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Adverse eating attitudes and inadequate calcium intake and their relationship to the prevalence of skeletal fracture injuries among competitive American figure skaters

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ABSTRACT

ADVERSE EATING ATTITUDES AND INADEQUATE CALCIUM INTAKE AND THEIR RELATIONSHIP TO THE PREVALENCE OF SKELETAL FRACTURE INJURIES AMONG COMPETITIVE AMERICAN FIGURE SKATERS

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The Female Athlete Triad (Triad) and Relative Energy Deficiency in Sport (RED-S) describe conditions in which energy availability (EA) is low relative to the imbalance between dietary energy intake and energy expenditure required for health and activities of daily living, growth, and sporting activities. Figure skating as an aesthetic sport, requires great demands on time and is a sport whose participants can be affected by such syndromes, but has been minimally studied. The objective of this non-experimental, cross-sectional survey study was to identify the association between the Triad and RED-S' overlapping components of adverse eating attitudes, low calcium intake, and the prevalence for skeletal fracture injuries among competitive American figure skaters. An online survey was administered over an 8-month

period, and risk for adverse eating attitudes, calcium intake, and history of skeletal fracture injury was assessed by collection self-reported data through this online survey.

A total of 74 skaters participated in this study. Of those 74, 50 skaters (8 males and 42 females) completed the survey in its entirety, with an average age of 18.12 years $\pm$ 4.27 years. Findings were not significant for an increase in risk for adverse eating attitudes among skaters, X^2 (1, n = 60) = 0.04, p = 0.84. No significant association was found between being at risk for adverse eating attitudes and inadequate calcium intake, X^2 (1, N = 54) = 0.48, p = 0.49. However, there was a statistically significant, negative linear relationship (r = -0.28, p < 0.05,) between EAT-26 scores and the calcium intakes. No association was found between the prevalence for skeletal fracture injury and one's risk for having adverse eating attitudes, X^2 (1, N = 51) = 0.05, p = 0.87. Prevalence for skeletal fracture injury and inadequate calcium intake were not significantly associated, X^2 (1, N = 50) = 0.14, p = 0.07. There were no significant differences in the mean EAT score between males and females, t(58) -1.01, p = 0.32. While these findings do not support the increased risk to adverse eating habits and inadequate calcium intake reported in other studies, the negative relationship between calcium intake and increased risk to adverse eating attitudes is of note and warrants further investigation. Research would benefit from understanding more about the changes seen in the health of figure skating's athletes, with efforts made to increase recognition and resources available for the prevention, diagnosis, and treatment of each component of the Triad or RED-S.

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ADVERSE EATING ATTITUDES AND INADEQUATE CALCIUM INTAKE AND THEIR RELATIONSHIP TO THE PREVALENCE OF SKELETAL FRACTURE INJURIES AMONG COMPETITIVE AMERICAN FIGURE SKATERS

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CHAPTER 1

INTRODUCTION

Figure skating is a physically demanding sport that requires a unique combination of artistic ability, speed, agility, flexibility, and power, all of which can be achieved only by long-term, persistent training.[1] Aside from these demands, figure skating is among many sports such as dance, gymnastics, freestyle wrestling, and running, that stresses a thin body-ideal. Unlike freestyle wrestling and running, but similar to dance and gymnastics, a skater's success and degree of execution of each element performed is tediously analyzed and judged by certified officials in the sport. United States Figure Skating (USFS) serves as the nation's primary governing body for the sport and currently has over 140,000 members ranging in all ages and disciplines including, but not limited to singles, pairs, ice dancing, and synchronized skating.

Another notorious similarity this sport shares is the prevalence for the development of a triad of conditions referred to as the Female Athlete Triad (Triad). The Triad is defined as the interrelationship of low energy availability (EA) with or without an eating disorder or disordered eating (ED/DE) habits, menstrual dysfunction, and low bone mineral density (BMD) or osteoporosis.[2,3]An increasing public health concern across the globe is the rise in mental health illnesses with approximately 1 in 5 adults in the United States experiencing illness, with 4% noting substantial interference with or limits to one or more of their major life activities due to the mental illness.[4] Eating disorders are defined as serious disturbances in eating behaviors that exist as anorexia nervosa, bulimia nervosa, binge-eating disorder. In America, 13% of children

aged 8-15 years old and 21.4% of children aged 13-18 years old, experience a severe mental disorder at some point during their life.[5] EDs have the highest mortality rate of any mental illness. At least 30 million people of all ages and gender nation-wide suffer from an ED.[6] Although genetics, environmental factors, and personality traits all contribute to increased risk for an ED, so too does one's chances if they are an athlete.[6] In weight-class sports (wrestling, rowing, horseracing) and aesthetic sports (bodybuilding, gymnastics, swimming, diving) about 33% of male athletes are affected. In female athletes in weight class and aesthetic sports such as figure skating and gymnastics, prevalence for DE is doubled; estimates of up to 62%.[7]

As the most common bone disease in humans affecting 54 million Americans, osteoporosis constitutes another major public health problem.[8] Osteoporosis is a silent disease characterized by brittle bones that are easily susceptible to bone fractures—fractures that occur following minimal trauma or, in some cases, with no trauma. Although irreversible, unlike the precursor osteopenia, osteoporosis can be prevented, diagnosed, and treated prior to fractures occurring. Although it is more commonly diagnosed in older adults, teenagers are equally susceptible.[8] By age 24 and regardless of gender, individuals reach peak bone mass, making calcium and vitamin D intake and physical activity essential components of one's healthy lifestyle.

Recent research has determined related findings among the male athletic population, noting the presence of low EA and co-occurring disordered eating or eating disorders, low BMD and low endocrine function.[2,3] The International Olympic Committee (IOC) recently published an updated consensus statement, recognizing such similarities and calling for an update in the title and qualifications for these detrimental conditions. The IOC's expert working group

introduced “Relative Energy Deficiency in Sport” (RED-S) to describe impaired physiological function including, but not limited to, metabolic rate, menstrual function, bone health, immunity, protein synthesis, and cardiovascular health caused by relative energy deficiency.[9] Similar to the Triad, the recognized cause of RED-S is low EA relative to the imbalance between dietary energy intake and energy expenditure required for health and activities of daily living, growth, and sporting activities. However, in contrast to the Triad, RED-S is not identified as a triad of the three entities but instead is defined as a syndrome that affects many aspects of physiological function, health, and athletic performance.[9]

Problem Statement

In 2011, Scoffier, Woodmand, and Arripe-Longuivelle reported that the intensity of disordered eating attitudes increased perceived physical ability that is positively linked to performance among competitive female figure skaters.[10] These results supported the need for interdisciplinary work between coaches, parents, psychologists, and dietitians to promote healthy development and growth while encouraging a balanced perspective on their body image ideal relative to their sport performance.[10] To date, gaps in the literature exist for the sport of figure skating, and in particular among male athletes of this population, with principles and concepts applied to this population based on other male aesthetic sport athletes such as gymnastics, dance, long-distance running, and diving. The findings of low BMD in athletes similarly experiencing other Triad or RED-S symptoms is concerning because of the timing that bone mass is being

negatively affected.[11] As many athletes retire from figure skating by age 30, physiological peak bone mass may never be established for skaters at risk of osteoporosis, especially if their calcium and vitamin D intake is inadequate. In 2016, Tenforde et al. reported the parallels with the Triad in male athletes, stating that further research is needed to evaluate the relationship between vitamin D and calcium intake in male athletes as a means of comparison between bone health and reduction in bones stress, in addition to hormonal and metabolic effects.[2] Because of the natural desire for any athlete to improve their sport performance, their healthy dietary behaviors and related well-being may be motivating to this population.

Figure skating is among many sports such as dance, gymnastics, wrestling, and running, that stresses a thin body-ideal. Unlike wrestling and running, but similar to dance and gymnastics, a skater's success and degree of execution of each element performed is tediously analyzed and judged by certified officials in the sport. In 2004, the sport's infamous 6.0 judging system changed to the International Judging System (IJS) which quantifies a skaters' performance. Based on the elements executed and their quality, cumulative points are awarded from a technical base value score and five additional program components: skating skills, transitions, performance, composition and interpretation of the music/timing. This change stemmed from a history of controversy regarding the subjective scoring of a skater's performance with the 6.0 system, and thus the IJS system was created to serve as a more objective way of scoring. With this objective nature, the IJS system has rapidly increased the complexity and demands of the sport, requiring greater practice time to master difficult elements as a means of earning the most points in a given performance. Although much information is available to relate aesthetic sport culture to the health of its athletes, gaps in the literature exist

solely pertaining to figure skating's current population with the new demands placed on its athletes.

Purpose of the Study

There is reason to believe that regardless of gender, competitive figure skaters are at an increased risk for the development of the Triad conditions and compromised health due to sport-specific demands placed on body ideals. There is a dearth of studies regarding the relationship between gender-neutral components of the Triad in the modern figure skating population. The purpose of this study was to investigate the relationship between adverse eating attitudes, low calcium intake, and skeletal fracture injuries among competitive American figure skating athletes. This study investigated the relationship between these two entities of the Triad and the prevalence for compromised bone health in this population across gender, age, skating discipline, and skating level.

Independent Variables

The independent variables for this study were risk for adverse eating attitudes, risk for nutritional calcium deficiency, and gender.

Nominal Definition of Risk for Adverse Eating Attitudes

The nominal definition of risk for adverse eating attitudes for this study is the presence and frequency of extreme weight control habits that correlate with behaviors regarding food choices and tendencies.[12]

Operational Definition for Risk for Adverse Eating Attitudes

The operational definition for risk for adverse eating attitudes entailed a self-report assessment using the EAT-26 questionnaire (Appendix A). These scores were then tallied to determine if an individual is at risk for an adverse eating attitude. EAT-26 scoring standards qualify a score of $\geq$ 20 as "at risk" and a score of < 20 as "not at risk".

Nominal Definition for Inadequate Calcium Intake

The nominal definition of risk of inadequate calcium intake for this study is based on the Recommended Daily Allowance (RDA) for calcium determined by the U.S. Food and Nutrition Board. The RDA for calcium for children aged 9-18 years of age is 1,300 mg/day and 1,000 mg/day for adults aged 19-70 years.

Operational Definition for Inadequate Calcium Intake

The risk for inadequate calcium intake was measured using a calcium-specific FFQ (Appendix B) developed and validated by Magkos, Manios, Babaroutsi, and Sidossis.[13] Responses of the FFQ were scored based on the frequency and total quantity of calcium consumed per day based on the calcium content of the foods assessed in the questionnaire (Appendix C).[13] The original creators of this FFQ, determined their FFQ's validity for distinguishing low (< 500 mg/day) from high (> 1000 mg/day) calcium intake.[13] For this reason,

FFQ values calculated to be $\leq$ 500 mg in this study qualified a participant to be at risk for inadequate calcium intake.

Nominal Definition of Gender

The nominal definition for gender for this survey was female or male, based on the participant's identification with masculine or feminine traits.

Operational Definition of Gender

The operational definition of gender for this survey was based on participant's self-identification as male or female on the survey.

Dependent Variables

The dependent variables for this study are the risk for inadequate calcium intake, history of skeletal fracture injuries, and risk for adverse eating attitudes.

Nominal Definition of History of Skeletal Fracture Injuries

The nominal definition of history of skeletal fracture injuries is defined as stress fracture and/or bone fracture injuries that occurred during a skater's competitive career. "Competitive skaters" is defined as those who compete at a U.S. Figure Skating sanctioned qualifying competition – Regionals, Sectionals, and/or the U.S. Figure Skating Championships. It was not required for participants to be medically diagnosed to report such injury.

Operational Definition of History of Skeletal Fracture Injuries

The operational definition of history of skeletal fracture injury was based on the participant's report and recollection of their incidences of skeletal injury during one or more of the US Figure Skating qualifying competitions they competed at previously or were experiencing during the 2017 qualifying season. Total number of injuries were collected, and data were grouped into history or no history of skeletal fracture injuries.

Research Hypotheses and Research Questions

Research Question 1: Are competitive figure skaters at an increased risk for adverse eating attitudes?

Research Hypothesis 1: Competitive figure skaters are at an increased risk for adverse eating attitudes.

The **variable** needed to test this hypothesis was:

Risk for adverse eating attitudes

The **data** for each variable consisted of:

The percentage of skaters determined to be at risk for adverse eating attitudes.

Research Question 2: Does skaters' risk adverse eating attitudes correlate with inadequate calcium intake?

Research Hypothesis 2: Competitive figure skaters that report adverse eating attitudes will report inadequate calcium intake.

