesCAN, 2018). However, just because an athlete is competing at a high level does not

guarantee them funding, and usually only the top athletes in each sport will receive government support. Since funding is not always available, athletes may be forced to look for external sponsorships, or work to support themselves on top of the countless hours spent practicing. However, the sacrifice involved in an elite athlete lifestyle is justified by the success and passion in their sport.

Elite athletes are in constant pursuit of excellence. They are driven to work hard as there is always more to be done. Perfectionism is often found in elite athletes whether that takes the form of strivings or concerns (Gade, Schermelleh-Engel & Klein, 2017). Perfectionistic strivings refer to individuals being motivated by success, learning from mistakes, setting high personal standards (Gade et al., 2017). Individuals that show perfectionistic strivings tend to have high conscientiousness, use positive coping methods to stress. The striving type of perfectionism is often thought to be positive and facilitate performance (Gotwals, Stoeber, Dunn & Stoll, 2012). In contrast, perfectionistic concerns are seen to be maladaptive to performance. Those who experience perfectionistic concerns are often motivated by the fear of failure. In some cases, there is a discrepancy between the individual's evaluation of their performance and the actual outcome (Gade et al., 2017). Those with perfectionistic striving are known to be hard on themselves, set unrealistic expectations, and use maladaptive coping techniques (Gotwals et al., 2012). Elite athletes often exhibit perfectionistic striving characteristics as this is beneficial for high performance. If an individual is struggling with perfectionistic concerns, they may work with a sport psychologist to reframe their goals to be adaptive to performance. Elite athletes are highly motivated, both intrinsically and extrinsically to pursue their sport. They strive towards goals and push themselves to be their best.

There is enormous pressure and stress that accompanies elite sport. Successful athletes competing at this level are mentally tough. They are committed to their sport and are able to work towards measurable goals. Elite athletes do not shy away from challenges that they may be faced with and perceive those challenges as opportunities rather than threats. Elite athletes often exhibit the Four C's of mental toughness (Clough, Earle & Sewell, 2002). Control; the individual feels like they have influence over the situation and its outcome. Commitment; the individual is prepared to work to achieve their goals. Challenge; the individual will react positively to setbacks and changes in their environment. Confidence; the individual has an unshakable belief in their skill set and ability to accomplish tasks (Clough et al., 2002). No matter the setback, athletes understand what they have control over and are able to regulate their emotions and cope with any issues that may arise. Elite athletes have an unshakable confidence in themselves and believe that they have the tools both physiologically and psychologically to be their best.

### **Disordered Eating Attitudes:**

Disordered eating attitudes (DEAs) refer to a continuum of abnormal thoughts and behaviours associated with feeding and eating in an individual (Sundgot-Borgen & Torstveit, 2010). The continuum ranges from dieting behaviours to sub-clinical eating disorders to clinical disorders found in the Diagnostic Statistical Manual (DSM-V; American Psychiatric Association, 2013) like Anorexia Nervosa (AN) and Bulimia Nervosa (BN) (Sundgot-Borgen & Torstveit, 2010). While DEAs are similar to feeding and eating disorders as outlined by the DSM-V, and even include specific clinical disorders, a distinction can be made when examining the individual's understanding of food and its relationship to his or her body composition (Koven & Senbonmatsu, 2013). For example, the DEA continuum encompasses behaviours that individuals usually participate in to alter his or her body composition or cause weight loss.

Individuals may strive to reach a negative energy balance as a means to achieve this goal (Sundgot-Borgen & Torstveit, 2010). Conversely, feeding and eating disorders as outlined by the DSM-V, include behaviours associated directly with how and what an individual consumes for food. For example, individuals with the disorder Pica have compulsions to consume non-food items as food (e.g., soil, metals, chemicals, and hair) (American Psychiatric Association, 2013).

Once an individual begins to participate in behaviours that fall on the continuum and internalize the attitudes that accompany them, he or she is much more likely to move further along the continuum, engaging in more serious maladaptive eating behaviours (Sundgot-Borgen & Torstveit, 2010). DEAs affect between 0.4% to 4.78% of people between the ages of 15-24. While the disorder is found in both genders, approximately 10 females for every one male is at risk. The prevalence of DEAs are more common than clinical eating disorders (i.e., 0.4% – 1.5%) because they encompass such a wide spectrum of behaviours. In addition, the mortality rate of clinical eating disorders is as high as 5% due to the multitude of physiological health consequences that accompany the disorder (American Psychiatric Association, 2013). Another concerning statistic is the prevalence of DEAs in athlete populations. Due to the performance demands placed on athletes by their sport, this population is at a much greater risk for developing a DEA (Sundgot-Borgen & Torstveit, 2010). Recent studies suggest that the prevalence of DEAs in athlete populations is as high as 9% (Greenleaf, Petrie, Carter, & Reel, 2009).

### **Orthorexia Nervosa:**

Orthorexia Nervosa (ON) is a relatively new condition that has yet to be recognized by the DSM-V. The symptoms of the condition straddle both the DEA continuum and Obsessive-Compulsive Disorder (OCD) - like behaviours. Individuals with ON show an extreme obsession with healthy eating. A main difference between ON and other disordered eating attitudes is the

goal that the individual is trying to achieve. With most DEAs, individuals experience a drive for thinness whereas it could be argued that individuals with ON experience a drive for health (Dunn & Bratman, 2016). This obsession can lead to restricting certain foods, since they are perceived to be unhealthy for consumption. While the individual may initially choose to remove specific foods, this behaviour can snowball until he or she has restricted their food intake to the point of unintentional malnutrition. The food that orthorexics deem healthy and acceptable to eat is often meticulously weighed, calculated and double-checked for portion size, nutrients, and calories before consumption occurs. These behaviours often mirror those of high level athletes who need to be aware of the food they are using to fuel their body for sport performance (Haman, Barker-Ruchti, Patrikson, & Lindgren, 2015). Due to the individual's compulsion to control his or her food intake, orthorexics will often eat alone, alienating themselves from any social situation associated with meals. The disorder often has OCD-like symptoms, where individuals experience intrusive thoughts about food, and catastrophize what would occur if they were to eat unhealthy foods and feels compelled to participate in their behaviour in order to curb their obsession (Koven & Senbonmatsu, 2013). Prevalence data is hard to determine since literature on the disorder is lacking, and it is even uncertain which gender the condition affects more (Koven & Abry, 2015). However, there have been reports 6.9% of the population experiencing ON (Varga, Dukay-Szbabo, Tury, & van Furth Eric, 2013).

### **Risk Factors:**

Social and cultural norms have created an ideal body type that is usually preoccupied with thinness (Rohde, Stice, & Marti, 2015). Parents and peers of an individual often reinforce this sociocultural norm (van der Berg, Thompson, Obremski-Brandon & Covert, 2002). Internalization of information portrayed by the media as well as comparisons to the ideal body

type can result in body dissatisfaction and may lead to maladaptive eating behaviours (van der Berg et al., 2002).

The onset of DEAs rarely occurs before puberty or after the age of 40 and is found more commonly in females than males (DSM-V, 2013). Similar to other psychiatric disorders, genetics is a risk factor for DEAs. Individuals with a family history of psychological disorders are at an increased risk of about 7%-20% for developing a DEA (Klein & Walsh, 2004). Also, previous or current psychological disorders may increase the individual's risk of developing a comorbid DEA. Up to 90% of individuals with a DEA will experience a comorbid disorder (Godart et al., 2007).

### **Sport as a Risk Factor:**

While there are a variety of risk factors for the general population, high performance athletes are exposed to additional factors that may increase the likelihood of acquiring a disordered eating attitude. Sports that are judged, involve a weight class, or require strong endurance put the athlete at an increased risk (Sundgot- Borgen & Torstveit, 2010). Moreover, the level of competition of sport can also increase an athlete's risk. Disordered eating attitudes are reported in competitive athletes more than recreational athletes (Pitkanen, 2002).

Some sports require their athletes have a high strength to weight ratio in order to improve performance in their sport. A higher ratio allows athletes to move their bodies more efficiently over distances (i.e., horizontally or vertically). Athletes in sports with weight classes benefit from having a high strength to weight ratio as well (Sundgot-Borgen & Torstveit, 2010). Wrestlers often try to compete in a weight class lower than their normal weight resulting in a higher strength to weight ratio. To achieve this result, athletes partake in extreme weight control behaviours including purging, restrictive eating, and extreme dehydration by way of saunas and

sweat suits. Behaviour of this nature is tremendously dangerous and has resulted in death. In 1997, within a one month period, three wrestlers at the NCAA level died from dehydration (Lingor & Olson, 2010).

Judged and aesthetic sports pose as a risk of the eating behaviour of athletes (Voelker, Gould, & Reel, 2014). Factors for an aesthetic athlete to develop a DEA are two fold. The athlete may have poor body image and self-esteem, partaking in maladaptive eating behaviours in an effort to attain societal beauty standards and the ideal body type. However, the athlete may also use maladaptive eating behaviours for performance reasons. It is often advantageous for the athlete to meet ideal beauty and body standards, as it is implicitly more appealing for the judges to watch the execution of technical elements and may result in higher scores and increased performance (Ferrand, Champley, & Filaire, 2009; Martisen, Bratland-Sanda, Eriksson, & Sundgot-Borgen, 2010).

### **Statement of the Problem:**

The prevalence of DEAs in elite athlete populations is greater than that of non-athletes (Sundgot-Borgen & Torstveit, 2010). This high prevalence is due in part to the sport performance demands placed on the athletes (e.g., outcome importance, aesthetic elements, and judging). These demands may cause athletes to partake in disordered eating behaviours that allow them to strictly control their weight while maintaining a facade of overall health (Sundgot-Borgen & Torstveit, 2010). While studies have targeted DEAs in varsity athlete populations in the United States, little is known about the prevalence of DEAs in Canadian elite athletes. The difference in environment and sport performance demands from the varsity to the national level may affect the prevalence of DEAs and ON in the population. In addition, there is very little research on ON. However, as the concept of the DEA continuum continues to be studied and the

literature on sub-clinical eating disorders grows, exploring ON may contribute to the growing body of research on the topic. Participating in DEAs and ON can lead to serious psychological and physiological health consequences, the most severe of which result in hospitalization or, at the extreme, death (Klein & Walsh, 2004). At present, there is no information regarding who or how many athletes are currently struggling with a DEA or ON. The current research strives to inform the athletic community on this issue, and ultimately improve the health of Canadian elite athletes.

Furthermore, since ON is a fairly new DEA, there is little understanding of how to measure it. Currently there is only one diagnostic tool, and the validation studies of this tool are limited. The current research also hopes to contribute to the literature regarding the diagnostic method of ON.

**Purpose:**

The purpose of the study is two-fold. First, to determine the prevalence of DEAs and ON in the Canadian elite athlete population, and second, to conduct a factor analysis on the ORTO-15 to contribute to the literature about diagnostic and evaluation measures of ON. After data collection and analysis, results will be reported back the Canadian Sport Institutes across the country to help inform policy makers, athletes, and coaches about DEA and ON with the objective to improve education prevention and treatment of the disorders.

**Research Question:**

The current research set out to answer the question “What is the prevalence of disordered eating attitudes and orthorexia nervosa in Canadian elite athlete populations?”

**Hypothesis:**

Based on the high prevalence of DEAs in athlete populations, it is hypothesized that the results of this research would reflect that of previous studies (i.e., females and athletes in at risk sports would experience a higher rate of DEAs than males and athletes in low risk sports). The prevalence of DEAs would be consistent with the rates of DEAs in previously studied athlete populations. However, it is predicted that the prevalence of ON may be higher than that of DEAs because the symptomology of ON encompasses many common behaviours in elite sport (i.e., portion control, nutrient tracking, and calorie counting) (Haman et al., 2015).

**Research Design:**

For the present cross sectional study, 110 male and female national team athletes from all sport types were recruited from six Canadian Sport Institutes across the country and 55 National Sport Organizations. Participants were required to complete three questionnaires to develop an understanding of participant demographics and their eating attitudes. The ORTO-15 will measure symptoms of Orthorexia Nervosa while the EAT-26 will measure disordered eating attitudes. Participants will complete the demographic survey, ORTO-15, and EAT-26 online via Simple Survey, a Canadian internet-based survey software. Descriptive statistics were used to assess prevalence, frequency, and distribution of disordered eating attitudes.

**Significance:**

The current survey attempts to quantify the prevalence of disordered eating attitudes and orthorexia nervosa in Canadian elite athlete populations. While studies of this nature have been conducted on other athlete populations (e.g., varsity sport and American athletes), the current study is one of the few that are concerned with disordered eating and orthorexia nervosa in this specific population. Disordered eating attitudes affect 0.4% to 4.78% of people between the ages

of 15-24. While the disorder is found in both genders, about 10 females for every one male are at risk. In addition, the mortality rate of disordered eating attitudes is as high as 5% (American Psychiatric Association, 2013). Athletes are considered to be a population at a greater risk for developing an eating disorder. Studies suggest that the percentage of female athletes with some form of disordered eating ranges from 0%-9% (Greenleaf et al., 2009) and 1% of males (Petrie, Greenleaf, & Carter, 2007). While the prevalence of males who have been diagnosed with a clinical disordered eating attitude is lower than females, a study found that 16.6% of NCAA Division 1 males are symptomatic (Petrie et al., 2007). The alarming rate of disordered eating attitudes in other athlete populations makes it imperative that studies are conducted on Canadian elite athlete populations to understand the extent to which our athletes are effected. An exploratory study of this nature on DEAs and ON will contribute to the body of literature. Once there is an understanding of the population that disordered eating attitudes and orthorexia nervosa effects and the prevalence of disorder, further research can be conducted on risk factors, prevention and detection methods, and treatment. By presenting the research back to the Canadian Sport Institutes, policy makers, coaches and athletes will be educated on the topic and can use the research to inform the development of prevention and treatment strategies for at-risk athletes in the future. In addition, the factor analysis that will be performed on the ORTO-15 will further provide further evidence as to whether this questionnaire is a valid measurement tool for future studies.

Understanding and developing awareness, preventative interventions and treatment protocol for disordered eating attitudes and orthorexia nervosa in Canadian athlete populations will benefit and contribute to the health, mental well-being, and performance of our elite athletes who represent Canada on the world stage.

## **Chapter Two: Literature Review**

### **Disordered Eating Attitudes**

Originally thought to occur as distinct constructs, the theory that disordered eating attitudes (DEAs) exist on a continuum is now widely accepted in the psychology community (Shisslak, Crago, & Estes, 1995). The DEA continuum spans from healthy, normal eating at one end to clinical disorders at the other, and includes dieting behaviours, restrictive food intake, binge eating disorder, sub-clinical disorders like Eating Disorders Not Otherwise Specified (EDNOS), and clinical disorders like Anorexia Nervosa (AN) and Bulimia Nervosa (BN) (Sundgot-Borgen & Torstveit, 2010). Once an individual begins to participate in some form of disordered eating, he or she is much more likely to move down the continuum to more severe behaviours (Sundgot-Borgen & Torstveit, 2010). Since the continuum addresses the subtleties of DEAs and acknowledges all maladaptive eating behaviours, recognizing and managing initial risk factors for sub-clinical and clinical disorders becomes easier to do (Muazzam & Khalid, 2011).

It is easy to confuse disordered eating and eating disorders. While the two are similar, disordered eating refers to all forms of maladaptive eating behaviour. For instance, it may be that a certain individual will have some, but not all of the characteristics needed to be diagnosed with a clinical or sub-clinical eating disorder and an overlap in symptomology occurs. While this individual does not have an eating disorder, he or she is still partaking in maladaptive eating behaviour, which would be classified as disordered eating (Thomas, Vartanian, & Brownell, 2009). Eating disorders exist when an individual exhibits the symptoms that fit the criteria for a clinical disorder as defined by the Diagnostic Statistical Manual and includes such disorders as Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder (DSM-V, 2013).

The clinical disorders that exist on the DEA continuum fall under the DSM-V category of feeding and eating disorder, specifically under eating disorders. It is important to make the distinction between the two since feeding and eating disorders encompass different behaviours. Feeding disorders refer to how and what an individual consumes as food. For example, Pica, a feeding disorder, occurs where an individual may consume non-food materials as his or her main source of sustenance (e.g., paper, rocks, or metals). Conversely, eating disorders are particularly concerned with how an individual understands the relationship between food and his or her body composition (American Psychiatric Association, 2013).

The present study uses the term attitudes rather than behaviours as the two words hold different meanings (Goldschmidt, Aspen, Stinton, Tonofsky-Kraft, & Wilfey, 2008). Disordered eating begins with thoughts and feelings (attitudes) an individual holds about his or her body composition, that then result in maladaptive eating behaviours. For example, body dissatisfaction, poor body image, or negative affect may result in an individual restricting their food intake to change his or her body composition to something the individual finds more desirable (Rohde et al., 2015). Due in part to societal beauty standards, individuals with DEAs often strive towards a thinner body composition (Rohde et al., 2015). This drive for thinness is usually accomplished through behaviours resulting in an intentional negative energy balance (Sundgot-Borgen & Torstveit, 2010).

### **Orthorexia Nervosa**

Orthorexia Nervosa (ON) is a DEA that has a literal translation of “proper appetite” (Koven & Abry, 2015). Individuals with the condition exhibit an obsession with health, specifically an obsession with healthy eating. ON was conceptualized in the mid 1990’s. It is considered to be a fairly new DEA and has yet to be classified by the DSM-V. In the 1970’s, Dr.

Steven Bratman, an American physician was working as a chef at a commune outside New York City. It was there he observed extreme demands and behaviours of the individuals he was cooking for and chose to explore the phenomena during his work as a physician (Bratman, 1997). The literature on the disorder is limited as the American Psychological Association has yet to recognize ON in the Diagnostic Statistical Manual.

If one were to contrast ON with clinical disorders like AN and BN, it could be argued that while individuals with clinical eating disorders exhibit a drive for thinness, those with ON exhibit a drive for health. The symptomology of ON begins with what looks like positive, health-conscious eating behaviours. However, over a longer period of time the disorder can result in severe physiological and psychological health consequences (Koven & Senbonmatsu, 2013). While the individual may initially choose to remove certain processed or sugary foods, the behaviour can snowball until he or she has restricted their food intake to the point of unintentional malnutrition. The food that orthorexics deem healthy and acceptable to eat is often meticulously weighed, calculated and double-checked before consumption occurs. Due to the individual's compulsion to control his or her food intake, orthorexics will often eat alone, alienating them from any social situation surrounding meals (Koven & Senbonmatsu, 2013). The disorder often has OCD-like symptoms, where the individual experiences intrusive thoughts about food, catastrophizes what would happen if he or she were to eat unhealthy foods, and feels compelled to participate in certain behaviours in order to curb the obsession (Koven & Senbonmatsu, 2013).

Though some researchers have expressed concern over aspects of the DSM, the symptomology of most DEAs is widely accepted throughout the research and clinical community, specifically AN and BN. However, research on new DEAs like ON is emerging, and

requires a closer look. To date, ON is not yet classified in the DSM and has yet to be recognized as a mental illness. Therefore, research on ON is necessary to further our understanding, and must be done carefully and with scrutiny. For example, the questionnaire that has been developed for the classification of ON, the ORTO-15, has concerns over its validity (Dunn & Bratman, 2016). However, there is currently no other developed measures for ON, meaning that studies including the one conducted by Koven and Senbonmatsu in 2013 have no option but to use the ORTO-15 or develop their own measure. The potential lack of well-developed measures for ON studies raises questions about both the internal and external validity of current ON literature.

### **Clinical Eating Disorders – Anorexia Nervosa and Bulimia Nervosa**

Anorexia Nervosa (AN) and Bulimia Nervosa (BN) are clinical eating disorders where an individual experiences dissatisfaction with his or her current body composition coupled with an extreme fear of weight gain that leads to severe weight loss (DSM-V, 2013; Hagman et al., 2015). The disconnect between their perceived body image and their physical health can cause a drive for thinness that exacerbates their illness (Dickie, Wilson, McDowall, & Surgenor, 2012). The distinction between the two disorders is evident in the types of weight loss behaviour in which they engage. The two subtypes of AN include the restrictive subtype, where an individual achieves weight loss through calorie restriction and fasting, and the binge/purge subtype where the individual attempts to purge what little calories he or she does consume through self-induced vomiting or laxative use. Individuals with BN also participate in binge/purge behaviours. However, the individual will use purging methods as compensation for recent episodes of binge eating due to feelings of extreme guilt and fear associated with weight gain (Klein & Walsh, 2004).

Individuals will be diagnosed with an Eating Disorder Not Otherwise Specified (EDNOS) if he or she exhibits some, but not all, of the symptoms associated with AN and BN (Le Grange, Swanson, Crow, & Merikangas, 2012). While these individuals are considered to be a sub-clinical population, the psychological characteristics of the disorder may be equally as present as the clinical population (Thomas et al., 2009).

### **Tripartite Model**

The tripartite model provides an understanding of an etiological framework of disordered eating attitudes (DEAs). The connection between culture and eating behaviours is explored in this model, specifically eating behaviours, body image ideals, and perceptions of health (Markey, 2004). Research has unpacked pathways of influence, identifying family, peers, and the media as the three primary factors that mediate the internalization of cultural norms (van der Berg et al., 2002). There is often thought to be a culture surrounding high performance elite sport. The use of the tripartite model can lend an understanding of the relationship and influence sport culture has on athlete eating behaviours.

### **Eating Behaviours**

Cultural and social eating behaviours are taught at a young age by interactions with family and peers. Culture prescribes a number of eating norms including how to eat, how much to eat, the pace of meals, and what foods an individual will eat (Markey, 2004). In a culture that is preoccupied with a slender ideal body image, food preference is important. Nutritional content and quality of food is emphasized and individuals often avoid unhealthy foods (Markey, 2004). Food regulation may also be scrutinized in cultures with thin body ideals. Portion size and restrictive food intake that align with cultural body ideals are often abided by (Markey, 2004).

Meal times are usually social in nature, and family and peers can play a large role in the internalization of cultural eating behaviours.