The **variables** needed to test this hypothesis were:

Independent variable: Risk for Adverse Eating Attitudes

Dependent variable: Inadequate Calcium Intake

The **data** for each variable consisted of:

Independent variable: Risk for adverse eating attitudes as measured by EAT-26 scores

Dependent variable: Inadequate calcium intake as measured by the Calcium-Specific FFQ

Research Question 3: Does skaters' risk adverse eating attitudes correlate with their history of skeletal fracture injuries?

Research Hypothesis 3: The prevalence of skeletal fracture injuries is related to incidences of reported adverse eating attitudes for competitive figures skaters.

The **variables** needed to test this hypothesis were:

Independent variable: Risk for Adverse Eating Attitudes

Dependent variable: History of Skeletal Fracture Injury

The **data** for each variable consisted of:

Independent variable: Risk for adverse eating attitudes as measured by EAT-26 scores

Dependent variable: History of skeletal fracture injury as measured by reports of stress fractures or bone breaks.

Research Question 4: Does skater's inadequate calcium intake correlate with their history of skeletal fracture injuries?

Research Hypothesis 4: History of skeletal fracture injuries is related to inadequate calcium intake.

The **variables** needed to test this hypothesis were:

Independent variable: Inadequate Calcium Intake

Dependent variable: History of Skeletal Fracture Injury

The **data** for each variable consisted of:

Independent variable: Inadequate calcium intake as measured by the Calcium-Specific FFQ

Dependent variable: History of skeletal fracture injury as measured by reports of stress fractures or bone breaks.

Research Question 5: Is a figure skater's gender related to her risk for adverse eating attitude?

Research Hypothesis 5: Female competitive figure skaters are at an increased risk for adverse eating attitudes versus male competitive figure skaters.

The **variables** needed to test this hypothesis are:

Independent variable: Gender

Dependent variable: Risk for Adverse Eating Attitudes

The **data** for each variable consisted of:

Independent variable: Gender will be measured by participants' identification with male or female in the Demographic portion of the survey.

Dependent variable: Risk for adverse eating attitudes as measured by EAT-26 scores.

CHAPTER 2
REVIEW OF LITERATURE

Low Energy Availability

Low energy availability (EA) and related nutrient deficits for athletes may be intentional due to dieting per coach, parent, or self-induced beliefs and related ED/DE behaviors, or it may unintentionally result from misconceptions regarding the amount of energy necessary to support elevated energy expenditure (EE) demanded by the sport. EA is calculated as energy intake (EI) minus the estimated energy expenditure (EE) relative to fat-free mass (FFM) [EA (kcal/kg FFM/day) = EI (kcal/day) - EEE (kcal/day). In healthy adults, a value of 45 kcal/kg FFM/day equates energy balance, whereas in athletes, this value may be increased to due to increased sport-specific demands.[14] The recommendation for estimated caloric intake appropriate for an athlete depends on the sport, hours spent training each day, and competitive nature of an athletes training regimen. It is important to recognize the body's increased demands in these athletes because the contrary can be detrimental to their physical performance. During chronically decreased EA, physiological processes that require energy, including but not limited to reproduction, thermoregulation, growth, and cellular maintenance are directly inhibited by limited supply provided in the form of calories from an individual's diet.[15] Although it cannot be

stated that low EA is strictly correlated with prevalence for ED/DE diagnosis, reports of low EA have been found in athletes with ED/DE, regardless of gender.[16,17]

Screening and diagnostic tools utilized to determine the existence or severity of these RED-S or Triad components vary because no specific tool has been validated to be the most accurate and currently several of the Triad's tools are not tailored to examine males. As proposed by the IOC, because low EA plays a major role in the existence of co-morbid conditions related to the Triad and RED-S, diagnosis of either syndrome should include examining this as a preliminary determinant.[9] Additional information required to confirm one's EA on a daily basis includes assessing an athlete's dietary habits to determine EI through the use of a self-reported prospective 3-day food diary, retrospective 24-hour dietary recall, or completion of a retrospective food frequency questionnaire (FFQ).[9] One's eating habits should also be examined for presence of ED/DE, and although there is still no single diagnostic tool verified for ED/DEs, the Eating Attitudes Tests (EAT-40 or EAT-26) are used most frequently due to their validity and reliability.[18] Both questionnaires assess an individuals' attitudes and behaviors associated with ED/Des and are comprised of either 26 or 40 questions related to dieting, bulimia and food preoccupation, and oral control subscales.[19] To determine one's EEE, their physical activities (duration, types, and intensity) can be recorded similarly in prospective or retrospective nature through self-reported journal logs or can be monitored with the use of heart rate monitors. It is important to note that EI and EEE data collection should occur over the same period as dietary intake is recorded.

Osteoporosis and Bone Mineral Density

Osteoporosis, is medically characterized as low bone mineral density (BMD), deterioration of bone tissues and disruption of bone architecture, compromised bone strength, and thereby increased risk for skeletal fracture.[8] Bone health can be ensured with adequate intake of calcium and vitamin D, as well as the incorporation of physical activity to maximize bone turnover rate. The type and amount of loading exerted to bone is an important determinant of bone mass and strength.[20]

When testing BMD, dual energy x-ray absorptiometry (DXA) is currently the most precise and valid technique for assessing an individual's BMD. It is important to note that athletes in weight-bearing sports should have 5-15% higher VMD than non-athletes or athletes who participate in non-weight bearing activity like swimming or cycling, and athletes can be diagnosed with low BMD is they have a Z-score reading between -1.0 and -2.0 standard deviation (*SD*), accompanied with a history or current co-existing conditions of ED/Des, hypoestrogenism, and stress fractures.[9] DXA readings below -2.0 *SD* are indicative of osteoporosis. Adequate Vitamin D and calcium consumption may indicate healthy BMD and decrease one's risk for osteoporosis. A study conducted a retrospective age-matched cohort study to compare BMD of competitive female teenage figure skaters who had a history of fractures to those who had never reported a fracture injury. In this study, BMD was estimated using an ultrasound machine, while the following information was collected from their subjects: exercise levels, calcium intake, weight, height, family history of fractures, personal history of fractures (from both skating and unrelated causes), and menstrual history, site of fracture, age and skating

ability at the time of fracture, the time required to recover, and the incidence of additional fractures.[21]

As micronutrients, calcium and vitamin D play vital interdependent roles in skeletal health throughout the lifespan, and therefore inadequate intake of these micronutrients can serve as a risk indicator in the pathogenesis of osteoporosis.[22] Due to their roles in the musculoskeletal system, and vitamin D's immune function and inflammatory response, levels may directly affect an athlete's overall health and athletic ability.[23,24] Furthermore, athletes that partake in indoor sports are more likely to be deficient in Vitamin D than those that are exposed to the sun in an outdoor setting.[25] Assessing an individual's usual calcium and vitamin D intake can determine their susceptibility to poor bone health. Food frequency questionnaires (FFQs), 24-hour dietary recalls, and 3-day food records can both be utilized for ranking individual nutrient intake, identifying individuals at the extremes of intake and, in theory, for providing quantitative information on individual intakes as well.[22] Unlike FFQs, 24-hour dietary recalls are not appropriate for epidemiological research with the intended purpose of comparing the individual's typical intake to that of their actual health status, because an individual's dietary intake can fluctuate on a daily basis and determining conclusions cannot be made after analyzing just one day of an individual's intake. Additionally, 24-hour diet recalls are less appropriate for drawing conclusions relative to an individual's micronutrient intake, and rather serve as better indicators of macronutrient consumption distribution. In adolescents, it has been found to be decreased compliance and completion rates associated with food recalls in comparison to a FFQ because the recalls require participant responsibility to remember to complete these records over several

days.[13] In comparison to multiple day recalls, FFQs provide a practical, less burdensome, and low-cost alternative to assessing the usual intake of an individual or population cohort.

Various FFQs have been developed and tested for the validity of their results contingent on type and number of questions asked and the targeted population. Studies examining the validity of FFQs to determine calcium and macronutrient intake in children, adolescents, and adults of both genders found that their FFQs proved adequate to determine the calcium and macronutrient intakes for the sake of population-based epidemiological studies or screening programs involving individuals where the primary interest is to discriminate between individuals of low or high risk for insufficient calcium intakes.[22,13,26] Another study tested the validity of a FFQ for assessing calcium and vitamin D intake in adolescent AN and healthy girls aged 12-18 compared to a validated 4-day food recall and concluded that the FFQ was effective in assessing these micronutrients in their subjects.[13] Among other calcium-focused, pediatric-tailored FFQs created and tested for validity and reliability was the Bone Mineral Density in Childhood Study (BMDCS) calcium FFQ. This block calcium/vitamin D FFQ was designed by NutritonQuest and developed from dietary data collected as part of the third National Health and Nutrition Examination Study (NHANES III). This FFQ was tested and proven valid and reliable among male and female children and adolescents aged 5-21 years following a large, national BMD Childhood Study which investigated the determinants of adequate bone growth among US children and adolescents.[27-29]

Amenorrhea and Hormonal Imbalances

Amenorrhea represents the most severe menstrual disturbance along a continuum of abnormalities, including, but not limited to oligomenorrhoea, or irregular menstrual cycles lasting from 36-90 days.[30] Irregular menses in athletes (oligo- or amenorrhea) have been associated with a greater incidence of stress fractures and low BMD, particularly at the spine.[18,19] Disturbances in hormone levels and compromised function can be determined through a period of irregular menses or cessation in menstruation for more than three months, and understanding of an individual's use of medication such as birth control should also be considered when determining one's reproductive and endocrine system functions. Other more invasive techniques exist for understanding disturbances in menstrual cycles such as ultrasounds.[9] Although these physical signs may make it easier to recognize compromised endocrine function, it is important to note that males are just as likely to suffer from impaired endocrine function and related bone health due to low EA.[31] The true prevalence of low testosterone due to hypogonadotropic hypogonadism in male athletes remains unknown, with little correlation in findings for testosterone levels and compromised BMD.[2]

Eating Disorders in Athletic Populations

Elite figure skaters have been assessed to determine their total energy intakes, the macro and micronutrient content of their intake records, and their eating attitudes to gain insight into the

nutritional and psychological concerns of this population. Contradictory information exists though, in that several studies have noted adverse eating attitudes, while others have reported normal eating behaviors.[19] Sundgot-Borgen and Torstveit conducted a study to determine the prevalence of eating disorders in elite athletes versus non-athletes. Their findings determined that a 25 times greater prevalence of EDs in male athletes in lean-based sports, including aesthetic, endurance, weight class, and anti-gravitational sports than in non-athlete general population, similar to findings regarding female athletes.[32] Studies, however, have been conclusive in verifying low average daily caloric intake trends among this population.[19] In other aesthetic sports such as gymnastics, both female and male populations have been studied to determine prevalence for adverse eating attitudes. Disordered eating attitudes were found to be more prevalent in females (17%), while only 8% of all males scored above the cut-off point after completing EAT-26 evaluation tool.[21]

Skeletal Injuries Among Figure Skaters

Wolff's law describes how bone responds and adapts to various physiological stressors, including ground reaction forces applied to bone during exercise, suggesting that those who participate in sports which promote high-impact and multidirectional bone loading will have higher BMDs versus those athletes of low-impact or non-weight bearing sports such as horse jockeys, swimmers, and cyclers.[33] Figure skating is classified as a sport of high-impact and multidirectional bone loading, as it places great demand especially for the singles and pairs

disciplines which require jumps as a major constituent of practice and performance. It has been found that the landing force of a jump performed in figure skating is that of 8-14 times the body weight of the skater performing the jump based on jump height and number of revolutions in the air.[34] The timing of loading exposure to bone may also play a role, particularly during the second decade of life, during which BMD approximately doubles. Most individuals reach their highest bone mass by their late teens and early twenties.[8]

Cognizant of the relation that skeletal health plays in preventing injury among this population, one study compared BMD of competitive female teenage figure skaters with a history of fracture to skaters without fracture.[9] By assessing their exercise levels, calcium intake, anthropometric information, personal history of fractures (including site, age, and skating level at the time of the injury), and menstrual history, and after comparing each group to age-matched, nonathletic controls, results noted stress fracture type injuries are not caused by low BMD but rather may result from the high impact and force placed on the skaters' skeletons due to jumping.[9] In this study, BMD was estimated at the calcaneus using ultrasound technique; however, the results generated from this instrument were noted to be selective due to the limited examination of only the heel. Further research is needed to justify the results of this study.[9]

Another study examined the types of injuries and overuse syndromes in elite Junior level skaters.[20] They reported that in across all disciples, more than 50% of the injuries stem from over-use syndromes, with stress fractures being the most common.[19] Additionally, they reported that pairs and ice dance skaters were at a higher risk for acute injuries in comparison to their counterparts due to the likelihood to encounter injuries related to falls from lifts and throw jumps.[19]