### **Body Image Ideals**

Social and cultural norms create an ideal body type. Cultural understandings of beauty will influence the ideal body type resulting in a variation across cultures or changes to the ideal body type over time (Markey, 2004). For example, Euro-American individuals tend to desire a slender body, while African-American or Latino cultures idealize a larger size (Markey, 2004). Thin body ideals, like the one desired by Euro-American culture, are extremely difficult, if not impossible for the average person to attain (Streigel-Moore & Bulik, 2007). The media portrays unrealistic images of models that have been airbrushed or photo enhanced to a standard that is nearly impossible for anyone to reach (Streigel-Moore & Bulik, 2007). Exposure to thin body ideals starts at an early age and children begin to understand their body composition in relation to cultural body ideals (Markey, 2004). For example, Barbie, a doll that is a common toy among young children, is so thin that the probability of acquiring her body measurements is 1 in 100,000 (Norton, Olds, Olive, & Dank, 1996). Exposure to the portrayal of thinness and beauty in this way often results in unrealistic comparisons between social norms and an individual's body. Internalization of this social norm can cause individuals to draw comparisons between themselves and societal standards. These comparisons can be a catalyst for poor body image and low body esteem, leading to dissatisfaction with one's body composition (Rohde et al., 2015). For example, individuals with disordered eating attitudes often have a disturbed sense of their body image (Hagman et al., 2015). This failure in self-perception is called Body Image Distortion (BID), and the cause is two-fold. First, individuals have a skewed cognitive perception of their size and often overestimate their body composition. The second aspect of BID is related

to the individual's understanding of the "ideal" body type, self-esteem, and body satisfaction. Individuals with BID report that his or her body type does not match the one that they perceive to be ideal. The disconnect between his or her perceived body image and the ideal one can often create a drive for thinness in the individual (Hagman et al., 2015). In addition to media portrayals of body ideals, family and peers also play a role in influencing an individual's eating attitudes. Overweight individuals are often teased about their weight from their family and peers, and also experience indirect support for subscribing to the body image ideal (Markey, 2004; van der Berg et al., 2002). Individuals may perceive that others (e.g., family and peers) are dissatisfied in their body composition, which may result in the individual partaking in dieting behaviours (van der Berg et al., 2002).

### **Health Perceptions**

Cultural perceptions of health can influence an individual's eating behaviour. Again, there may be cross-cultural differences as well as changes over time as to what is viewed as healthy or unhealthy (Markey, 2004). For example, in the 1800's, overweight individuals were often considered to be healthy as they had access to proper nutrition and food while slender individuals were thought to be ill. This understanding of health has changed, and now those that are overweight are considered to be unhealthy (Markey, 2004). To be diagnosed with most eating disorders, the individual must possess an extreme fear of gaining weight or being overweight (American Psychiatric Association, 2013). In order to avoid making this fear a reality, the individual strives to obtain a thin body type. This desire to be thin causes the individual's thoughts to be consumed with his or her weight and food consumption, and motivates individuals to participate in disordered eating behaviours (Dickie et al., 2012). In addition to fear of gaining weight, if the person has a distorted body image, the drive to be thin may be stronger. This

misperception makes the discrepancy between their perceived body type and the ideal thin body type larger (Dickie et al., 2012).

Symptoms associated with disordered eating have also been recognized as unhealthy. However, there are cross-cultural differences in the understanding of mental health versus physical health (Markey, 2004). For example, an individual that presents with all psychological characteristics of disordered eating, but their physical health has yet to be affected may still be considered healthy, neglecting a diagnoses of the condition (Markey, 2004). Understanding cultural differences of health is important when looking at the etiology of DEAs.

### **Sport as a Risk Factor**

While there are a variety of risk factors for the normal population, sport culture exposes high performance athletes to additional factors that may increase the likelihood of developing a disordered eating attitude. Sports that are judged, involve a weight class, or require endurance put the athlete at an increased risk (Sungot-Borgen & Torstveit, 2010). Moreover, the level of sport at which the individual is competing can also increase his or her risk. Disordered eating attitudes are reported in competitive athletes more than recreational athletes (Pitkanen, 2002). The tripartite model states that culture influences eating behaviours, body image ideals, and health perceptions (Markey, 2004). The model could be used as an explanation as to why there is a difference in eating behaviours across sport types and competition levels.

Some sports require their athletes to have a high strength to weight ratio to improve performance. The higher ratio allows athletes to move their bodies more efficiently over distances (i.e., horizontally or vertically). For example, it is beneficial for gymnasts to have a high strength to weight ratio in order to jump higher; an additional two pounds on the athlete may result in poor performance (Sundgot-Borgen & Torstveit, 2010). The athlete understands

that to perform well, a ratio of this kind is important, and can influence the individual to change his or her eating behaviour in a way that will allow for this type of ratio to be possible. While the change in behaviour may initially fall on the less dangerous end of the disordered eating continuum as stated above, once an individual starts changing his or her eating attitudes, it is more likely that he or she will partake in more unhealthy eating behaviours, increasing their risk for developing a clinical eating disorder (Sundgot-Borgen & Torstveit, 2010).

Athletes competing in sports that have weight classes are also at an increased risk of developing a DEA (Sundgot-Borgen & Torstveit, 2010). The culture of weight class sports (i.e., wrestling, boxing) often promotes weight cutting. Athletes often try to compete in a weight class lower than their normal weight, an attempt to increase their strength to weight ratio and overpower their opponent whose ratio may not be as high. To achieve this desirable ratio, athletes partake in extreme weight control behaviours including purging, restrictive eating, and extreme dehydration through the use of saunas and sweat suits. Behaviour of this nature is tremendously dangerous and has resulted in death. In 1997 three male wrestlers at the NCAA level died in the span of one month from dehydration (Lingor & Olson, 2010). While there has been a push for policy to move away from weight cutting, changing athlete eating behaviour that is so deeply engrained in the sport culture of weight class sports may be challenging. The tripartite model notes that culture influences an understanding of what is healthy and what is unhealthy (Markey, 2004). It could be inferred using the tripartite model that the normalization of weight cutting in weight class sports may have influence the health perceptions of the athletes and coaches involved in the sport, disregarding the dangers of extreme weight control behaviours.

In addition, judged and aesthetic sports pose a risk for the eating behaviour of athletes (Voelker et al., 2014). While the execution of certain skills is explicitly scrutinized by judges, the appearance of the athlete may be implicitly adjudicated. With a strong emphasis placed on the appearance of the athlete, the culture of aesthetic sports can create an environment where the athlete feels the need to meet the norms of beauty and thinness standards (Ferrand et al., 2009). As previously mentioned, these body ideals are often hard to attain and can create behaviours that fall on the disordered eating continuum. Motivating factors for an aesthetic athlete to partaking in disordered eating behaviours may be two fold. The athlete may have low body image and self-esteem, using maladaptive eating and weight control behaviours to attain the ideal body type the culture of the sport promotes. However, the athlete may also develop disordered eating behaviours for performance reasons. It is often advantageous for the athlete to meet ideal beauty and body standards, as it is implicitly more appealing for the judges to watch the execution of technical elements and may result in higher scores and increased performance (Ferrand et al., 2009; Martisen et al., 2010). Research by van der Berg et al., has explored the influence of parents, peers, and the media in the development of maladaptive eating behaviours. It may be interesting for future research to explore the influence of coaches, teammates, opponents, and judges and the role they play in an athlete's eating behaviour.

### **Other Risk Factors:**

#### **Perfectionism**

Perfectionism can be described in a few different ways. *Neurotic perfectionism* is seen in individuals who strive for unrealistic goals and are driven by a fear of failure. In contrast, *normal perfectionism*, individuals strive for high, yet attainable goals and use failure as a learning experience (Bardone-Cone et al., 2007). Within both neurotic and normal perfectionism exists

positive and negative perfectionism. Similar to reinforcement theory, negative perfectionists are motivated by a reward that removes something undesired, while positive perfectionists are motivated by the addition of a reward (Bardone-Cone et al., 2007). In individuals with disordered eating attitudes, perfectionism is a common trait. The ideal body type acts as a goal for which to strive and fear of failure or gaining weight, acts as a motivator (Luo, Forbush, Williamson, Markon, & Pollack, 2013). When exploring perfectionism in those with DEAs, neurotic negative perfectionism is often apparent (Bardone-Cone et al., 2007).

### **Age and Gender**

Disordered eating attitudes are commonly considered to be a condition concerned with the individual's sense of self, values, beliefs, and belonging (Wood & Knight, 2015). The onset of disordered eating behaviours rarely occur before puberty or after the age of 40 (American Psychiatric Association, 2013). Individuals use their environment, social and cultural norms, and interactions with peers and family to create their own beliefs and values, shaping their sense of self (Benish-Weismen, Daniel, Schiefer, Mollering, & Knafo-Noam, 2015). Considering that adolescence is a time where the individual tries to create an understanding of the self, and that disordered eating is an egosyntonic disorder, one could argue that age is a risk factor for developing a disordered eating attitude (Stiegel-Moore & Bulik, 2007). The importance of beauty, thinness, and the ideal appearance is a societal norm that adolescents and young adults are susceptible to internalizing. Again, internalization of this norm may lead to body dissatisfaction, a common predictor for developing a DEA (Stiegel-Moore & Bulik, 2007).

Females are more likely to develop an eating disorder than males (DSM-V, 2013). The DSM-V states that the prevalence of anorexia nervosa and bulimia nervosa in females is 0.4% and 1% -1.5% respectively, while in males anorexia nervosa and bulimia nervosa rates are as low

as one male for every ten females effected (DSM-V, 2013). In the media, women are portrayed as thin while men are portrayed as muscular and strong. For most women to meet slender body ideals, participation in maladaptive eating behaviours may be the only way to achieve such a specific body composition (Striegel-Moore & Bulik, 2007).

### **Trauma**

Significant life events that cause psychological stress or trauma can increase ones risk for developing a psychological disorder. Childhood sexual abuse was recorded in 48% of participants in a study conducted in 2005 (Carter, Bewell, Blackmore, & Woodside, 2006). Individuals may feel as though they have a lack of control over occurrences in their life and turn to food restriction to compensate for said eating (Surgenor, Horn, & Hudson, 2003). However, this is only perceived control; as the disorder progresses it begins to directly control their behaviour (Klein & Walsh, 2004).

### **Genetics, Heritability and Comorbid Disorders**

Similar to other psychiatric disorders, there is an aspect of heritability in disordered eating attitudes. Individuals with a family history of psychological disorders are at an increased risk of about 7% - 20% for developing a disordered eating attitude (Klein & Walsh, 2004). In addition, previous or current psychological disorders may increase the individual's risk of developing a comorbid disordered eating attitude. Up to 90% of individuals with a disordered eating attitude will experience a comorbid disorder (Godart et al., 2007). Research suggests that those with Anorexia Nervosa have obsessive personality traits. In OCD, serotonin dysfunction has been recorded. Scientists are exploring serotonin function as a potential genetic marker for disordered eating attitudes, specifically Anorexia Nervosa (Klein & Walsh, 2004).

A study conducted by Wagner et al. (2008) suggested that there may be some neurobiological factors at work when exploring the causes of disordered eating. A fMRI study concerned with the relationship between food taste and reward centers compared individuals with disordered eating attitudes to a control group. When participants received a sugar water solution, those with an eating disorder recorded less neural activity in the insula and striatum, the areas associated with dopaminergic reward pathways, than those without an eating disorder. This suggests that individuals with disordered eating attitudes derive less pleasure from food and that there are clear neurobiological underpinnings to DEAs (Kaye, Wierenga, Bailer, Simmons, & Bischoff-Grethe, 2013).

### **Prevalence**

To date, the majority of research surrounding disordered eating attitudes specifically within athlete populations has been done in the in the United States. Moreover, the level of sport included in most of those studies is limited to the varsity level. There are limited studies addressing the prevalence of DEAs in Canadian elite athlete populations. The below prevalence data has been collected from a variety of sources and may not reflect the prevalence of DEAs in the population of interest in this study. However, it is important to understand the global prevalence of DEAs in both athlete and normal populations as to inform the present research.

### **Anorexia Nervosa**

Compiled in the DSM-V international studies from 1935-1999 to gather data on the prevalence of Anorexia Nervosa. The studies found that approximately 0.4% of females age 15-24 will experience the disorder (American Psychiatric Association, 2013). The disorder is more common females, with one male experiencing the disorder to every ten females (Klein & Walsh, 2004).

### **Bulimia Nervosa**

Prevalence of Bulimia Nervosa was also reported by the DSM-V at a rate of 1%-1.5% of females, usually developing during adolescence and young adulthood. There is the same 10:1 ratio of females to males with the disorder as there is with Anorexia Nervosa (Klein & Walsh, 2004).

### **Binge Eating Disorder**

Unlike Anorexia Nervosa and Bulimia Nervosa, Binge Eating Disorder is more common in males effecting 1.6% of the population, while only 0.8% of females have the disorder (DSM-V, 2013). The DSM-V also notes that this disorder is more common in ethnic minorities than Caucasians and also more common in those pursuing treatment for weight loss (DSM-V, 2013).

### **Orthorexia Nervosa**

Orthorexia Nervosa is not yet recognized by the DSM-V as a clinical disorder. Though literature on the disordered eating behaviour is increasing, there have been limited studies that target the prevalence of orthorexia in normal populations. While there have been reports of 6.9% of the population experiencing ON, more research is needed to understand the prevalence of the disorder (Varga et al., 2013). In addition, the survey tools that have been created to measure and diagnose ON have not been widely used and some validation studies have stressed using caution when administering the tool (Dunn & Bratman, 2016). Due to the lack of research on the disorder, there is no understanding of its occurrence in the general population.

### **EDNOS**

EDNOS was removed from the new edition of the DSM and replaced with Other Specified Feeding and Eating Disorders (OSFED) where no prevalence is stated. However, for the purpose of this paper, it is important to include the prevalence of the disorder, even if that

means drawing from data in the DSM-IV and the World Health Organization Composite International Diagnostic Interview (WHO CIDI). One study used cross-sectional surveys using criteria from the DSM-IV and WHO CIDI to determine the prevalence of EDNOS. They found that about 4.78% and 4.64% of adolescence and adults respectively, experienced the disorder (Le Grange et al., 2012).

### **Athlete Populations**

Athletes are considered to be a population at a greater risk for developing an eating disorder (Greenleaf et al., 2009). While generally the prevalence of DEAs is generally greater in athlete populations, the data follows similar trends of prevalence when isolating age and sex. Though prevalence studies are many, there has been a wide range of findings on how common the disorders actually are. This could be due to different access to athletes, their level of sport, or their type of sport. Studies suggest that the percentage of female athletes with some form of disordered eating range from 0%-9% (Greenleaf et al., 2009) and 1% of males (Petrie et al., 2007). While the prevalence of males who have been diagnosed with a clinical disordered eating attitude is lower than females, a study found that 16.6% of NCAA Division 1 males were symptomatic (Petrie et al., 2007). It is important to acknowledge that these statistics do not refer to a specific eating disorder, but rather all types of disordered eating attitude. The majority of athletes who do experience abnormal eating behaviour have EDNOS (Petrie et al., 2007).

Furthermore, when considering prevalence in athlete populations level of competition and type of sport need to be considered. Prevalence is more common with individuals competing at a high level and with individuals competing in a leanness or aesthetic sport (Sundgot-Borgen & Torstveit, 2010). Voelker et al., (2014) explored the prevalence of DEAs in figure skaters and found that 13.2% of elite figure skaters had been identified with an eating disorder, this is higher

than athletes who are not in aesthetic sports. As mentioned in the risk factors section, athletes in leanness or aesthetic sports may have performance as a motivating factor to start abnormal eating behaviours (Martisen et al., 2010).

### **Psychological Health Consequences**

Unlike most psychological disorders, the health consequences associated with disordered eating attitudes are both psychological and physiological. This can make treating disorders of this nature fairly difficult, and teams of physicians and psychologists are usually involved (Wood & Knight, 2015).

#### **Social Seclusion**

Additional psychological symptoms can present themselves beyond the initial disordered eating behaviour. Though some comorbid psychological disorders are eating disorder specific, some are experienced across the continuum. For example, DEAs hold a significant amount of stigma, causing most individuals to participate in these behaviours in private or secrecy (Schreiber-Gregory et al., 2013). Not only does this make it more difficult to detect if someone is partaking in disordered eating behaviours, it can also lead to social seclusion. Eating is often considered a social behaviour. By eating in private, or skipping meals that could be shared with friends or family, the individual isolates himself or herself from their social circles (Koven & Senbonmatsu, 2013). Another reason the individual may avoid eating in public or with friends/family is due to the lack of control he or she has over their meals. This is often the case in AN and ON, as the individual may be unaware of the ingredients, calories or nutrients in the meal. In addition, when eating with others, they may feel pressured to eat more than they normally would, given that they usually eat alone (Koven & Senbonmatsu, 2013).

## **Anxiety**

Maintaining a sense of control is important for those with disordered eating attitudes. A lack of control over the food they are consuming can cause the individual to experience anxiety (Koven & Senbonmatsu, 2013). Anxiety symptoms can be a strong motivator for a person to avoid scenarios that may result in a similar emotional response leading to further social seclusion. Moreover, the need for control can lead to a lack of spontaneity and in an individual with DEA (Kaye et al., 2013).

## **Obsessive Compulsive Disorder**

The need for control over food consumption can often mirror OCD-like symptoms. Similar to OCD, individuals with DEAs find themselves preoccupied with certain intrusive thoughts, in this instance, food consumption and weight gain. They are compelled to participate in certain eating behaviours like restrictive eating or purging, in order to curb their obsessions with weight and food intake. If they do not participate in the behaviours, they may experience anxiety or catastrophize the possible outcomes that may occur as a result ( American Psychiatric Association, 2013; Koven & Senbonmatsu, 2013).

## **Depression**

Depression is a mood disturbance that frequently accompanies disordered eating attitudes (DSM-V, 2013). While it is sometimes hard to tell which comes first, eating disorders are often predictors for mood disorders. Some may argue that this is because depression and disordered eating contain many similar symptoms (Godart et al., 2007). Low self-esteem, negative mood, irritability, self-doubt, insomnia and a lower libido are seen in those with disordered eating and those who are experiencing depression (Dobmeyer & Stein, 2003).

## *Cognitive Deficits*

Studies have been conducted to determine the effects of disordered eating behaviours on cognition. Executive function and cognitive flexibility is impaired in those with disordered eating attitudes. A study in 2013 used the Wisconsin Card Sort Task to measure executive function and set shifting in individuals with orthorexia nervosa, anorexia nervosa, OCD, and controls. Set shifting requires inhibition of previously learned rules and the flexibility to apply new rules to different situations. Individuals who exhibited more disordered symptoms scored worse on the task than those who had less symptoms, implying that executive function, set shifting, and cognitive flexibility are impaired in those with the anorexia nervosa, orthorexia nervosa, and OCD (Koven & Sobenmatsu, 2013). Individuals with the three disorders in study follow strict rules and routines. Parallels can be drawn from the behaviours that these individuals partook in and his or her performance on the Wisconsin Card Sort Task (Koven & Sobenmatsu, 2013). The same study found individuals with disordered eating attitudes have less awareness of their affect (i.e., due to their increased self-monitoring) on other people due to their elevated focus on themselves (Koven & Sobenmatsu, 2013).

### **Physiological Health Consequences**

The malnutrition and dehydration caused by disordered eating behaviours can have physiological health consequences that have a large range in severity. Disturbances in sleep patterns to organ failure have been physiological consequences reported in individuals with disordered eating attitudes. Treatment for the psychological portion of the disorder is equally as important as the physiological symptoms in order to get to the root of the problem (Wood & Knight, 2015).

A slow heart rate (bradycardia) and low blood pressure (hypotension) are common in individuals with Anorexia Nervosa. (Yahalom et al., 2013). Rapid weight loss is also known to

cause a build up of fluid in the heart (pericardial effusion). Decreased heart mass, heart disease, arrhythmias, and chest pain are also reported in individuals with severe disordered eating behaviour (Mehler & Brown, 2015; Mehler et al., 2004). In addition, DEAs decrease an individual's lung capacity and increase the risk of the person developing (a collapsed lung) and pneumoperitoneum (the presence of gas in the abdomen) (Mehler & Brown, 2015).

A heavy reliance on laxatives, as seen in BN cases, can lead to chronic constipation or inflammatory bowel disease (Mehler & Brown, 2015; Mehler et al., 2004). In Bulimia Nervosa, ulcers on the stomach lining and the esophagus are common as well as esophagitis and sometimes, in severe cases, esophageal ruptures. Health consequences surrounding the esophagus are due to the prolonged exposure to stomach acid from self-induced vomiting. Exposure to stomach acid has also caused tooth erosion and mouth ulcers (Mehler et al., 2004).

Cerebral atrophy is a result of extreme AN. The atrophy can be so severe that fMRI scans of those with Anorexia Nervosa can be comparable to those with Alzheimer's (Mehler & Brown, 2015). There are no reported neurological effects of Bulimia Nervosa. The most common endocrine consequence in individuals with disordered eating attitudes is amenorrhea, a lack of menstruation (Vale et al., 2013). Oligomenorrhea may be present in individuals with Bulimia Nervosa, specifically during binge eating episodes (Mehler et al., 2004). The effect on sex hormones can slow growth in adolescents and even cause infertility (Mehler & Brown, 2015).

Research surrounding the *Female Athlete Triad* is growing. This syndrome occurs when the individual has disordered eating, amenorrhea and osteoporosis. The female athlete triad is common in athletes competing endurance and leanness sports (Weiss Kelly & Hecht, 2016).

Other less severe symptoms are also associated with disordered eating attitudes. Individuals may experience sleep disturbances and fatigue from the lack of caloric energy they are consuming. Due to lack of body fat, the body may begin to grow extra hair in order to keep warm, this is called *Lanugo* hair and grows commonly on the face and spine. The individual also becomes more susceptible to hypothermia. If weight loss is very extreme, the body will deplete fat stores and begin to break down proteins in the muscles, individuals with severe disordered eating behaviours are usually very weak (Wood & Knight, 2015). Eating disorders can have dire consequences. The result of severe disordered eating and the physiological symptoms that accompany the disorders can be death. Individuals with anorexia nervosa and bulimia nervosa have mortality rates of 4.0% and 3.9% respectively (Crow et al., 2009).