Only a few studies have reportedly tested calcium intake among figure skaters, with these studies noting a trending low intake in this micronutrient vital to adequate BMD. [9,18] After gathering 3-day, self-reported food records, thirty-six elite female figure skaters aged 13-22 years reported diets high in carbohydrates, but low in total caloric, fat, and micronutrient intakes essential for proper bone growth. [18] Calcium intake was also low among another cohort of skaters, falling below the recommended daily allowance of 1200 to 1500mg/d for teenage girls; however, they did not that those skaters that had a history of bone injuries were now reporting higher intakes of calcium due to recommendations from their physicians to prophylactically take calcium supplements or increase calcium in their diet. [9]

Amenorrhea Among Figure Skaters

Figure skating is a knowingly physically demanding sport that requires initial specialization in the sport, defined by long-term, persistent training.[19] Through the years, though, adolescents alike experience a pubertal transition cognitively and biologically. In individuals in aesthetic sports, including but not limited to diving, skating, and gymnastics, one's age at menarche typically is later in life in comparison the average age of 12 years, and is associated with various anthropometric measures noting BMI's at or below the standard recommendation.[22] Smallness in size and shape associated with later maturation in these sports can be linked to various judging criteria due the precision and effortless appeal at which difficult jumps and or spins are more aerodynamically executed. After exploring pubertal time and pre-elite

competitive figure skaters' physical self-perceptions, it was found that 80% of skaters experienced late maturation.[9]

Furthermore, a known correlation exists between the impacts of training and delayed menarche. It has been proven that high-intensity training before menarche postpones its onset.[35] Another study, focused its attention on ballerinas and evaluated the influence of intensive training and of dietetic and anthropometric factors on menstrual cycles in female ballet dancers. They supported prior findings, noting high-intensity training being positively associated with late onset of menarche, menstrual disorders, lower BMI, and abnormal eating behaviors.[36]

Sport Pressures and the Thin-Ideal

Interlacing pressures from their athletic partners, coaches, parents, the sport's athletic demands, and/or a sport's culture may be to blame and may compromise the overall wellness of the athlete themselves. Among the aesthetic sports mentioned thus far, it is evident that trends exist related to the Triad components. In the ballet and dance-type sports, harmonious passion was found to have positively predicted self-esteem, while obsessive passion positively predicted self-evaluative perfectionism, conscientious perfectionism, and disordered eating attitudes after the completion of EAT-26.[19] With regard to figure skating, skaters with partners reported lower perceptions of their health, suggesting potential origins for risks of injuries among the pairs and ice dance disciplines.[22] Figure skaters eating disorders have been found to directly negatively influence the quality of their relationship with their parents, despite a positive relationship with

their perception of physical ability.[36] Limited research though has been collected on male figure skating athletes and the pressures they may feel to succumb to sport-specific, expected body ideals.

The purpose of this study is to investigate the relationship between adverse eating attitudes and low calcium intake among elite American figure skating athletes to explain the prevalence for skeletal fracture injuries in this population. This research study will be designed to answer the following questions: Are elite figure skaters at an increased risk for adverse eating attitudes? If these skaters score at or above 20 on the EAT-26 test, do they also note nutritional deficiencies of calcium (<500 mg/day)? Are elite figure skaters at higher risk for developing skeletal fracture injuries if they score at or above 20 on the EAT-26 test and have insufficient calcium intake (<500 mg/day)? It is hypothesized that the prevalence of stress fractures and other types of fracture injuries will be increased if these athletes report increased risk for adverse eating attitudes and low calcium intake.

CHAPTER 3

METHODOLOGY

Study Design

To date there is limited research on the relationship between eating attitudes and calcium intake as a risk factor for skeletal fracture injuries among figure skaters. A non-experimental study design was used to identify the association between adverse eating attitudes and low calcium intake on the prevalence for skeletal fracture injuries among competitive American figure skaters. An online survey was used to collect the data.

Participants

A combination of convenient and snowball sampling was used to obtain the desired study participants. The reason for convenience sampling was used because the researcher works with this population, therefore had easy accessibility to participants. Snowball sampling was used because of the connections that are often made in a sport organization. Because of the specific

population requirements, several participants recruited using convenience sampling were asked and were willing to recruit additional study participants of similar qualifications.

Eligibility criteria for participants included current male and female competitive skaters competing at any level (Pre-preliminary through Senior) and in one or more of the following disciplines: pairs, ice dance, or singles. To be considered "competitive," eligible skaters included those who had, or were going to compete at one or more of the following USFS 2017 qualifying structure competitions: regionals, sectionals, or the USFS Championship event. There were no gender or age exclusion criteria for this study.

Eligible participants were recruited through direct message (Appendix D) by the primary researcher via social media platforms, including Facebook, Twitter, and Instagram. Additionally, participants were actively recruited via face-to-face conversation directed to skaters, parents, and coaches at three figure skating competitions held in the Chicagoland area. These participants received access to the survey via a printed Qualitrics-generated QR code that was provided on a business card (Appendix E) and distributed at these events. Participants also were given the option to complete the survey while they were at the rink, and used the researcher's computer available at the recruiting booth. If skaters approached the researcher with interest to complete the survey, the participants were first asked to obtain parental approval to complete the survey, thereby ensuring parental consent if the skaters were under the age of 18. As included in the survey's design, skaters could not continue the survey without indicating their assent or parental consent if under the ag of 18. Participants who choose to complete the survey on their own time were told how to access the survey by scanning the QR code with their smartphone and were informed of the first step of the survey which required parental assent or pariticipant consent.

Information regarding the study was also sent out to various U.S. Figure Skating sanctioned clubs throughout the nation and a message (Appendix D) was published on their social media websites or through their monthly newsletters.

At the conclusion of the survey, links to the following approved sites were included as a means for participants to obtain additional resources regarding the topics relevant to this study:

- https://www.eatingdisorderhope.com/
- http://www.teamusa.org/About-the-USOC/Athlete-Development/Sport-Performance/Nutrition/Resources-and-Fact-Sheets.aspx

Permission to Use Human Subjects in Research

Prior to the distribution of the survey and collection of data, permission was obtained for the use of human subjects in research from the Northern Illinois University Institutional Review Board (Appendix F). Participants consent or parental consent and skater assent depending on age was obtained at time of data collection (Appendix G).

Instrument

The one-time, online survey (Appendix G) administered consisted of 3 parts: (1) EAT-26 questionnaire, (2) calcium-specific FFQ, and (3) demographics related to the skater's personal background.

The Eating Attitudes Test (EAT-26) (Appendix A) instrument was used in this study to screen participants and measure the independent variable, risk for adverse eating attitudes, because it serves as the most widely used standardized, self-reported screening tool to assess risk of ED in high school, college, and other special risk population groups such as athletes.[37,38] Permission to use this screening instrument is not required because it can be downloaded at no cost online at http://www.eat-26.com/downloads.php. There are two screening tests EAT-40 and EAT-26, named with respect to the number of items in each test, are both designed to be of minimal burden for those taking the test and those administering and analyzing it. For this study, the EAT-26 screening test was selected because the stated average time to complete the test is two minutes. The validity and reliability of responses to the EAT-26 was first tested in 1998 among high school students of both genders and it was determined that this instrument could decipher cases at risk for clinical spectrum eating disorders, and continues to be tested and utilized for research and medical screening purposes.[38,37] The 26 items of EAT-26 fall under three subscales: dieting, bulimia and food preoccupation, and oral control.[37] The total score of the EAT is the sum of the scores of the individual item scores on the test. For the EAT-26 test, scores at or above 20 are indicative of individuals at a high risk to an eating disorder or who are concerned about their body weight, dieting, and/or may have subsequent disordered eating behaviors, while scores 10-19 indicate an intermediate risk. Scoring is based on a scale of 0-3, which corresponds to 5 responses. For items 1-25 of the questionnaire, the following scores were assigned to the ordinal response options: always = 3, usually = 2, often = 1, sometimes = 0, rarely = 0, never = 0. For item 26, the opposite scoring scale is applied: always = 0, usually = 0, often = 0, sometimes = 1, rarely = 2, never = 3. Each participant's responses scores were tallied,

and the score classified as < 20 or $\geq$ 20 indicating whether or not they were "at risk" or "not at risk" for adverse eating attitudes.

Permission (Appendix H) was obtained to use part 2 of the survey; the calcium-specific FFQ (Appendix B) which was developed and validated by Magkos, Manios, Babaroutsi, and Sidossis. The 30-item FFQ questionnaire included the following calcium-rich sources: ten dairy products (milk, yogurt, and eight types of soft and hard cheeses), four types of pie, two cereal products, two types of nuts, four vegetable products, legumes, four fish products, eggs, as well as ice cream and chocolate.[13] True to the design and intentions of FFQs, participants were asked to answer questions regarding the frequency (never or rarely, or times per month/week/day, as appropriate) and amount (natural units or standard quantities, but not actual weights) of consumption of these foods during the previous 12 months.[13] As noted by its creators, no visual aids or food models are included in the FFQ to estimate portion sizes, but rather simple serving size suggestions are utilized. This FFQ was additionally chosen because it requires minimal participant burden and on average takes five minutes to complete. Furthermore, this FFQ has been selected because validity evidence for responses for low calcium intake (< 500 mg/d) has been demonstrated in both genders among children and adult population groups, it is free of charge, and its condensed nature places less of a burden on time for the participants.[13] It is important to note that this FFQ was developed and tested in Greece, and this fact will serve as a preconceived potential limitation to the proposed research because dietary assessment tools do need to be culturally appropriate to the target population being evaluated.[40]

To determine participants' average calcium intake, the FFQ was scored by converting responses into times per month each food item was consumed and then that value was converted

into calcium consumed per day by using the authors' calcium content per food item value and dividing month values by 30, the average number of days per month per year. The final calcium values per day consumed per participant were compared to the FFQ's guidelines for high, medium, or low based on the calcium content of the foods asked in the questionnaire (Appendix B).[13] Per the FFQ's authors' procedures for determining adequacy of calcium intake, the following ranges were used: $\leq$ 500 mg/day (low), 501-999 mg/day (moderate), $\geq$1000 mg/day (high). Therefore, total mg of calcium $\leq$ 500 mg/day categorized a participant as "at risk" for inadequate calcium intake.

The third part of the questionnaire was the demographical information. This data representing the dependent variable, history of skeletal fracture injury, was collected at the end of the survey. Skaters were asked to indicate the number of current or past skeletal fracture injuries experienced during any qualifying structure competition seasons. Participants were asked to indicate the type of injury by selecting skeletal break and/or stress fracture injury on the questionnaire. In addition to the type of injury, participants were instructed to provide the location of such injury (ankle/foot, lumbar/back, wrist/hand, ribs/sternum, hip/pelvis, leg/knee, fingers/toes, arms/shoulder/clavicle, and ribs/sternum). Total number of injuries were collected, and data were grouped into history or no history of skeletal fracture injuries.

Additional questions in this section of the survey included: respective discipline (pairs, ice dance, and/or singles), competitive level (novice, junior, or senior), average time (measured in hours) spent training off the ice and on the ice, and, if female, age of onset of menses and any history of amenorrhea.

Data Collection

From November 1st, 2016-August 1, 2017 the survey link was made available for participants to take. Eligible participants were contacted by the researcher via one of the various social media platforms (Appendix D). They may also have been recruited to take the survey by other participants via the snowball collecting methods. Furthermore, participants were recruited at 1 of 3 figure skating competitions held during the summer months of 2016 at Chicagoland ice arenas. Participants could have also voluntarily completed it after seeing it advertised by their personal U.S. Figure Skating Club's forms of communication. In April of 2016, all potential participants originally directly messaged by the researcher were re-contacted to remind them to take the survey, and requested again to reach out to any other eligible participants in their circles.

As part of the recruitment message (Appendix D) or in-person recruitment, participants were provided an explanation of the survey. Prior to participation in this study, electronic written consent was obtained for those skaters 18 years or older. Electronic parental consent and participant assent was obtained for skaters less than 18 years of age. Because an online survey was administered, an additional waiver of signatures was obtained. The signature of participants confirming their consent/assent and the signature of the parents confirming their consent was not included because the research involved minimal risk to the subject and involved no procedures for which written consent is normally required outside of the research context. Rather, the participants completing the online survey selected from multiple choices, pertaining to their individual agreement and acknowledgements of the study design and their rights as human

subjects. These choices were: (1) “I am under the age of 18. By clicking this, I am acknowledging my parents and/or guardians consent and my assent;” (2) “I am 18 years or older. By clicking this, I am acknowledging my consent;” (3) “I do not consent. I do not wish to participate in this study.” If “I do not consent. I do not..." is selected, then the designed survey was programmed to skip to end of the survey; otherwise, participants began the survey. One of the three options must have been selected to begin the survey.