### **Prevention, Detection, Treatment, and Management in Athlete Populations**

Participation in high-level sport increases an individual's risk of developing a disordered eating attitude (Sundgot-Borgen & Torstveit, 2010). However, treatment, prevention, and management of the disorders are unique in athlete populations (Sherman & Thompson, 2001). Often, athletes participate in disordered eating behaviours as a means to improve sport performance (Sundgot-Borgen & Torstveit, 2010). While nutrition plans can help an athlete achieve the necessary nutrients for their bodies to perform in their sport, when taken to an extreme, eating behaviours can begin to harm sport performance, and more importantly their overall physiological and psychological health (Bonci et al., 2008). Prevention of disordered eating should be the first step in managing disordered eating attitudes in sport, but if the behaviour becomes severe, treatment plans and return to play protocols need to be followed.

## **Prevention and Detection**

Preventing disordered eating behaviours should be the top priority of sport bodies (Bratland-Sanda & Sundgot-Borgen, 2013). One way to help prevent disordered eating attitudes is through targeted education of athletes and their coaches (Martinsen et al., 2014). Creating an understanding of the risk factors (e.g., type of sport, gender, low body-esteem, sociocultural factors, and comorbid illnesses), as well as identifying symptoms that are common in individuals with the disorder can be key to preventing or detecting disordered eating behaviours early (Bonci et al., 2008). However, it is important to recognize that while disordered eating attitudes usually effect certain populations more than others, awareness of DEA's in males, and low risk sports is still important for prevention and detection (Bonci et al., 2008). Holding workshops or sessions for athletes, their families, and the coaches is important, however follow up sessions are necessary to check in with the athlete to assess their eating behaviours (Bonci et al., 2008).

Coaches play a vital role in the prevention and detection of disordered eating attitudes (Martinsen et al., 2014). Coaches spend a significant amount of time with the athletes, are in a position to develop a strong rapport, and can exercise a lot of influence over the athlete. Martinsen et al., (2014) created an education program for coaches that encompassed nutrition, physiology, detecting and managing disordered eating, some psychological skills training, and self-esteem. The study found that coaches who had participated in the program had fewer athletes with disordered eating attitudes than those who did not participate in the program (Martinsen et al., 2014).

Policy is being implemented at a governing body level to help mitigate the risks of their athletes obtaining a disordered eating attitude. For example, after three college wrestlers died during a month-long time span due to severe dehydration, the NCAA implemented protocol that

banned the use of saunas, participation in restrictive eating, and the use of sweat suits. This was done with the intent to curb practices that put athletes at serious risk during competition (Lingor & Olson, 2010). In addition, the protocol surrounding weigh-ins and dehydration tests have been changed in hopes to decrease the number of athletes partaking in harmful disordered eating behaviours (Lingor & Olson, 2010).

Governing bodies have also recommended that screening methods be used to assess the eating behaviours of athletes as well as their thoughts and feelings surrounding body esteem and their relationship to food (Bonci et al., 2008). Monitoring of physiological symptoms should occur frequently to evaluate any weight fluctuations or nutrient deficiencies that may be caused by disordered eating behaviour. The National Athletic Trainers' Association recommends that check-ins should occur every 2 to 3 months (Bonci et al., 2008).

### **Treatment and Management**

While treatment for disordered eating attitudes in athletes generally uses the same tools that would be used in normal populations, there are factors of disordered eating in athlete populations that can be both challenging and beneficial for their treatment (Sherman & Thompson, 2001). The physicians and psychologists involved in treatment need to understand the culture of the sport the athlete is competing in as well as disordered eating behaviours to create a plan that will be the most comprehensive and effective for the athlete (Sherman & Thompson, 2001). For example, a wrestler who participates in binge-purge behaviours will have different motivators for engaging in that behaviour than a non-athlete (Bratland-Sanda & Sundgot-Borgen, 2013). Understanding the motivating factors that cause the athletes to participate in unhealthy eating behaviours can inform treatment protocols (Sherman & Thompson, 2001).

One example of the athletic environment being both beneficial yet challenging to treatment is the number stakeholders that are to be included in the treatment process (Bonci et al., 2008). In addition to family members, psychologists and physicians, athlete treatment includes the participation of coaches, trainers, and sometimes teammates (Sherman & Thompson 2001). While the addition of people involved in the treatment group can improve support for the individual, it can also increase the chances of those people hindering the treatment process. Because of this, it is important that everyone involved in the process is trained properly to help the individual with his or her disorder (Bonci et al., 2008).

Creating healthy eating behaviours and restoring the individual's weight when necessary usually poses a challenge in treatment for those with disordered eating attitudes. However, in athletes the individual may not only be concerned about his or her body image, but they also have to consider their sport performance, and the impact their new diet will have (Sherman & Thompson, 2001). The athlete may be reluctant to participate in new eating behaviours for fear of a negative effect on their sport performance (Bonci et al., 2008). Although the added motivators can make treatment more difficult, some athletes also have access to a dietician that can help them feel more comfortable about the refeeding process (Arthur-Cameselle & Quatromoni, 2014). Working intensively with a dietician, the athlete can create a plan that will not only create healthier eating behaviours, but also give them the necessary nutrients for their sport (Bonci et al., 2008).

Due to the nature of disordered eating attitudes in athletes, outpatient treatment settings usually meet the needs of the athlete since the severity of their disorder tends to be mild (Bonci et al., 2008). In addition, certain treatment and therapy protocols for disordered eating

behaviours are more effective for certain individuals than others. With this in mind, the treatment team should use a protocol for the athlete that fits their needs.

### **Return to Play Protocol**

In some cases, disordered eating behaviours may be so severe that the athletes needs to withdraw from their sport to seek proper and intensive treatment or because the disordered eating behaviour has made participating in sport a severe health risk (Joy et al., 2014). Joy et al. developed a return to play protocol for athletes experiencing female athlete triad. While the protocol is intended for this population, assessments for other athletes can be made using similar protocol that omits bone mineral density tests (Joy et al., 2014).

The protocol begins by evaluating the athlete's health. Patient demographics, history of family mental illness, genetics, comorbid psychological disorders, along with previous medical history should be considered. In addition, physiological symptoms associated with disordered eating (e.g., bradycardia, low BMI, and amenorrhea) and specifically for the female athlete triad, bone mineral density needs to be taken into consideration. After an evaluation of the athlete's health, evaluation of the risk of returning to participate in sport needs to occur. The type of sport, and level of sport are taken into consideration as possible risk factors for the individual. Lastly, any other variables such as the timing within the season, potential conflicts of interest including scholarships or sponsorships are evaluated as well as the athlete's willingness to return to their sport and the opinions of coaches and family members are taken into consideration (Joy et al., 2014)

### **Conclusion**

Disordered eating attitudes include a variety of nuanced thoughts, feelings, and behaviours ranging from dieting behaviours to clinical disorders. Genetic and environmental

factors can put an individual at risk for developing a DEA, specifically elite sport. Participation in DEAs can have severe psychological and physiological health consequences. The combination of the two can make treatment difficult for those affected with DEAs and must be tailored to fit the needs of an individual. Prevention, treatment, and management is especially important for athlete populations as the environment of elite sport can exacerbate illness. Further research is needed to understand DEAs in athlete populations and will contribute to the health, mental well-being, and performance of the elite athletes.

## Chapter Three: Methodology

### Research Questions

The primary objective of the current study is to understand the prevalence of disordered eating attitudes and orthorexia nervosa in Canadian elite athlete populations. The research set out to explore the following questions:

- 1) What is the prevalence of disordered eating attitudes and orthorexia nervosa in Canadian elite athlete populations?
- 2) What is the prevalence of disordered eating attitudes and orthorexia nervosa among different demographics (i.e., sport type, gender, level of competition) in Canadian elite athlete populations?
- 3) Are there associations between specific demographics and scores on the ORTO-15 and EAT-26?
- 4) Is there a relationship between scores on the EAT-26 and the ORTO-15
- 5) Is the ORTO-15 a valid and reliable measure?

### Operational Definitions

<b><i>Term</i></b>	<b><i>Operational Definition</i></b>
Disordered Eating Attitudes (DEAs)	A continuum of maladaptive eating behaviours that include dieting, abnormal food intake, subclinical, and clinical eating disorders (Sundgot-Borgen & Torsveit, 2010). Measured using the EAT-26.
Orthorexia Nervosa (ON)	Encompassing both DEA and OCD type symptoms, individuals experience an extreme obsession with healthy eating that may lead to malnutrition and other severe health consequences (Koven & Abry, 2015). Measured using the ORTO-15
Elite Athlete	An individual competing at an international or national level. Olympic sports and Pan-American sports are included.

Eating Attitudes Test – 26 (EAT-26)	The EAT-26 is used to measure disordered eating attitudes across the DEA continuum. Scores over a threshold of 20 suggest the individual is at risk or experiencing a DEA (Garner, Olmsed, Bohr, & Garfinkel, 1982).
Orthorexia -15 (ORTO-15 )	This measure targets both disordered eating attitudes and obsessive compulsive behaviours associated with Orthorexia Nervosa. Scores under a threshold of 40 are considered to be at risk or experiencing ON (Donini, Marsili, Graziani, Imbriale, & Canella, 2005).

Table 1. Operational Definitions

## Research Instruments

### Eating Attitudes Test -26

The Eating Attitudes Test- 26 (EAT-26) is a 26-item questionnaire that addresses eating behaviours associated with disordered eating attitudes and screens for clinical eating disorders (Ocker, Lam, Jensen, & Zhang, 2007). While this is not a diagnostic measure, it can give valuable insight into the eating attitudes of the individual. The measure, created by Garner and Garfinkel in 1982, was adapted from the EAT-40, a forty-item questionnaire that is considered to be a valid and reliable measure (Ocker et al., 2007). The shorter version, the EAT-26, is considered to be a valid and reliable measure when exploring DEAs. It is highly correlated to the EAT-40 ( $r=0.98$ ) and has relatively high internal consistency with Cronbach's alpha at 0.72 (Garner, Olmsed, Bohr, & Garfinkel, 1982). Consisting of three subscales, the questions within the EAT-26 target specific behaviours and attitudes associated with dieting, bulimia and food preoccupation, and oral control. Questions in the dieting subscale target body image disturbances such as drive for thinness and size overestimation. The bulimia and food preoccupation subscale explore binge and purge behaviours as well as repetitive thoughts about food. Lastly, the oral control subscale evaluates restrictive food intake and perceived outer pressure to gain weight (Garner et al., 1982). The EAT-26 is a self-report measure where individuals respond to a

statement on a 6-point Likert scale that includes *1- always to 6- never*. The answers to questions 1-25 on the EAT-26 are scored as follows; *Always* = 3, *Usually*, = 2 *Often* = 1, other answers are given a value of 0, while the 26<sup>th</sup> question is scored in reverse. Responses are scored and totaled. Scores over 20 indicate the individual is experiencing a disordered eating attitude. In addition to the first 26 questions, there are five behavioral questions that touch on behaviours associated with bulimia (e.g., laxative abuse and self-induced vomiting). These are particularly concerning behaviours if an individual partakes in any of them it is recommended that her or she seek an evaluation by a mental health professional (Garner et al., 1982). The EAT-26 was selected for the current study over the EAT-40 to diminish any potential participant fatigue that may come with completing an online survey. Extensive statistical analysis both by the survey creators, and other researchers have confirmed that the EAT-26 is an equally reliable and valid measure for screening DEAs and eating disorders.

### **ORTO-15**

The ORTO-15 is one of two measures that have been created to measure Orthorexia Nervosa. The ORTO-15 was selected over the Bratman Orthorexia Test (BOT), due to the lack of validation or reliability studies conducted on the BOT. While the ORTO-15 also lacks a large amount of research on its psychometrics, there have been a few studies exploring its validity and reliability. The measure targets both disordered eating attitudes and obsessive-compulsive behaviours associated with Orthorexia Nervosa. Questions include concern over health status, obsessive thoughts about food consumption, and control over eating habits among others. Validation studies have found the measure to have a positive predictive value of 17.6% and a negative screening value of 100% (Donini, Marsili, Graziani, Imbriale, & Canella, 2005). There are few studies reporting internal consistency of the ORTO-15, with Cronbach's alpha levels

ranging from 0.14 to 0.70 (Koven & Abry, 2015). The survey is a self-report measure using a 4 point Likert scale including the responses *1 –always to 4-never*. Responses are scored and totaled with scores ranging between 15 and 60. If an individual fails to reach a score above 40, he or she is considered to be at risk for Orthorexia Nervosa (Dunn & Bratman, 2016).

### **Demographic Questionnaire**

Participants were asked to fill out a number of demographic questions including their age, gender, type of sport, level of competition, level of success, any previous mental health diagnoses, current height, weight, and desired weight. Gender, as opposed to sex, was selected for this study due to the social constructs that accompany disordered eating attitudes. Individuals were asked to identify as male or female. Individuals were also given the option to select other or opt out of disclosing gender. Individuals also reported the sport that they participate in. Level of competition was classified as either international or national. Level of success was broken into categories regarding how the athlete is ranked in their sport (i.e., one to five, six to ten, eleven to fifteen, sixteen to twenty, and twenty-one or lower). Individuals also reported the number of podium performances they have had in the past two years. Previous mental health diagnoses required the individual to disclose if he or she has been diagnosed with Major Depressive Disorder, Generalized Anxiety Disorder, Obsessive Compulsive Disorder, Anorexia Nervosa, Bulimia Nervosa, Eating Disorders Not Otherwise Specified, or another disorder. These mental illnesses are commonly associated comorbid disorders to DEAs (Klein & Walsh, 2004).

### **Research Protocol**

#### **Study Design**

Ethics approval was obtained from the CHREB and the University of Calgary (REB16-027). Male and female participants over the age of 18 were recruited for the study through

Canadian Sport Institutes and National Sport Organizations. Email was used to contact sport directors, high performance directors, head coaches, and team managers. The email outlined the basic information on the topic of interest and study design, the role of the participant, and the link to the survey. Those who received the initial contact email were asked to forward the survey link and the information to athletes they worked with directly should they choose to participate. Anonymity and privacy was emphasized for all participants involved.

The questionnaire was hosted online using the survey software Simple Survey. The server is based in Canada and abides by Canadian privacy laws. Data held on the software are retained as long as the account with the survey is active. While the account is in use, the data are stored and managed in a secure manner. To participate, individuals simply clicked on the link that was sent to them via email.

### **Participants and Sample Selection**

Individuals competing at a national or international level were recruited for the study. To be recruited, individuals must be actively training (off-season) or competing with a national or international team. Injured athletes, or athletes under the age of 18 were not recruited for the study. In addition, Paralympic athletes were not recruited for the study since they may have other health concerns that impact their eating behaviours. As the aim of the study was to determine prevalence, there was no set number of participants.

The demographic questionnaire, EAT-26, and ORTO-15, were administered to 72 participants electronically via SimpleSurvey, an online survey software. Fifty-five national sport organizations and six Canadian Sport Institutes were contacted to participate in the study. The researchers relied on snowball sampling to recruit a convenient sample of participants.

## **Analysis**

Descriptive statistics (e.g., frequency, distribution, mean, median, and mode of scores on both questionnaires) were used to understand the prevalence of both disordered eating attitudes and Orthorexia Nervosa in the sample. Scores on the EAT-26 and the ORTO-15 were analyzed to determine the percentage of the population with disordered eating attitudes and/or Orthorexia Nervosa. Linear regression analysis was used to explore a possible relationship between scores on the EAT-26 and ORTO-15. As the ORTO-15 is a fairly new measure, this analysis helped create an understanding of the measure. Chi-squares were also conducted to determine any associations between other factors (i.e., gender, sport type, level of success) and scores on each questionnaire. Due to the recent development of the ORTO-15, this questionnaire has limited studies confirming its validity and reliability. Thus, a factor analysis was performed upon completion of data collection to determine the validity of the measure. An exploratory factor analysis (EFA) was conducted to determine the factors in the ORTO-15 and participant responses based on these factors. An EFA will determine the factors in a questionnaire by using regression coefficients to analyze how much each variable or question effects a group of variables (Fabrigar, MacCallum, Wegener, & Strahan, 1999).

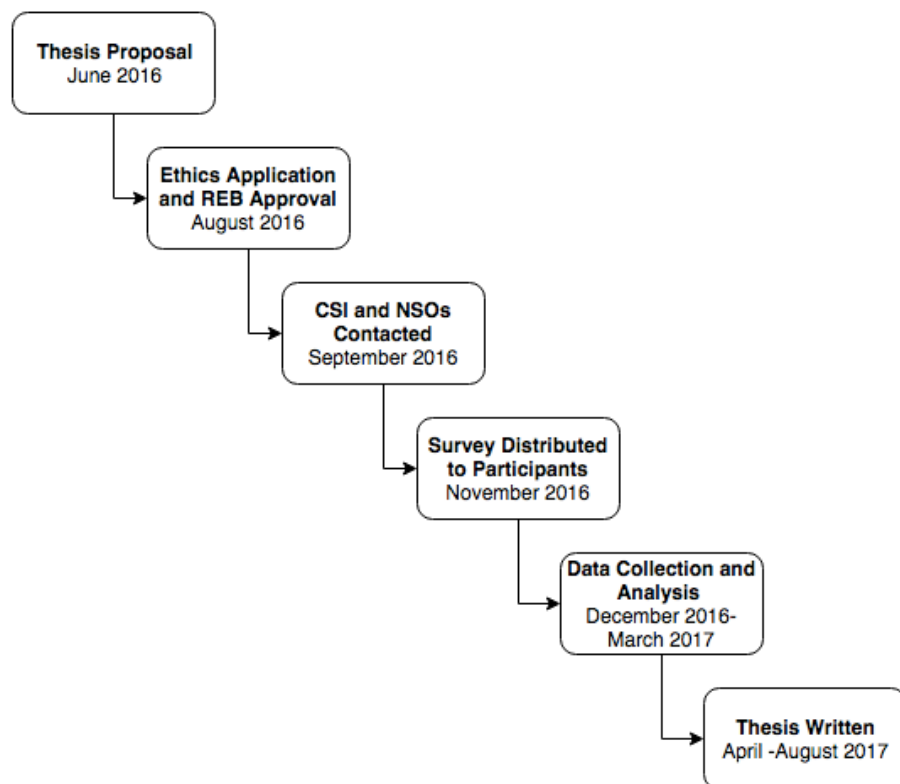


Figure 1. Flow chart outlining the research process taken for the current study.

## **Chapter Four: Results**

### **Descriptive Statistics**

Initially, 110 participants logged in and started the survey, however, after data cleaning, the current study has 72 completed surveys ( $N=72$ ). Participants included 36 males and 36 females with an average age of 23.14 years ( $SD=4.97$ ). Participants represented 22 different sports; Alpine Skiing ( $n=5$ ), Artistic Gymnastics ( $n=9$ ), Athletics ( $n=1$ ), Distance Running ( $n=2$ ), Biathlon ( $n=1$ ), Cycling ( $n=2$ ), Diving ( $n=1$ ), Figure Skating ( $n=4$ ), Freestyle Skiing ( $n=5$ ), Judo ( $n=1$ ), Lacrosse ( $n=1$ ), Luge ( $n=2$ ), Sailing ( $n=1$ ), Soccer ( $n=1$ ), Speed Skating ( $n=6$ ), Sprint Canoe ( $n=2$ ), Sprint Kayak ( $n=2$ ), Squash ( $n=5$ ), Trampoline ( $n=3$ ), Triathlon ( $n=11$ ), Water Polo ( $n=2$ ), Water Skiing ( $n=5$ ). Participants competed at either a national ( $n=15$ ) or international level ( $n=57$ ) and had an average of 4.94 ( $SD= 5.73$ ) podium performances over the past two competitions seasons. Participants were asked to report their height and weight to calculate BMI. The average BMI among participants was 22.50 ( $SD=2.26$ ). Ideal weight was also reported by the participants, with only 22.2% currently at their ideal weight. The amount of participants that reported previously experiencing a mental health diagnoses was 19.44%.

### **Prevalence**

The Eating Attitudes Test -26 (EAT-26) consists of 26 questions that include three subscales addressing disordered eating attitudes (i.e., dieting, bulimia and food preoccupation, and oral control). Each question is given a score out of six (e.g., 1-always to 6- never) and responses are totaled. An individual is considered to be at risk for a DEA according to the EAT-26 if he or she obtains a score of over 20. The prevalence of those with scores over 20 and therefore categorized with a disordered eating attitude is 13.9% of all participants (10 out of 72 participants). The prevalence breakdown by gender is as follows, 19.4% of females (7 of 36) and

8.3% of males (3 of 36). Of those competing at an international level, 12.2% (7 of 57) are considered symptomatic while 20% (3 of 15) of national level participants reach scores over 20. The sports where participants scored over 20 on the EAT-26 were Alpine Skiing, Artistic Gymnastics, Freestyle Skiing, Triathlon, and Water Polo. The EAT-26 also includes behavioural questions. If an individual reports partaking in these behaviours, it is suggested they seek help from a professional. Those that reported partaking in concerning behaviours was 22.2% (16 of 72) of the participants.

The ORTO-15 measures Orthorexia Nervosa by including questions that target disordered eating attitudes and obsessive-compulsive behaviours associated with the condition. The questionnaire consists of 15 items that are scored and totaled. For an individual to be considered to be at risk for Orthorexia Nervosa and fall into the symptomatic category, the participant must score under 40 on the ORTO-15. The prevalence of individuals with scores under 40 was 75% (51 of 68 participants). By gender, 80% of females (28 of 35) and 69.6% of males (23 of 33) scored under 40 on the ORTO-15. International level of competition saw a prevalence of 74.5% (41 of 55), while national level of competition was recorded at 76.9% (10 of 13). Every sport included in the study (i.e., Alpine Skiing, Artistic Gymnastics, Athletics, Distance Running, Biathlon, Cycling, Diving, Figure Skating, Freestyle Skiing, Judo, Lacrosse, Luge, Sailing, Soccer, Speed Skating, Sprint Canoe, Sprint Kayak, Squash, Trampoline, Triathlon, Water Polo, Water Skiing) had at least one athlete with a score under 40.

### **Associations**

Pearson Chi Square tests were used to identify any potential associations between scores on the survey tools and the demographic data recorded. Participants were categorized as either being symptomatic or asymptomatic on both the EAT-26 and the ORTO-15.

There was no significant association between gender for both the EAT-26,  $X^2(1, 72, 1.858 p= 0.173)$  and the ORTO-15,  $X^2(1, 68, 0.962 p=0.327)$ .