All responses were recorded anonymously, and participants were informed of this as part of the initial study description page of the survey and the recruitment message. All the records were password protected and stored via Qualtrics. Records will be kept for three years after data collection. The survey results will then be deleted in Qualtrics following that time.

Statistical Analysis

Hypothesis 1: *Competitive figure skaters are at an increased risk for adverse eating attitudes*, was tested using Chi Square goodness-of-fit test to assess if the proportion of competitive figure skaters who are “at risk” differs from the general population.

The **data** needed to test this hypothesis were:

Independent variable, number of figure skaters vs. general population that completed EAT-26: Study participants who completed the EAT-26 portion of the survey instrument and the 2000 National Eating Disorder Screening Program (NEDSP) study participants.

Dependent variable, risk for adverse eating attitudes: Responses to EAT-26 survey

The test for Hypothesis 2: *Competitive figure skaters that are at risk for adverse eating attitudes will have inadequate calcium intake,* was a bivariate Pearson correlation, two-tailed test for significance using the raw scores from EAT-26 and FFQ because data were continuous and the relationship between these two data sets was being assessed. Furthermore, both data sets consist of independent cases and the relationship is unknown. In addition, a chi-square test of independence was used to determine whether there was an association between the categorical values of a risk for adverse eating attitudes and inadequate calcium intake.

The **data** needed to test this hypothesis were:

Independent variable, risk for adverse eating attitudes: Responses to EAT-26 survey

Dependent variable, inadequate calcium intake: Responses to Calcium-Specific FFQ

To test for Hypothesis 3: *The prevalence of skeletal fracture injuries is related to incidences of reported adverse eating attitudes for competitive figures skaters,* a chi-square test of independence because data were categorical and the significance of association between the two variables is desired.

The **data** needed to test this hypothesis were:

Independent variable, risk for adverse eating attitudes: Responses to EAT-26 survey

Dependent variable, history of skeletal fracture injuries: Responses to reports of stress fractures or bone breaks.

Hypothesis 4: *History of skeletal fracture injuries is related to inadequate calcium intake,* was tested using a chi-square test of independence because data were categorical and the significance of association between the two variables is desired.

The **data** needed to test this hypothesis were:

Independent variable, inadequate calcium intake: Responses to calcium-specific FFQ

Dependent variable, history of skeletal fracture injuries: Responses to reports of stress fractures or bone breaks.

To test for Hypothesis 5: *Female competitive figure skaters are at an increased risk for adverse eating attitudes versus male competitive figure skaters,* an independent sample *t*-test to understand the statistical differences between the means of the two groups – males vs. female.

The **data** needed to test this hypothesis were:

Independent variable, gender: participants' identification with male or female in the demographic portion of the survey.

Dependent variable, risk for adverse eating attitudes: Responses to EAT-26 survey

CHAPTER 4

RESULTS

The following will address the results and findings of this study regarding the relationship between eating attitudes, calcium intake, and skeletal fracture injuries among competitive figure skaters. All data were analyzed using the SPSS version 22.0 for Windows Statistical Software (SPSS Inc., Chicago, IL, USA). First the demographics of the sample used in this study will be discussed. Then, the findings of skaters at risk for adverse eating attitudes, calcium intake trends, and skeletal fracture injury prevalence were addressed.

Participant Characteristics

Seventy-four (n = 74) participants participated the study survey, with the three main components – the EAT-26, the calcium-specific FFQ, and the demographic section (Table 1). Although 74 participants started the survey, cases were excluded due to incomplete or inaccurate responses for all or parts of the survey (Figure 1). Total sample size for the EAT-26 portion of this survey was 60, because 14 surveys were deemed incomplete and excluded from the study. Of these 60 participants, 49 were female (82%) and 11 were male (18%). The total sample size for the calcium-specific FFQ was 54, because 19 surveys were incomplete, and 1 participant was

removed due to prediction of inaccurate data reported after testing for skewness. Of these 54 participants, 44 were female (81.5%) and 10 were male. Total sample size for skeletal fracture injuries was 51, with 23 excluded due to incomplete data. Overall, 50 participants completed all three parts of the survey appropriately, resulting in a 69% completion rate. Of the 50 participants, 42 were female (84%) and 8 were male (16%). The mean age of the 50 participants was 18.12 years $\pm$ 4.27 years. Of the 50 participants 41 skaters competed in the singles division, 4 competed in the pairs division, 2 in the ice dance division, 2 skaters that competed in both singles and ice dance, and 1 skater that competed singles and pairs. Therefore, 88% of participants identified themselves as singles skaters, 10% as pair skaters, and 8% as ice dancers. With regards to level of participation, 1 skater was pre-preliminary, 2 were preliminary, 0 were pre-juvenile, 7 were juvenile, 6 were intermediate, 12 were novice, 5 were junior, and 17 were senior level skaters. BMI of participants was unable to be calculated due to error in data collection options for participants for this question of the survey instrument.

Table 1. Demographics Characteristics of Respondents

Variable	Male Skaters (%)	Female Skaters (%)	*n* (%)	Mean ± *SD*
EAT-Score (*n* = 60)				8.73 ± 7.02
Not at Risk (< 20)	11 (20)	42 (79.25)	53 (88.33)	6.40 ± 4.60
At Risk (≥ 20)	0 (0)	7 (100)	7 (11.67)	26.43 ± 4.50
Calcium Intake (*n* = 54)				1001.28 ± 641.14
Adequate	8 (17)	39 (83)	47 (87.04)	1314.48 ± 641.14
Inadequate	2 (28.57)	5 (71.42)	7 (12.96)	319.61 ± 99.10
History of Skeletal Fracture Injury (*n* = 50)				N/A
Yes	3 (15)	17 (85)	20 (40)	
No	5 (16.67)	25 (83.33)	30 (60)	

Variable	Male Skaters (%)	Female Skaters (%)	*n* (%)
Type of Skeletal Fracture Injury (*n*- = 20)			
Ankle/Foot	2	9	11 (55)
Lumbar/Back	1	6	7 (35)
Wrist/Hand	0	6	6 (12)
Ribs/Sternum	0	2	2 (10)
Hip/Pelvis	1	1	2 (10)
Leg/Knee	1	1	2 (10)
Fingers/Toes	1	1	2 (10)
Arms/Shoulder/Clavicle	1	1	2 (10)
Ribs/Sternum	0	1	1 (2)
Skating Discipline (*n* = 50)			
Singles	5	40	45 (90)
Pairs	2	2	4 (8)
Ice Dance	1	3	4 (8)
Multi-discipline:			
Singles/Ice Dance	0	2	2
Singles/Pairs)	0	1	1
Skating Level (*n* = 50)			1 (2)
Pre-Preliminary	0	1	2 (4)
Preliminary	0	2	0 (0)
Pre-Juvenile	0	0	7 (14)
Juvenile	0	7	6 (12)
Intermediate	0	6	12 (24)
Novice	2	10	6 (12)
Junior	0	6	16 (34)
Senior	6	10	

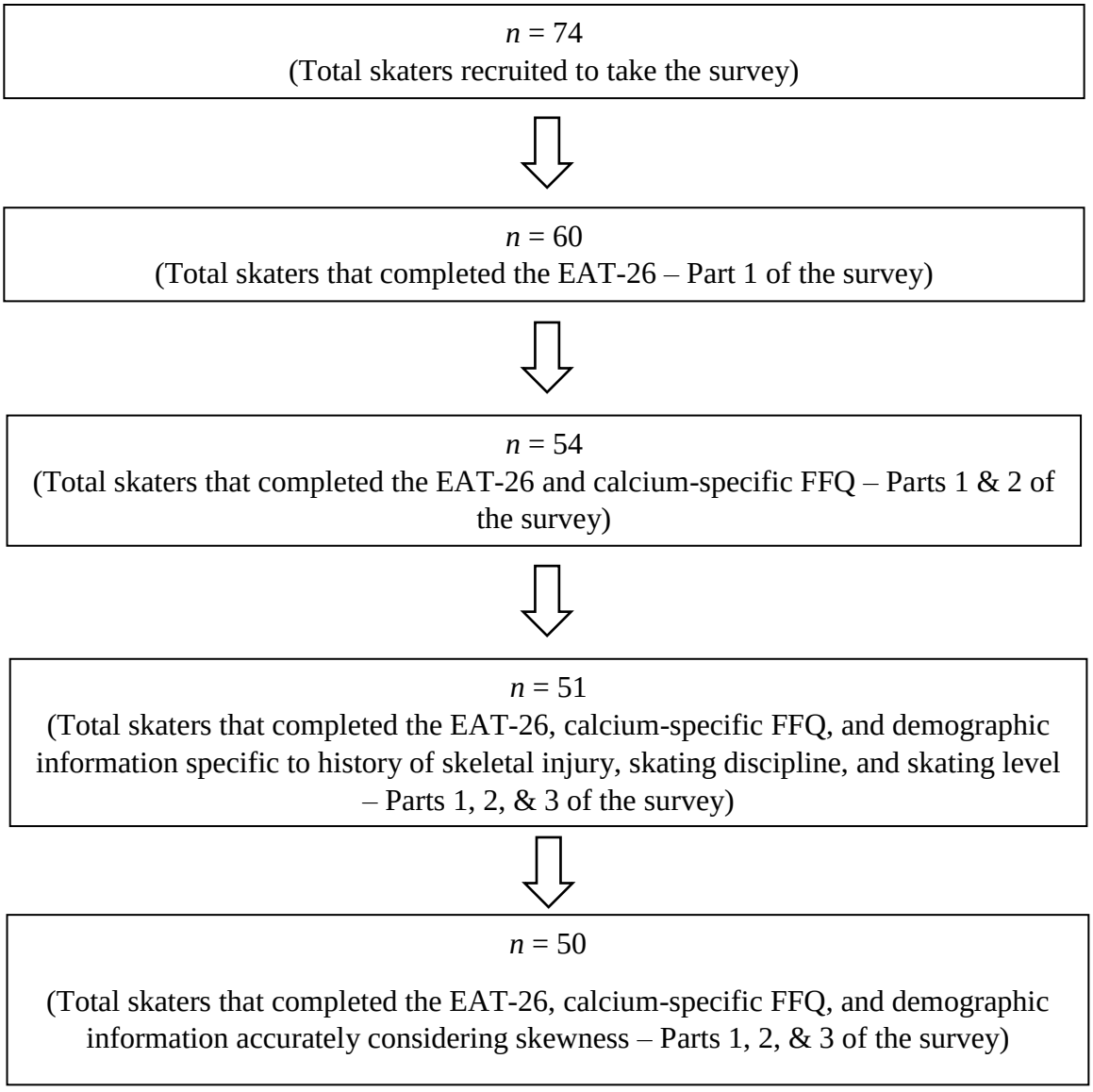

Figure 1. Reduction in Data

Results of Survey Instrument

Scores from both the EAT-26 and the calcium-specific FFQ used in this study have been validated and have been historically noted to produce reliable dats.[6,9] The demographic portion of the survey instrument used for this study was prefaced by reminding participants the importance of being as truthful as possible when answering the questions regarding this objective information. Personal interviews were not conducted as part of data collection strategies for this study.

Results of Hypothesis Testing

The following will identify the research hypotheses for this study and the results generated from statistical data analysis.

Risk for Adverse Eating Attitudes

Research Hypothesis 1: *Competitive figure skaters are at an increased risk for adverse eating attitudes* was tested using a chi-square goodness of fit to determine whether the skater participants at risk for adverse eating attitudes were at an increased risk for adverse eating

attitudes versus the National Eating Disorder Screening Program (NEDSP) initiative which surveyed high schoolers (n = 5,567) in the United States in 2000.[41] The NEDSP found 15% of females and 4% of males to be at risk ($\geq$ 20) for possible eating disorder utilizing the EAT-26, totaling 10.84% participants identified as being at risk for adverse eating attitudes.[41] The current study found no significance for an increase in risk for adverse eating attitudes among the participants in this study compared to the high schoolers, X^2 (1, n = 60) = 0.04, p = 0.84. Therefore, the null hypothesis was not rejected, and these results do not support the research hypothesis.