EAT-26		Gender		Total
		Female	Male	
Asymptomatic	Count	29	33	62
	% within Gender	80.6%	91.7%	86.1%
Symptomatic	Count	7	3	10
	% within Gender	19.4%	8.3%	13.9%
Total	Count	36	36	72
	% within Gender	100.0%	100.0%	100.0%

Table 2. Frequencies and percentages EAT-26 symptomatic groups and gender.

ORTO-15		Gender		Total
		Female	Male	
Asymptomatic	Count	7	10	17
	% within Gender	20.0%	30.3%	25.0%
Symptomatic	Count	28	23	51
	% within Gender	80.0%	69.7%	75.0%
Total	Count	35	33	68
	% within Gender	100.0%	100.0%	100.0%

Table 3. Frequencies and percentages ORTO-15 symptomatic groups and gender.

There was no significant association between level of competition and symptomatic status on the EAT-26,  $X^2(1, 72, 0.592, p= 0.442)$ . There was no significant association between level of competition and symptomatic status on the ORTO-15,  $X^2(1, 68, 0.032, p= 0.859)$ .

		Level of Competition		
		1.00 Internatio nal	2.00 National	
EAT-26				Total
Asymptomatic	Count	50	12	62
	% within group	87.7%	80.0%	86.1%
Symptomatic	Count	7	3	10
	% within group	12.3%	20.0%	13.9%
Total	Count	57	15	72
	% within group	100.0%	100.0%	100.0 %

Table 4. Frequencies and percentages EAT-26 symptomatic groups and level of competition.

		Level of Competition		
		1.00 Internatio nal	2.00 National	
ORTO-15				Total
Asymptomatic	Count	14	3	17
	% within group	25.5%	23.1%	25.0%
Symptomatic	Count	41	10	51
	% within group	74.5%	76.9%	75.0%
Total	Count	55	13	68
	% within group	100.0%	100.0%	100.0 %

Table 5. Frequencies and percentages ORTO-15 symptomatic groups and level of competition.

A Mann-Whitney U test was used to determine any significant association between level of success and symptomatic status on the EAT-26 and ORTO-15. There was no significant difference between level of success and the EAT-26 ( $U= 254.00, p=0.415$ ). There was a signification difference between level of success and status on the ORTO-15 ( $U=246.50, p=0.009$ ).

## Regression

Linear regression analysis was used to determine the existence of any relationships within the data. The relationship between scores on the ORTO-15 and the EAT-26 was analyzed as well as the relationship between BMI and scores on the ORTO-15 and EAT-26.

There was a significant relationship found between scores on the EAT-26 and the ORTO-15 ( $F(1,69) = 4.571, p = 0.036$ ) with an  $r^2$  of 0.062. While significant, the relationship between scores on the two measures is weak.

There was no significant relationship found between scores on the EAT-26 and BMI ( $F(1,70) = 1.180, p = 0.281$ ) with an  $r^2$  of 0.017. There was also no significant relationship found between scores on the ORTO-15 and BMI ( $F(1,69) = 1.941, p = 0.544$ ) with an  $r^2$  of 0.005.

## Exploratory Factor Analysis

The ORTO-15 is a fairly new measure with few studies on its validity and reliability. To gain an understanding of the construct validity of the measure being used in the current study, an exploratory factor analysis (EFA) was conducted on the ORTO-15. A Kaiser- Meyer – Olkin test of adequate sampling (KMO) and Bartlett's Test for Sphericity were conducted initially to determine the suitability of our sample for the EFA. The KMO revealed an adequate sample at 0.7 as well as the Bartlett's Test for Sphericity at  $p < 0.001$ . The EFA in this study identified five factors within the ORTO-15. The first factor, named *emotional status*, includes statements about worry, guilt, and confusion about food choices. This factor is strong, with a cronbach's alpha level of 0.812. The second factor, *health perceptions*, involves questions that focus on the participant's understanding of the perceived benefits of eating healthy. This scale reported a cronbach's alpha level of 0.633. The third factor, *conscious choices*, is concerned with an individual's choices when purchasing food. This cronbach's alpha level of this scale is 0.530.

The fourth factor, *health principles*, includes statements about an individual's will power to make consciously healthy choices. This subscale has a cronbach's alpha level of 0.377. The last factor, *nutritional control*, involves two statements about social interaction and health status. Again, the cronbach's alpha level for this factor was low, at 0.277.

**ORTO-15 - Exploratory Factor Analysis Rotated Component Matrix**

Question	Component				
	1	2	3	4	5
3. In the last three months did the thought of food worry you?	.907				
7. Does the thought of food worry you for more than three hours a day?	.874				
13. Do you feel guilty when transgressing?	.685				
9. Do you think your mood effects your eating behaviour?	.680			.313	
2. When you go in a food shop do you feel confused?	.488				
11. Do you think that eating healthy changes your life-style (frequency of eating out, friends...)?		.813			
12. Do you think that consuming healthy food may improve your appearance?		.781			
10. Do you think that the conviction to eat only healthy food increases self-esteem?		.755			.312
6. Are you willing to spend more money to have healthier food?			.768		
1. When eating, do you pay attention to the calories of the food?	.338		.633		
14. Do you think that on the market there is also unhealthy food?		.374	.543		
5. Is the taste of food more important than the quality when you evaluate food?				.747	
8. Do you allow yourself any eating transgressions?				.746	
15. At present, are you alone having meals?					.794
4. Are your eating choices conditioned by your worry about your health status?	.311		.431		.504

Table 6. Exploratory Factor Analysis for the ORTO-15

## **Chapter Five – Discussion**

### **Introduction**

The current study set out to understand the prevalence of Disordered Eating Attitudes (DEAs) and Orthorexia Nervosa in Canadian elite athlete populations. In the final chapter of this thesis, findings of the study, as well as strengths and limitations of the methods used in the research will be discussed. As this study is the one of the first to explore DEAs and ON in this specific population of athletes, some of the challenges experienced by the researcher will also be elucidated in this chapter. Lastly, the chapter will consider future directions for research in this field.

### **Prevalence of DEAs and ON**

To examine the prevalence of DEAs and ON, participants were asked to complete the EAT-26 and the ORTO-15. Both surveys involved a scoring component, where, to be considered symptomatic with either a DEA or ON, the individual would have to achieve a certain score. To be considered to be experiencing a DEA, the individual must have scored above 20 on the EAT-26. In addition, a score of below 40 on the ORTO-15 would indicate symptomatic status of ON. Results from the survey showed that 13.9% of participants were currently experiencing a DEA and 75% of participants were considered to be experiencing ON.

As hypothesized, the prevalence of DEAs found in the current study was fairly congruent with findings in previous literature. Studies have reported a range in prevalence data from 0%-16.6% depending on the population in question (Greenleaf et al., 2009; Martisen et al., 2010; Petrie et al., 2007). The present study reported a prevalence of 13.9%, fitting within the range of prevalence data previously reported. Moreover, in the present study, 19.4% of females experienced DEAs and 8.3% of males. As hypothesized, the prevalence of DEAs in female elite

athletes is greater than that of males. Again, this gender difference is consistent with previous literature (DSM-V, 2013). Gender is often considered a risk factor for developing a disordered eating attitude. The gender differences found in this study may be explained by social norms that idealize thinness in women (Rhode et al., 2015). Sport type is also seen as a risk factor for developing a DEA. Endurance, aesthetic, and weight class sports are considered to be the sports where athletes are most at risk for DEAs (Sundgot-Borgen & Torstveit, 2010). In the present study, participants with scores over 20 on the EAT-26 reported competing in Alpine Skiing, Artistic Gymnastics, Freestyle Skiing, Triathlon, and Water Polo. While Triathlon and Artistic Gymnastics are both sports considered to be high risk, Alpine Skiing, and Water Polo are not. More over, no participants who competed in other high-risk sports including Distance Running, Cycling, Diving, Figure Skating, and Trampoline had scores over 20, indicating a DEA. Upon evaluating the number of participants who reported each sport discipline, the discrepancy between the results of the study and previous literature may be explained by a sample size that is not representative of the population. For example, the study only had two participants from Distance Running. It may be that the prevalence for DEAs has been underestimated in the results as a result of self- selection bias.

The research found the prevalence of ON in Canadian elite athletes to be high, with 75% of the participants failing to score above 40 on the ORTO-15. It was hypothesized that the prevalence of ON would be greater than that of DEAs. However, such a large discrepancy between prevalence data of the two conditions was not expected. Again, there were gender differences in the data with 80% of females and 69.6% of males scoring under 40 on the ORTO-15. Every sport that was included in the study reported scores on the ORTO-15 that put them in the symptomatic category.

The high prevalence of ON found in this study may be attributed to performance demands placed upon the athletes (Sundgot-Borgen & Torstveit, 2010). Diet is an important aspect of performance. Detailed nutrition plans are common among high level athletes in order to ensure they are providing their bodies with the proper energy to train and compete. The behaviours that indicate an individual is experiencing symptoms of ON may align with nutrition management for high performance sport. The necessity of nutrition management for high performance athletes does not minimize the psychological and physiological health consequences that accompany DEAs and ON.

The prevalence results of ON in this study should be read with some caution. The measurement tool used to evaluate ON is lacking reliability and validity data. Potential issues with the studies measurement of choice may have caused an overestimation of ON in the population. However, there are no previous prevalence studies of ON in Canadian elite athletes to compare the findings with, making it difficult to draw conclusions about the accuracy of the results in this study. It is important to mention that the prevalence of DEAs was consistent with previous findings. In addition, the percentage of participants who reported previously experiencing a mental health diagnoses was also consistent with the percent reported by the Mental Health Commission of Canada at 20% (MHCC, 2013).

### **Associations**

To determine any significant associations between symptomatic status on the EAT-26 and ORTO-15 with demographic data collected as part of the study, Pearson Chi-Square tests were used. While the percentage of those experiencing DEAs and ON by sex appeared to be different, analysis found no significant associations between gender and scores on the EAT-26 or the ORTO-15. This result is surprising as gender is considered to be a risk factor for DEAs

(DSM-V 2013). There was no significant association found between level of competition and the ORTO-15, in addition, no significant associations were found with the EAT-26 which is contrary to Pitkanen (2002), who reported that those participating in sport at a competitive level experience DEAs more than those at a recreational level. The different levels of competition included in the current study compared to that in Pitkanen (2002) could be an explanation for the contradictory findings.

A Mann Whitney- U test was used to determine any associations between level of success and symptomatic status on the EAT-26 and the ORTO-15. The findings reported no significant association on with the EAT-26, however, there was a significant association found with level of success and symptomatic status on the ORTO-15. The results suggest that symptomatic status on the ORTO-15 is related to the level of success that an athlete achieves. Those who are succeeding at a high level may be more at risk for DEAs and ON as the performance demands and pressure to succeed increase.

Regression analysis was performed to reveal a potential relationship between scores on the EAT-26 and the ORTO-15. While the results found were significant ( $p = 0.036$ ) the relationship was weak ( $r^2 = 0.062$ ). It was hypothesized that those who scored high on the ORTO-15 would have also scored high on the EAT-26 as both are disordered eating attitudes, however, this was not the case. A possible explanation for the lack of relationship between the two measures is the high prevalence of those experiencing ON in the sample. While still considered to be a DEA, the symptomology of ON fits the eating behaviours that high level athletes may partake in to manage nutritional requirements that accompany performing at a high level (Haman et al., 2015). For example, individuals may track their caloric intake, limit their eating transgressions, and eat alone but they may not be experiencing the thoughts and feelings

associated with a DEA. Another possible explanation for the lack of relationship may be the poor validity and reliability of the ORTO-15. One would expect a relationship to exist, suggesting there may be an issue with the ORTO-15.

### **ORTO-15 Exploratory Factor Analysis**

An Exploratory Factor Analysis (EFA) was conducted on the ORTO-15 to create a better understanding of the validity of the measure. To date, there are few studies exploring the validity of the ORTO-15. Furthermore, there are large discrepancies in the results found in the those studies. Koven and Abry (2015) report the ORTO-15 is intended to measure both DEA and OCD behaviours in the measure with questions that include concern over health status, obsessive thoughts about food, and control over eating habits. Upon completion of the EFA in this study, the researcher found there to be five factors in the ORTO-15. These include emotional status, health perceptions, conscious choices, health principles, and nutritional control.

The first factor, *emotional status*, includes five questions that encompass an individual's feelings when consuming or selecting food. Guilt over eating transgressions, confusion while in a grocery store, and consuming worry about food are all included in this factor. The cronbach's alpha for emotional status was 0.812 suggesting the reliability of this factor is strong (Colton, 1974). When examining the questions within the factor, those that exist within emotional status logically fit together. While this is the case here with this factor, there is greater difficulty to draw similarities from questions in other factors with weaker reliability.

The second factor, *health perceptions*, includes three questions that address the benefits an individual believes accompany a healthy eating. Change in lifestyle, improvement to appearance, and increased self-esteem as a result of healthy eating are all included in this factor. It is important to note that the questions included in this factor are all perceptions an individual

holds about healthy eating and are not necessarily truths. An individual who believes these statements to be true may strive more for healthy eating than an individual that does not believe the statements to be true, in an attempt to experience the perceived benefits. While not as strong as emotional status, this factor has a cronbach's alpha of 0.633 (Colton, 1974)

The third factor, *conscious choices*, involves questions regarding the thoughts an individual holds surrounding purchasing and consuming food. The factor consists of three questions and has moderate reliability with a cronbach's alpha of 0.530 (Colton, 1974). Within this factor are questions about spending money on healthy food, being aware of the caloric makeup of food, and being conscious of unhealthy food in stores. All these questions involve consciously selecting certain foods over others.

The fourth factor, *health principles*, encompasses two questions about an individual's conviction to eat healthy. Comparing taste to the quality of food, and the allowance of eating transgressions are included in this factor. While one could argue the two statements logically fit together, they have a weak reliability with a cronbach's alpha of 0.377. It is with the last two factors discovered in the ORTO-15 that the validity begins to appear concerning.

The fifth factor, *nutritional control*, is the weakest of them all. It is difficult to see a relationship between the two questions involved, this is further emphasized by the factors weak reliability ( $\alpha = 0.277$ ). One question is concerned with potential social seclusion as a result of the behaviours that accompany ON, while the other involves eating habits reflecting perceived health status. While both questions involve the individual's need for control, neither question relates directly to the other.

The findings of the EFA suggest that there is reason to be concerned over the validity and reliability of the ORTO-15. There seems to be quite a few factors in the ORTO-15 for a survey

with only 15 items. While there is no issue with multiple factors existing within a questionnaire, some factors involve few (i.e., two questions within two of the five factors) and the strength of the reliability within those factors is poor. The small amount of items within some factors, and the strength of reliability within them raises questions about what exactly the ORTO-15 is attempting to measure, and its effectiveness in doing so. While questions surrounding health status, food choices, and lifestyle incorporates the attitudes and behaviours associated with ON, issues still exist within the survey. This raises questions about the findings in the present study and the generalizability of the results.

### **Limitations**

Studies are rarely without their limitations and this one is no exception. It is important to address these limitations as they may effect the validity and generalizability of results found in a study. The two most concerning aspects of the present research are the sample size, and the ORTO-15 measurement tool.

The sample size in this study makes it difficult to generalize the results. While 55 National Sport Organizations and six Canadian Sport Institutes were contacted, only 72 participants completed the survey. If the sample size is broken down into specific demographics, many sports are only represented by one or two participants. This small sample size does not provide an adequate understanding of the eating attitudes experienced at a sport specific level. The participant split in level of competition reported was fairly uneven with 15 participants reporting a national competition level and 57 athletes reporting an international competition level. Again, the discrepancy in number of participants at each level makes drawing comparisons between the two groups difficult. The same statements can be made when unpacking the sample sizes of all demographic data in question. The limitations with sample size may raise some

concern over the accurate representation of disordered eating attitudes among Canadian elite athletes. To remedy this problem, further research with a larger sample size that draws more participants from all sport types is necessary.

It is important to mention a potential barrier to the distribution of the survey. The survey was released in November of 2016. This release was during the time that most winter sport competitions seasons are beginning. It may have been that winter athlete participants were busy with their competitive season and as a result completing the study was not a priority. While the survey was open until May 2017, winter athlete participants may have been preoccupied with their competition season. A remedy for this potential limitation would be to have a staggered release of the survey depending on the competitive season of the sports involved in the study.

The nature of the ethical considerations taken as a part of the research may have created other limitations with sample size. Only individuals 18 years of age or older were able to participate in the study. In many elite sports, athletes competing at the national or international level are often younger than 18 years old. The minimum age to compete at the Olympic Games is 16 years of age. Making the age of participation over 18 years old limited the number of athletes competing at a national or international level. In addition, age is a risk factor for developing a DEA (DSM-V, 2013). By only including athletes over 18 years of age the study may have missed a large portion of the population that is experiencing DEAs and ON.

The biggest potential limitation with this study is the use of the ORTO-15. There are limited studies validating the measure and of the few that do exist, the results vary drastically. In an attempt to further the understanding of the validity of the measure, an exploratory factor analysis was conducted on the ORTO-15. As mentioned previously, the analysis unveiled more concerns about the validity of the ORTO-15. As a result, the validity of the findings in this study

should be read with some caution. However, it is important to note that other measures for Orthorexia Nervosa are limited. Therefore, while the measure has its problems, it is important not to discount research that uses the ORTO-15.

Another limitation with the measurements used in the study are the scales and cutoff points used to determine if an individual is experiencing a DEA or ON. An individual is considered to be at risk for the condition once they score a certain number on the survey. The dichotomous approach used on the scales (e.g., the condition is present or not present based on one number) may not be the best way to assess an individual's eating attitudes. For example, for an individual to be considered to have Orthorexia Nervosa, he or she must score under 40 on the ORTO-15. However, if an individual scores 41 on the ORTO-15 they are not considered to have ON. This dichotomous approach may miss individuals that are at risk for the disorder. Instead, a scaled approach to scoring may be better at identifying those experiencing or at risk for DEAs and ON.

## **Challenges**

There were a number of challenges faced by the researchers while completing this research. The majority of challenges surrounded research with this specific population. It was very difficult to acquire participants for the study. During recruitment, 55 National Sport Organizations (NSOs) were contacted and six Canadian Sport Institutes. Of the 55 NSOs only eight responded to the request, moreover, only six agreed to participate. The rest of the participants were recruited via emails circulated to all athletes involved with the six sport institutes. The number of athletes that were recruited to participate ( $N=72$ ) is fairly small considering the amount of Canadian elite athletes that fit the criteria of the study. There is a need for more research in sport psychology and athlete mental health at an elite level in Canada.

However, that requires participation from athletes, coaches, and NSOs. While conducting the current study, the researchers found NSOs and coaches to be extremely selective of the studies of which they think their athletes should participate in. This section will discuss the variety of reasons that poor participation may have occurred.

Mental health and mental illness still face a large amount of stigma, especially in the athletic community (Schreiber-Gregory et al., 2013). A study of this kind, which attempts to quantify the prevalence of those struggling with their mental health may be approached tentatively by those involved in high performance sport. The hesitation to participate in the survey may have occurred at all levels of sport. Athletes, coaches, and governing bodies may have different reasons for their lack of participation. Though the survey is anonymous, athletes must disclose information of a personal nature. As mentioned previously, secrecy and feelings of guilt usually accompany participation in DEAs (Schreiber-Gregory et al., 2013). Athletes already experiencing some form of DEA may not want to disclose their information in the survey due to concerns over privacy, or feelings of guilt and shame. Coaches and NSOs may have a different reason for their hesitation to participate. Coaches and governing bodies have busy schedules and ongoing tasks to ensure the optimal performance and well-being of their athletes in their program. By completing this survey coaches and NSO's are potentially becoming aware of another problem they need to address with their athletes. With so much to plan and focus on already, athletes and coaches may be willing to look the other direction when it comes to DEAs and their athletes.

Another reason for poor participation could be due to the perceived lack of benefit to those involved. The study does not directly impact sport performance in the short-term but rather the research is only the start of understanding the complex issue of DEAs. It is important to note

that research of this kind lay the groundwork for further studies that will explore topics that do directly impact performance (i.e., prevention and treatment). However, the lack of explicit and short-term benefit to those involved may have influenced the participation of those contacted.

### **Significance**

Similar studies have been conducted with athlete populations however with they include different level of sport and exist in different countries. However, the current study is one of the first to explore DEAs and ON in the Canadian elite athlete population. Athletes are at an increased risk for DEAs and this specific population is no exception (Greenleaf et al., 2009). The prevalence of DEAs and ON in the study was 13.9% and 75% respectively. The present study uncovered the concerning rate of DEAs and ON in this population and can be used to inform future research. Now that there is an understanding DEAs and ON in the population, further research can be conducted on risk factors, prevention and detection methods, and treatment. The EFA conducted on the ORTO-15 adds to the literature on the validity and reliability of the measure. The results can be used to determine whether the ORTO-15 is an acceptable measure when considering the measure for future studies.

### **Future Directions**

There is plenty of work yet to be done in the field of athlete mental health specifically with DEAs and ON. Studies in the future can work to mitigate the limitations and overcome the challenges faced by the researchers. For example, recruiting a larger, more extensive sample size would create a better understanding of the prevalence of DEAs in Canadian elite athlete populations. In addition, including athletes on national and international teams under the age of 18, as well as Paralympic athletes would expand the reach of the study to further identify those at risk for DEAs and ON. Working closely with key stakeholders in NSOs and CSIs may help

increase the level of participation. Future studies validating the ORTO-15 or creating a new measure for the measuring the condition are necessary for ON research to move forward. Once there is a greater understanding of the prevalence of DEAs and ON in Canadian elite athletes, the results can inform future studies on the development of prevention and treatment of disordered eating in this population. More research on disordered eating in sport that situates the behaviours in some form of model is necessary. There are limited studies exploring the tripartite model in sport contexts. However it could be vital to understanding the etiology and nuances of DEAs in elite athletes. Results from this study and future research could be presented back to policy makers, coaches, and athletes to educate individuals on DEAs and ON. Developing awareness, prevention, and treatment protocol for DEAs and ON in Canadian athlete populations will benefit and contribute to the health, mental well-being, and performance of the elite athletes that represent Canada internationally.

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Best wishes,

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