Adverse Eating Attitudes and Calcium Intake

Research Hypothesis 2: *Competitive figure skaters that are at risk for adverse eating attitudes will have inadequate calcium intake* was determined with a correlation, two-tailed test for significance was used to test hypothesis 2 using the raw scores from EAT-26 and FFQ. EAT-26 scores and FFQ-determined daily calcium amounts consumed showed a statistically significant negative linear relationship (r = -0.28, p < .05). However, the strength of this relationship was weak (Figure 2). As the EAT-26 scores increased, the amount of reported calcium consumed decreased. Chi-square analysis test of independence was applied to further examine the negative relationship found between at risk eating attitudes and inadequate calcium intake. No association was found between risk for adverse eating attitudes and inadequate calcium intake, X^2 (1, n = 54) = 0.48, p = .49. Therefore, the null hypothesis was not rejected.

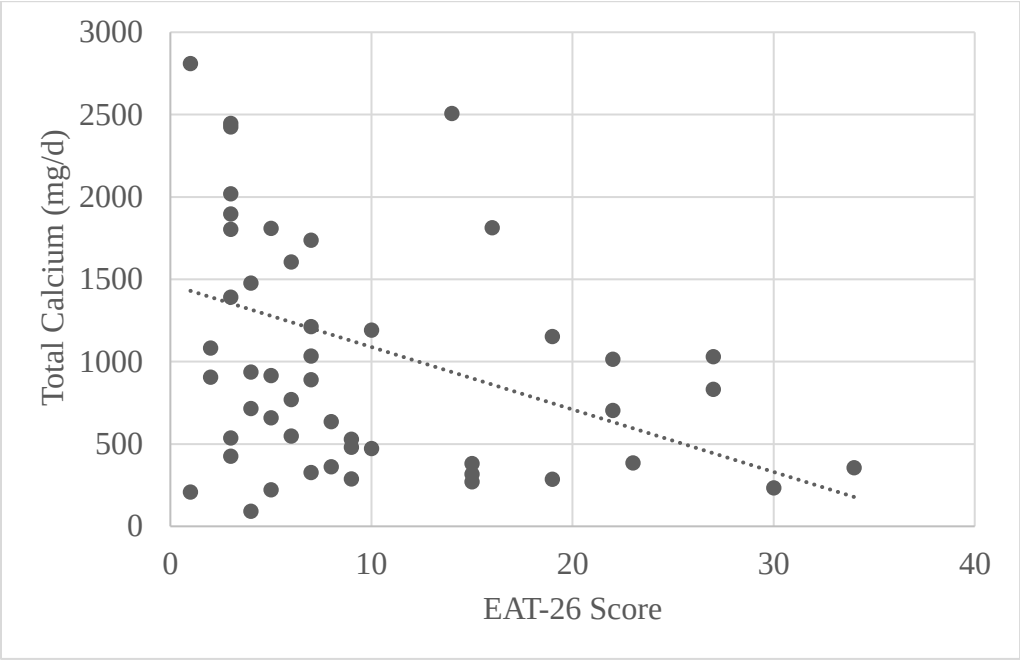

Figure 2. The Relationship Between EAT-26 Raw Scores and Total Daily Calcium Intake Values (mg) determined from the Calcium-Specific FFQ.

Of the 60 participants who complete the EAT-26 or part 1 of the survey, 7 scored $\geq$ 20, all of whom were female, and thus were noted to be at risk for adverse eating attitudes (Figure 3). The average EAT-26 score recorded was 8.7 which indicated no risk overall. Seventeen (17) of the FFQ (n = 54) participants were found to consume inadequate calcium intake levels (< 500 mg/d), 2 of whom were males, while the majority (15) were female. The average calcium intake per day was 1001 mg/day (SD = 706.89). Of those that completed the FFQ, 27 (50%) reported taking a calcium supplement daily. The total calcium intakes calculated did not take into consideration the amount supplied by the supplements.

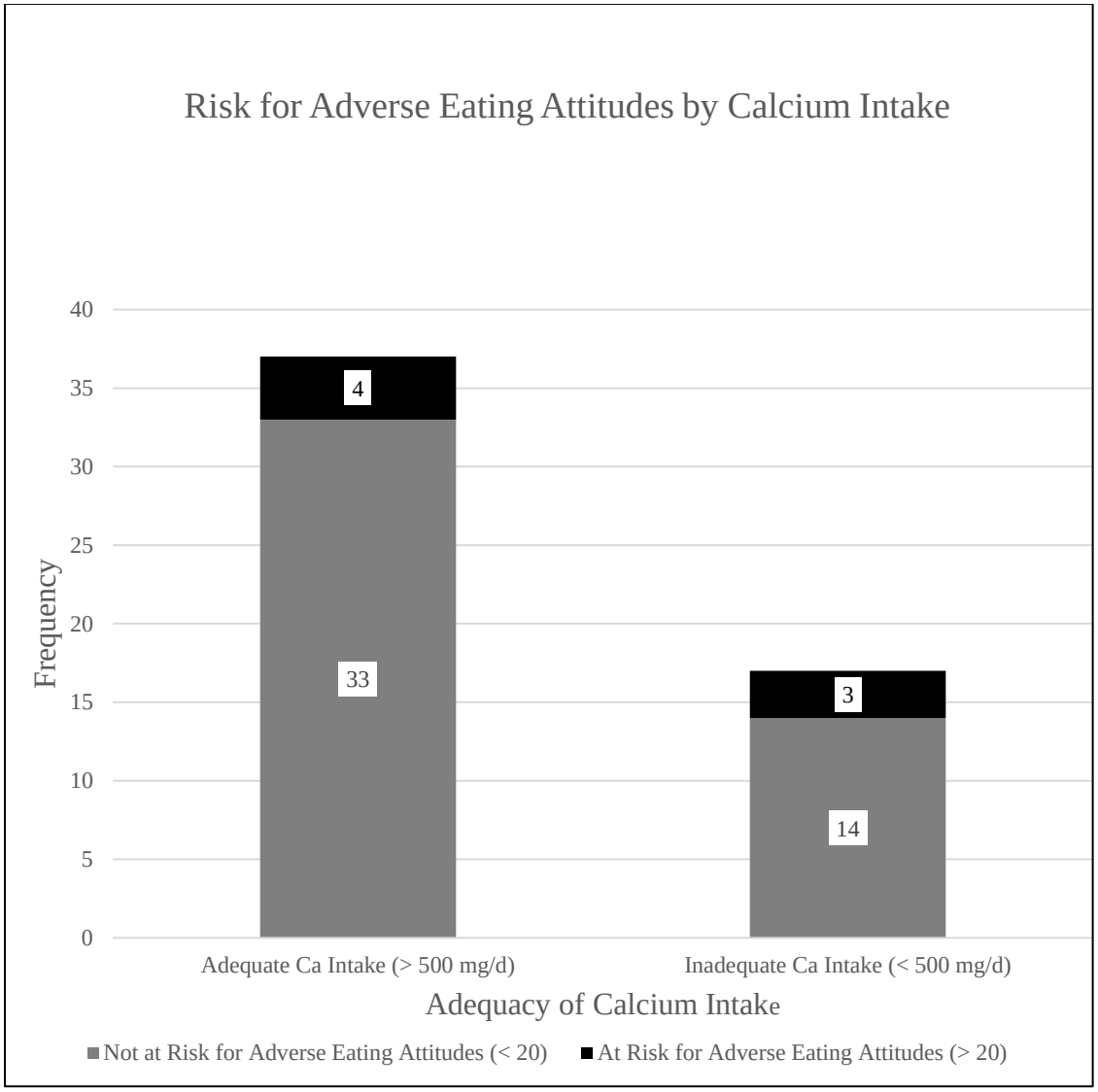

Figure 3. Frequency of Those Reporting Risk Status for Adverse Eating Attitudes by Adequacy of Calcium Intake

Adverse Eating Attitudes and History of Skeletal Fracture Injury

To test for hypothesis 3: *The history of skeletal fracture injuries is related to being at risk for adverse eating attitudes for competitive figures skaters,* the chi-square test of independence was conducted to determine the association between history of a skeletal injury and their risk of adverse eating attitudes. No association was found between the prevalence for skeletal fracture injury and risk for having adverse eating attitudes, X^2 (1, n = 50) = 0.05, p = .87. The null hypothesis was not rejected, demonstrating that the history of skeletal fracture injuries is not related to incidences of reported adverse eating attitudes for competitive figure skaters. These findings do not support the research hypothesis.

Additionally, an independent samples t-test analysis was conducted to further examine this hypothesis. The results (Table 2) showed skaters who did not have a history of skeletal injury had similar EAT-26 scores (M = 9.65, SD = 8.15) when compared to skaters who reported skeletal fracture injuries (M = 9.45, SD = 8.59), with no statistically significant group differences t(0.82) = 0.77, p = .05.

Of the 50 participants who completed the demographic portion of the survey, 20 (40%) reported a history of skeletal injury (Figure 4), 3 of whom were male, while the majority (17) were female (Table 1). A total of 35 injuries were reported due to participants' history of multiple skeletal fracture injuries (Table 1). The frequencies of specific skeletal injuries were reported as: ankle/foot = 11; lumbar/back = 7; wrist/hand = 6; ribs/sternum, hip/pelvis, leg/knee, fingers/toes, arms/shoulders/clavicle = 2 for each; ribs/sternum = 1 (Table 1). Of the participants

who reported history of skeletal fracture injury, 3 of 17 were also categorized as at risk for adverse eating attitudes.

Table 2. EAT-Scores and Total Calcium by History of Skeletal Injury

	History of Skeletal Injuries	*n*	Mean	Std. Deviation	Std. Error Mean
EAT Score	No	30	9.77	8.27	1.50
	Yes	20	9.45	8.59	1.92
Total Calcium	No	30	1188.90	1299.75	237.30
	Yes	20	972.31	705.58	157.77

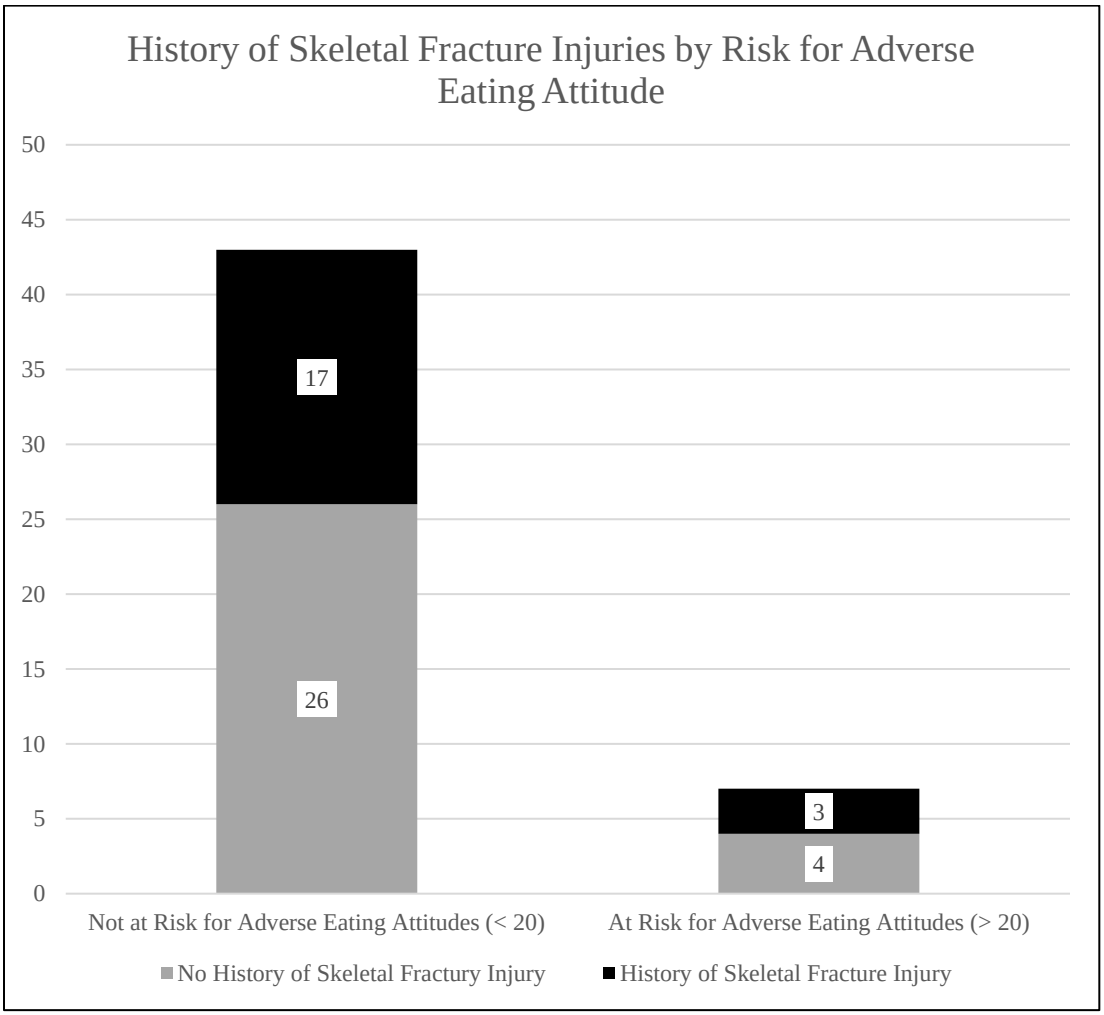

Figure 4. Frequency of Those Reporting At Risk Status For Adverse Eating Attitudes by History of Skeletal Injury.

History of Skeletal Fracture Injury and Calcium Intake

To assess hypothesis 4: *History of skeletal fracture injuries is related to inadequate calcium intake,* a chi-square test of independence was conducted. No association was found between the prevalence for skeletal fracture injury and inadequate calcium intake X^2 (1, n = 50) = 0.14, p = .71. The null hypothesis was not rejected, demonstrating the history of skeletal fracture injuries is not related to inadequate calcium intake. These findings do not support the research hypothesis.

Additionally, an independent samples *t*-test analysis was conducted to further examine this hypothesis. Table 2 shows skaters who did not have a history of skeletal injury had similarly adequate calcium intakes (M = 1188.90, SD = 1299.75) when compared to those who reported history of skeletal injury (M = 972.31, SD = 705.58). No statistically significant group difference was evident, t(0.68) = 0.50, p = .05. This is consistent with findings from the chi-square test of independence results.

Of those (n = 20) that reported history of skeletal injury, 7 (35%) reported inadequate calcium intake (Figure 5).

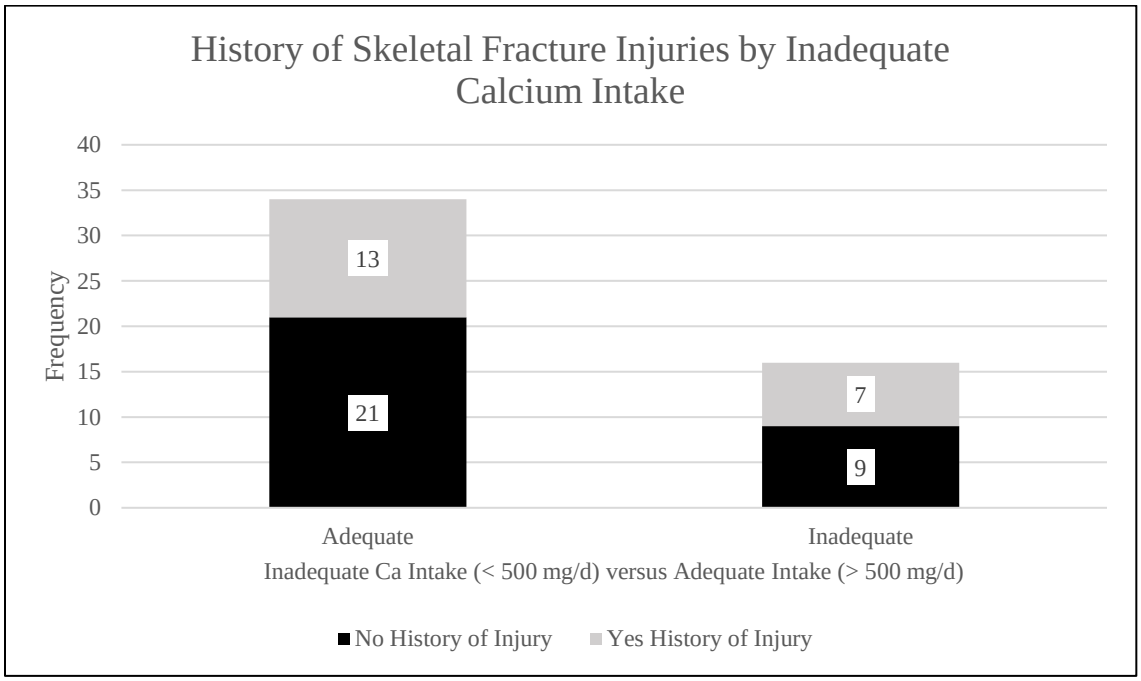

Figure 5. Frequency of Those Reporting History of Skeletal Injuries by Adequacy of Calcium Intake

Adverse Eating Attitudes and Gender

Hypothesis 5: *Female competitive figure skaters are at an increased risk for adverse eating attitudes versus male competitive figure skaters,* was tested using an independent samples *t*-test, with EAT-26 scores serving as the test variable, and gender representing the grouping variable. Results showed no significant differences between the male and female participants' mean EAT-26 scores $t(58)$ -1.01, $p = .32$. Thus, the null hypothesis was not rejected, and support was not found for the research hypothesis. For the males that completed EAT-26, $M = 6.55$, $SD = 4.74$; females scored $M = 9.22$, $SD = 8.43$ (Figure 6).

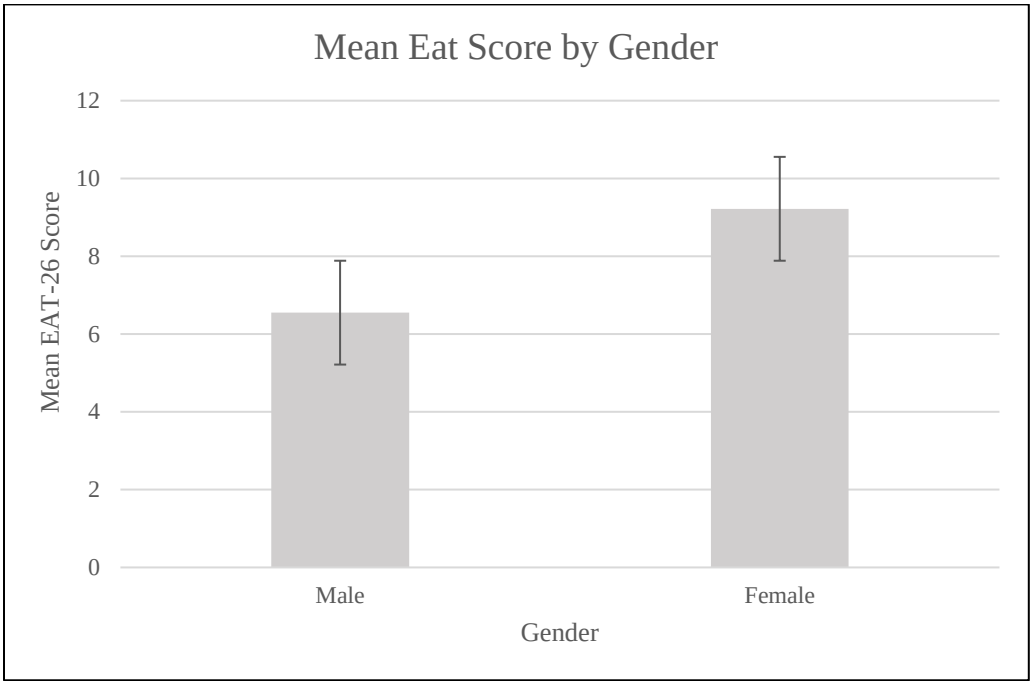

Figure 6. Mean EAT-26 Scores by Gender

CHAPTER 5

DISCUSSION

This study examined the risk for adverse eating attitudes amongst female and male figure skaters. It is expected that this population will be at risk for the components of the Triad and RED-S. They are at risk due to the physical demands and competitive nature of the sport, as well as sport pressure to adhere to a thin ideal.[19,32] The Triad's components include low EA, low bone mineral density resulting in osteoporosis, and hormonal imbalances resulting in amenorrhea. Similar to the Triad, RED-S is diagnosed by a myriad of detrimental physiological conditions all related to low EA.

In the current research study, calcium intake was determined through participants' responses to the calcium-specific FFQ. History of skeletal injury was reported in the final portion of the survey along with participant's current skating level, discipline, and if female, history of amenorrhea. Calcium, along with vitamin D and phosphorous, is essential for supporting skeletal structure and function, in addition to regulating blood clotting, muscle contraction, and nerve function. Research links low EA to various deficiencies of macro- and micronutrients, including calcium.[15] With depleted calcium and vitamin D stores, increased risk exists for the pathogenesis of osteoporosis and likelihood for brittle skeletal structures to fracture.[22]

In the current study, only female skaters reported high EAT-26 scores indicative of risk for adverse eating attitudes and related ED/DE tendencies. In the latest study published in 2012

assessing eating attitudes and food intakes of elite figure skaters, only female athletes were tested.[19] No studies have been found to assess male figure skaters' responses to either EAT-26 or EAT-40 questionnaires. In other aesthetic sports such as gymnastics, both female and male populations have been studied to determine prevalence for adverse eating attitudes. Disordered eating attitudes were found to be more prevalent in females (17%), while only 8% of all males scored above the cut-off point after completing EAT-26 evaluation tool.[18] Similarly, results from the current study found more females (7) than males (0) to be at risk; however, no significant difference existed among average EAT scores across gender.

The mean age of who completed the EAT-26 was 18.12 years $\pm$ 4.27 years, as was those that completed the test instrument in its entirety while the mean age of the females in this study was 17.33 $\pm$ 2.36 years. In the latest study published in 2012 assessing eating attitudes of elite figure skaters, the mean age of their participants was 16 $\pm$ 2.5 years.[19] Another study which assessed the disordered eating attitudes, menstrual dysfunction, and stress fracture prevalence, surveyed 220 females with a mean age of 16.4 $\pm$ 4 years.[17] Therefore, the age of the current research study was similar to previous studies. This is most likely due to the fact that, although there is no age limit for eligibility to be a competitive figure skater as defined by this study, there are age restrictions for the more elite Junior and Senior levels. To compete internationally in the junior level events, a skater must be between 13 and 19 years of age. If age and skill warrant, skaters are eligible to compete internationally in the senior level if they are at least 15 years old before July 1st of the previous year. In the current research study, 46% indicated they were at the Junior or Senior level, potentially explaining the slightly elevated age of the sample.

Childhood and adolescence years are critical for the maturation and development of an individual's body, with emphasis placed on the importance of consuming adequate nutrients to support this period of growth. Puberty is typical in girls aged 11 years and in boys closer to 12 years of age.[42] During puberty, an increase in bone mass results, which thereby maximizes bone accrual during the growth, modeling, and remodeling of the skeletal structures. In both males and females, it is generally believed that bone mass increases substantially during the first two decades, with peak bone mass being met as early as 20 years of age.[40] This study's sample mean age, as well as the general population age of competitive figure skaters, puts them at risk for failing to develop adequate peak bone mass if onset of puberty is delayed or the athlete has inadequate intake of key bone health micronutrients (calcium, vitamin D, and phosphorous). If peak bone mass is not appropriately accrued, the result is an increased risk in osteoporosis.[43]

Of the individuals that completed the FFQ, 44 were female (81.5%) and 10 were male (18.5%). The mean calcium daily intake for those that completed the FFQ (n = 54) was 1001.28mg, with 17 (31.5%) skaters indicating scores $\leq$ 500 and therefore categorized as at risk for inadequate calcium intake (Table 1). The current RDA for calcium intake is 1000-1300mg for young adults. Of the skaters (n = 17) that were categorized as having inadequate calcium intake (< 500mg/d), 2 (11.8%) were male and 15 (88.2%) were female (Table 1). Of those that completed both the EAT-26 and the FFQ (n = 54), 3 (5.6%) athletes were determined to be at risk for adverse eating attitudes with inadequate calcium intake.

The third component of the Triad, amenorrhea, was collected in the demographics portion of the survey instrument used for the current study. In this study, 15 (35.71%) out of 42 of females that completed the EAT-26 portion females reported history of amenorrhea. Of these

female participants, 4 (26.67%) were found in the “at risk” group for adverse eating attitudes. Current literature suggests that up to 69% of female athletes exhibit symptoms of secondary amenorrhea due to their high demands for energy expenditure and low energy availability, in comparison to 2-5% in the general public.[36] Additionally, 27% of female athletes show signs of disordered eating regardless of sporting event.[36]

Two skaters who completed the survey in its entirety (n = 50) were classified at risk for adverse eating attitudes, inadequate calcium intake, and history of skeletal fracture injury, indicating that 4% of the participants were at risk for a Triad or RED-S diagnosis. Although the results from this study do not lend to a greater prevalence for risk for adverse eating attitudes, results do support the notion that these symptoms exist among figure skaters. Subsequent discussion will consist of result from the five hypotheses examined in this study.

Risk for Adverse Eating Attitudes

The results of the current study showed a statistically insignificant increased risk for adverse eating disorders, resulting in failing to reject the null hypothesis, with support not provided for the research hypothesis. These findings are contrary to the results expected. It is important to recognize that comparative studies used similar athletes and/or age of participants. However, these findings may be explained by the data collection method of a convenience sample and snowball sample rather than a random sampling since those skaters were within the networks of the researcher. Additionally, due to the sensitive nature of the online survey,

participants may not have felt comfortable truthfully answering the EAT-26 portion of the survey. Studies have noted adverse eating attitude behaviors among the figure skating population.[19,35] The prevalence of eating disorders has been found to be elevated (25 times greater) in elite athletes in lean-based sports versus non-athletes.[32] In 2000, a national screening assessment utilizing EAT-26, determined that an estimated 10% of high schoolers reported increased risk for adverse eating attitudes.[41]

Adverse Eating Attitudes and Calcium Intake

The current study results demonstrated a significant negative relationship for these two variables, with elevated EAT-26 scores indicative of inadequate total calcium intake; however, no significant association was found between the variables. The null hypothesis was not rejected, consistent with predictions for adverse eating attitudes impacting consumption of this essential micronutrient. These findings suggest a better understanding of the prevalence for nutritional deficiencies if one indicates or admits adverse eating attitude beliefs. Predominantly found in dairy products, calcium may potentially be viewed negatively by any individual due to the nature of how dairy products are made, its fat and/or carbohydrate content, and related misconception of resulting weight gain from consuming these types of food sources. Additional reasoning for low calcium intake might have been caused by the nature of the Greek survey, which asked a few questions on cheese and other dairy products potentially unrecognizable by the participant thus causing inaccurate responses. Limited studies have tested calcium intake among figure skaters, with these studies noting a trending low intake in this micronutrient vital to adequate BMD.[9,18]

One study determined after gathering 3-day, self-reported food records from thirty-six elite female figure skaters aged 13-22 years reported diets high in carbohydrates, but low in total caloric, fat, and micronutrient intakes essential for proper bone growth.[18] Calcium intake was also low among another cohort of skaters previously studied, falling below the recommended daily allowance of 1200 to 1500mg/d for teenage girls.[9] Little research has been conducted specific to understanding the relationship between adverse eating attitudes and calcium intake.

Adverse Eating Attitudes and History of Skeletal Fracture Injury

In the current study, no association was found between adverse eating attitudes and history of skeletal injury. Similar EAT-26 scores existed among skaters who did not have a history of skeletal injury and those who had a history of skeletal fracture injury. This may be due to a timeline discrepancy between when the skater reported their history of a skeletal fracture injury and their involvement in the sport, that is, that an individual might have broken a bone prior to becoming a committed athlete. Potentially, the skaters reporting risk for adverse eating attitudes may be at risk for a skeletal injury but have yet to experience one yet out of chance, good technique, or precise coordination on and off the ice. Another possibility to explain such results, related to the small sample size of the study. These findings resulted in not rejecting the null hypothesis. Female athletes have been noted to have a greater risk for vitamin and mineral deficiencies due to inadequate dietary intake, menstruation, and inflammatory responses related to heavy physical activity.[42] Within the figure skating population, one study compared BMD of

competitive female teenage figure skaters who had a history of fracture to skaters who had no fractures.[9] Results noted stress fracture type injuries are not caused by low BMD but rather may result from the high impact and force placed on the skaters' skeletons due to jumping.[9] These results further support previous research's explanations of increased prevalence, which primarily attributes skeletal fracture injuries in the sport of figure skating to the demands placed on the body to withstand forces 8-14 times the body weight during repetitive jumping practice.[34]

History of Skeletal Fracture Injury and Calcium Intake

In the current study, 10 incidences of bone break injuries were reported and 32 incidences of stress fracture injuries were reported. History of non-skeletal fracture injuries was not investigated in the current research. In the current study, no association was found between the prevalence for skeletal fracture injury and inadequate calcium intake, with no significant group difference of calcium intake among those who reported history of injury versus those that did not. No association was found between these two variables, and the null hypothesis was not rejected. These results do not reflect previous research findings, but may be explained by the retrospective nature of the FFQ used, misunderstanding about the types of Greek cheese asked, as well as the further support that the reason more than 50% of the figure skating injuries stem from an instance of over-use syndromes.[20] Of those who reported skeletal fracture injuries (n = 20), all were singles skaters and one of those singles skaters also competes in the ice dance discipline. No pairs skater (n = 5) reported skeletal fracture injury. It has been reported that pairs and ice dance skaters are at a higher risk for acute injuries in comparison to their counterparts

due to the likelihood to encounter injuries related to falls from lifts and throw jumps and the implied risk of coordinating movement with another person.[20] Due to the small sample size of participants that identified as ice dancers or pairs skaters in the current study, these expectations were not met. Other studies have documented insufficient vitamin D and calcium status in female athletes, recognizing that which may be associated with injuries, such as stress fracture, may limit their ability to participate in regular physical activity.[41] Furthermore, teenage athletes have been found to be able to achieve most lifestyle factors to reach peak bone mass, with the exception of calcium intake due to lack of consumption of calcium rich foods.[43]

Adverse Eating Attitudes and Gender

Results from the current study determined no significant differences between mean EAT-26 scores across gender. Thus, the null hypothesis was not rejected, and support was not found for the research hypothesis. These results contradict current literature which has found females to more at risk for developing ED/DEs than males. In other aesthetic sports such as gymnastics, both female and male populations have been studied to determine prevalence for adverse eating attitudes. Disordered eating attitudes were found to be more prevalent in females (17%), while only 8% of all males scored above the cut-off point after completing EAT-26 evaluation tool.[21] The findings from the current study can be explained due to the poor representation of number of male skaters in comparison to females resulting from my smaller sample size.

Conclusion

Competitive figure skaters were not found to be at greater risk than the general population for having adverse eating attitudes. Results of this study found that competitive skaters that are at risk for adverse eating attitudes have a greater likelihood for consuming inadequate amounts of calcium. Competitive figure skaters' history of skeletal fracture injury is not related to their risk for adverse eating attitudes, nor to inadequate intake of calcium. No significant difference in risk for adverse eating attitudes for competitive figure skaters exists across gender; however, more females than males reported higher EAT-26 scores indicative of higher risk for adverse eating attitudes.

Findings indicate that adverse eating attitudes exist among this population and this behavior is negatively related to calcium intake. Therefore, the need exists for nutrition education among this population, specific to the importance of adequate calcium intake and ways to incorporate calcium-rich food sources in the diets of these athletes, especially those with adverse eating attitudes. Coaches and parents needed to be equally aware of the pressure placed on the athletes for the sake of sparing them from being at risk for the development of adverse eating attitudes linked to detrimental Triad and RED-S components.

CHAPTER 6

STRENGHTS, LIMITATIONS, AND FUTURE RESEARCH

Strengths

The major strength of this study was the reliability and validity of the survey instrument used. Supported by previous studies, the EAT-26 and calcium-specific FFQ used adequately fulfilled this study's purpose. The study design was also cost efficient from a monetary and time perspective, in addition to placing minimal burden on participants with freedom to complete the survey on their own accord. Additionally, ample time was given to participants to complete the survey as it was available from November 2016 to August 2017. This allowed skaters to complete the survey during "in" season and "off" season, and was done so as a means of convenience for study participants. Lastly, at the conclusion of the survey, links to reputable sites were included as a means for participants to obtain additional resources regarding the topics relevant to this study and as a means to offer additional support for participants. These links were to eatingdisorderhope.com and Team USA's Sport Performance Nutrition Resources and Fact Sheet.

Limitations

Limitations to this study include the final sample size of 50, constituting a 67.6% completion among those who agreed to participate. As noted in related previous studies, limitations to this study include self-reported data, skeletal injury history, history of amenorrhea, and self-reported nature of food recalls due to participants' inadequate recollection of either over- or under-estimating consumption of food items included. Participants' age could also have contributed to misreporting due to inaccurate responses, misunderstanding or misinterpretation of each component of the research instrument, and fatigue or disinterest impacting their ability to complete the study instrument in its entirety. Participants' responses were screened for accuracy in reporting calcium intake via the FFQ, and one was removed due to predicted incorrect values entered for frequency of food items questioned. Additionally, the FFQ used, was additionally a Greek survey tool, and further studies could compare these findings to that of a FFQ containing food more typical of the American population.[39] This preconceived limitation, stems from the suggestion that dietary assessment tools do need to be culturally appropriate to the target population being evaluated.[40] Finally, due to the sensitive nature of the EAT-26 test, participants may have under-reported or skewed their attitudes regarding their relationship with food, or chose to not participate any further after beginning this challenging, first portion of the survey instrument. Because it relies solely on subjective responses, there is no ability to screen the EAT-26 scores for error when entering information.

Future Research

Future studies should be similarly conducted to provide further insight into this sport-specific population, with further emphasis on incorporating males in their participant recruitment efforts. Research would benefit from understanding more about the changes seen in the health of figure's skating's athletes with regards to its increase in demands under the new judging system, and efforts made to increase recognition and resources available for the prevention, diagnosis, and treatment of each component of the Triad or RED-S. Because calcium and vitamin D depend on each other for adequate function and serum levels can indicate bone health, Vitamin D intake should be examined among this population too. As the most precise measurement of bone health, if financial and other resources are available, then participants' bone health via a DEXA should be considered. Also, because low EA is the primary constituent of both syndromes, future research could lend itself to understanding the relationship between training time and sport culture in comparison to other sports, as a means for determining sport-specific estimated energy needs per kilogram of body weight. Finally, a more behavior-theory-based design and inclusion of a dietary education follow-up constituent could not only benefit future research but also the athletes identified as being at risk.

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APPENDIX A

EATING ATTITUDES TEST (EAT-26)

EAT-26[16]

Eating Attitudes Test (EAT-26)©

Instructions: This is a screening measure to help you determine whether you might have an eating disorder that needs professional attention. This screening measure is not designed to make a diagnosis of an eating disorder or take the place of a professional consultation. Please fill out the below form as accurately, honestly and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Part A: Complete the following questions:

1) Birth Date	Month:		Day:		Year:	2) Gender:	Male ☐ Female ☐
3) Height	Feet :		Inches:				
4) Current Weight (lbs.):			5) Highest Weight (excluding pregnancy):				
6) Lowest Adult Weight:			7: Ideal Weight:				

Part B: Check a response for each of the following statements:		Always	Usually	Often	Some times	Rarely	Never
1.	Am terrified about being overweight.	☐	☐	☐	☐	☐	☐
2.	Avoid eating when I am hungry.	☐	☐	☐	☐	☐	☐
3.	Find myself preoccupied with food.	☐	☐	☐	☐	☐	☐
4.	Have gone on eating binges where I feel that I may not be able to stop.	☐	☐	☐	☐	☐	☐
5.	Cut my food into small pieces.	☐	☐	☐	☐	☐	☐
6.	Aware of the calorie content of foods that I eat.	☐	☐	☐	☐	☐	☐
7.	Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)	☐	☐	☐	☐	☐	☐
8.	Feel that others would prefer if I ate more.	☐	☐	☐	☐	☐	☐
9.	Vomit after I have eaten.	☐	☐	☐	☐	☐	☐
10.	Feel extremely guilty after eating.	☐	☐	☐	☐	☐	☐
11.	Am preoccupied with a desire to be thinner.	☐	☐	☐	☐	☐	☐
12.	Think about burning up calories when I exercise.	☐	☐	☐	☐	☐	☐
13.	Other people think that I am too thin.	☐	☐	☐	☐	☐	☐
14.	Am preoccupied with the thought of having fat on my body.	☐	☐	☐	☐	☐	☐
15.	Take longer than others to eat my meals.	☐	☐	☐	☐	☐	☐
16.	Avoid foods with sugar in them.	☐	☐	☐	☐	☐	☐
17.	Eat diet foods.	☐	☐	☐	☐	☐	☐
18.	Feel that food controls my life.	☐	☐	☐	☐	☐	☐
19.	Display self-control around food.	☐	☐	☐	☐	☐	☐
20.	Feel that others pressure me to eat.	☐	☐	☐	☐	☐	☐
21.	Give too much time and thought to food.	☐	☐	☐	☐	☐	☐
22.	Feel uncomfortable after eating sweets.	☐	☐	☐	☐	☐	☐
23.	Engage in dieting behavior.	☐	☐	☐	☐	☐	☐
24.	Like my stomach to be empty.	☐	☐	☐	☐	☐	☐
25.	Have the impulse to vomit after meals.	☐	☐	☐	☐	☐	☐
26.	Enjoy trying new rich foods.	☐	☐	☐	☐	☐	☐

Part C: Behavioral Questions: In the past 6 months have you:		Never	Once a month or less	2-3 times a month	Once a week	2-6 times a week	Once a day or more
A	Gone on eating binges where you feel that you may not be able to stop? *	☐	☐	☐	☐	☐	☐
B	Ever made yourself sick (vomited) to control your weight or shape?	☐	☐	☐	☐	☐	☐
C	Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?	☐	☐	☐	☐	☐	☐
D	Exercised more than 60 minutes a day to lose or to control your weight?	☐	☐	☐	☐	☐	☐
E	Lost 20 pounds or more in the past 6 months	Yes ☐		No ☐			

* Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control

APPENDIX B

FOOD FREQUENCY QUESTIONNAIRE (FFQ) FOR CALCIUM INTAKE

FOOD FREQUENCY QUESTIONNAIRE FOR CALCIUM INTAKE

Name: _____ Date: _____

Please, answer the following questions to define **how often** and **how much** of the following food items you *usually* consumed during the *previous 12 months*.

	Frequency →	> 6 times/d	4–6 times/d	2–3 times/d	1 time/d	5–6 times/wk	2–4 times/wk	1 time/wk	1–3 times/mo	Rarely or never
Food item ↓	**Quantity ↓**									
Milk (any kind)	1 glass									
Yogurt (any kind)	1 pot									
'Feta' cheese	1 matchbox									
'Graviera' cheese	1 matchbox									
'Kaseri' cheese	1 matchbox									
Mozzarella	1 matchbox									
Emmenthal, cheddar, gouda, or edam	1 matchbox									
Parmesan or 'kefalotiri' cheese (plain or with pasta)	1 tablespoon									
'Anthotiro' cheese	1 tablespoon									
Mashed cheese (soft, cream, cottage, etc.)	1 tablespoon									
Cheese pie	1 serving									
Cream pie	1 serving									
'Leafy vegetables' pie	1 serving									
Spinach pie with cheese	1 serving									
Bread (or similar	1 slice or 1 piece									
bakery products, e.g. cracker, bread-stick; any kind)										
Cereals (any kind)	½ cup									
Peanuts or almonds	1 handful									
Other nuts (hazelnuts, chestnuts, walnuts, etc.)	1 handful									
Spinach (plain or with rice)	1 cup									
Salad vegetables (any kind, raw)	½ cup									
Green vegetables (any kind, cooked)	½ cup									
Potatoes	1 medium									
Legumes	1 cup									
Sardines	10 small									
Scallops (any kind)	1 serving									
Shrimps	1 serving									
White fish or salmon	1 serving									
Eggs	1 egg									
Ice cream (any kind except sorbet)	2 scoops									
Chocolate (any kind except bitter)	5 squares									

Do you take any calcium or multivitamin supplements? YES _____ NO _____

Do you, for any reason, avoid eating dairy products? YES _____ NO _____

APPENDIX C

CALCIUM CONTENT OF FFQ CALCIUM SOURCES

Food item	FFQ quantity	Weight equivalent (g)	Calcium content (mg)
Milk	1 glass	250	250
Yogurt	1 pot	225	280
Feta cheese	1 matchbox	20	65
Graviera cheese	1 matchbox	20	180
Kaseri cheese	1 matchbox	20	150
Mozzarella	1 matchbox	20	88
Emmenthal, cheddar, etc.	1 matchbox	20	160
Parmesan or kefalotiri cheese	1 tablespoon	15	120
Anthotiro cheese	1 tablespoon	20	50
Mashed cheese	1 tablespoon	15	56
Cheese pie	1 serving	100	300
Cream pie	1 serving	100	150
Leafy vegetables pie	1 serving	100	50
Spinach pie with cheese	1 serving	100	200
Bread and similar	1 slice or 1 piece	30	25
Cereals	1/2 cup	100	20
Peanuts or almonds	1 handful	25	60
Other nuts	1 handful	25	30
Spinach	1 cup	240	216
Salad vegetables	1/2 cup	120	60
Green vegetables	1/2 cup	120	60
Potatoes	1 medium	100	10
Legumes	1 cup	240	96
Sardines	10 small	60	200
Scallops	1 serving	100	100
Shrimps	1 serving	100	200
White fish or salmon	1 serving	100	70
Eggs	1 egg	40	25
Ice cream	2 scoops	100	151
Chocolate	5 squares	25	50

APPENDIX D

RECRUITMENT MESSAGE TO ELIGIBLE PARTICIPANTS

Hello!

I am currently a graduate student at Northern Illinois University pursuing my masters in science degree in Nutrition and Dietetics. As part of my curriculum, I am currently in the process of completing my thesis research.

I am contacting you in hopes that you may consider being a participant in my research project that looks at eating behaviors, calcium intake, and histories of bone fracture injuries. Calcium and vitamin D are needed for adequate bone strength which figure skating requires. You have been asked to participate in this study because you are currently an American figure skater who has competed at or is planning to compete in one or more of the United States Figure Skating qualifying competitions (Regionals, Sectionals, and/or Nationals) in the singles, pairs, and/or ice dance disciplines.

If you agree to participate, you will be asked to complete a one-time survey, consisting of 20 questions related to your eating attitudes and calcium intake. The survey is expected to take no more than 10-15 minutes to complete.

If you are interested and willing to be a participant, the anonymous, one-time survey can be found at https://niu.az1.qualtrics.com/SE/?SID = SV_6mocot2oJtbr7k9. Thank you in advance for your generous consideration in helping me fulfill my graduation requirements.

APPENDIX E

BUSINESS CARD WITH SURVYE QR CODE


Northern Illinois University
NIU
Dana Sivak
Thesis Research Survey
Dsivak@niu.edu
Proof

APPENDIX F

IRB APPROVAL LETTER

Exempt Determination

17-Oct-2016

Dana Sivak

Family, Consumer and Nutrition Sciences

RE: Protocol # **HS16-0331 "The impact of adverse eating attitudes and inadequate calcium intake on the prevalence of skeletal fracture injuries among competitive American figure skaters**"

Dear Dana Sivak,

Your application for institutional review of research involving human subjects was reviewed by Institutional Review Board #1 on **17-Oct-2016** and it was determined that it meets the criteria for exemption 2.

Although this research is exempt, you have responsibilities for the ethical conduct of the research and must comply with the following:

Amendments: You are responsible for reporting any amendments or changes to your research protocol that may affect the determination of exemption and/or the specific category. This may result in your research no longer being eligible for the exemption that has been granted.

Record Keeping: You are responsible for maintaining a copy of all research related records in a secure location, in the event future verification is necessary. At a minimum these documents include: the research protocol, all questionnaires, survey instruments, interview questions and/or data collection instruments associated with this research protocol, recruiting or advertising materials, any consent forms or information sheets given to participants, all correspondence to or from the IRB, and any other pertinent documents.

Please include the **protocol number** (**HS16-0331**) on any documents or correspondence sent to the IRB about this study.

If you have questions or need additional information, please contact the Office of Research Compliance and Integrity at 815-753-8588.

APPENDIX G

ONLINE SURVEY ADMINISTERED

Welcome to the research study!

The purpose of this study is to understand the eating behaviors, calcium intake, and bone health of current, competitive American figure skating athletes. Eligibility requirements include skaters who have competed at or are planning to compete in one or more of the United States Figure Skating 2017 qualifying competitions (Regionals, Sectionals, and/or Championships) in the singles, pairs, and/or ice dance disciplines.

By clicking the button below, you acknowledge that you meet these eligibility requirements, that your participation in the study is voluntary, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason. All of your responses will be recorded anonymously. If you would like to contact the Principal Investigator in the study to discuss this research, please e-mail Dana Sivak at dsivak@niu.edu. Please note that this survey may be completed on a laptop, desktop computer, or utilizing your smartphone.

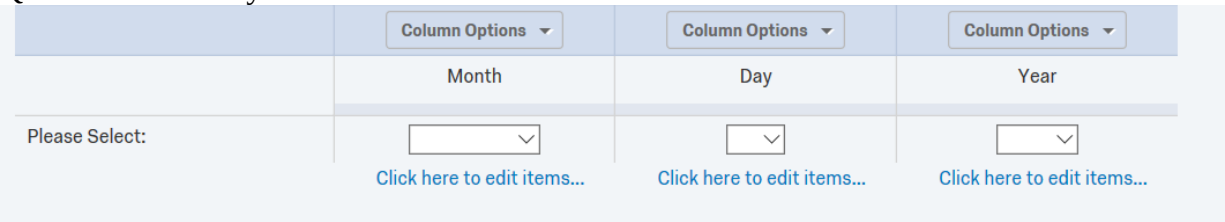
- I am under the age of 18. By clicking this, I am acknowledging my parents and/or guardians consent and my assent. Begin the study. (1)
- I am 18 years or older. By clicking this, I am acknowledging my consent. Begin the study. (2)
- I do not consent. I do not wish to participate in this study. (3)

If I do not consent. I do not ... Is Selected, Then Skip To End of Survey

Instructions: Please fill out Part A as accurately, honestly, and completely as possible. As a reminder, all of your responses are confidential.

- I understand. (1)

Q1 Please indicate your birth date:

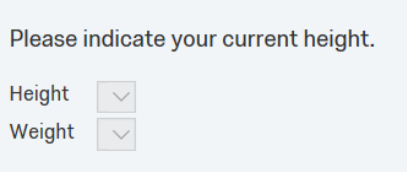


(Table Truncated to 63 Columns)

Q2 Please indicate your gender.

- Male (1)
- Female (2)

Q3 Please indicate your current height.



Q4 Please indicate your current weight (in pounds).

Q5 Please indicate your highest weight (in pounds), excluding pregnancy.

Q6 Please indicate your lowest adult weight (in pounds).

Q6 Please indicate your ideal weight (in pounds).

Q7 Select a response for each of the following statements:

	Always (1)	Usually (2)	Often (3)	Some times (4)	Rarely (5)	Never (6)
Am terrified about being overweight. (1)	•	•	•	•	•	•
Avoid eating when I am hungry. (2)	•	•	•	•	•	•
Find myself preoccupied with food. (3)	•	•	•	•	•	•
Have gone on eating binges where I feel that I many not be able to stop. (4)	•	•	•	•	•	•
Cut my foods into small pieces. (5)	•	•	•	•	•	•
Aware of the calorie content of foods that I eat. (6)	•	•	•	•	•	•
Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.) (7)	•	•	•	•	•	•
Feel that others would prefer if I ate more. (8)	•	•	•	•	•	•
Vomit after I have eaten. (9)	•	•	•	•	•	•
Feel extremely guilty after eating. (10)	•	•	•	•	•	•
Am preoccupied with a desire to be thinner. (11)	•	•	•	•	•	•

Think about burning up calories when I exercise. (12)	•	•	•	•	•	•
Other people think I am too thin. (13)	•	•	•	•	•	•
Am preoccupied with the thought of having fat on my body. (14)	•	•	•	•	•	•
Take longer than others to eat my meals. (15)	•	•	•	•	•	•
Avoid foods with sugar in them. (16)	•	•	•	•	•	•
Eat diet foods. (17)	•	•	•	•	•	•
Feel that food controls my life. (18)	•	•	•	•	•	•
Display self-control around food. (19)	•	•	•	•	•	•
Feel that others pressure me to eat. (20)	•	•	•	•	•	•
Give too much time and thought to food. (21)	•	•	•	•	•	•
Feel uncomfortable after eating sweets. (22)	•	•	•	•	•	•
Engage in dieting behavior. (23)	•	•	•	•	•	•
Like my stomach to be empty. (24)	•	•	•	•	•	•
Have the impulse to vomit after meals. (25)	•	•	•	•	•	•

Enjoy trying new rich foods. (26)	•	•	•	•	•	•

Q8 In the past 6 months you have:

	Never (1)	Once a month or less (2)	2-3 times a month (3)	Once a week (4)	2-6 times a week (5)	Once a day or more (6)
Gone on eating binges where you feel that you may not be able to stop?* (1)	•	•	•	•	•	•
Ever made yourself sick (vomited) to control your weight or shape? (2)	•	•	•	•	•	•
Ever used laxatives, diet pills, or diuretics (water pills) to control your weight or shape? (3)	•	•	•	•	•	•
Exercised more than 60 minutes a day to lose or to control your weight? (4)	•	•	•	•	•	•
Lost 20 pounds or more in the past 6 months. (5)	•	•	•	•	•	•

Q26 Instructions: Please fill out Part A as accurately, honestly, and completely as possible. As a reminder, all of your responses are confidential.

- I understand. (1)

Q9 Please answer the following questions to define how often and how much of the following food items you usually consumed during the previous 12 months.

	> 6 times/d (1)	4-6 times/d (2)	2-3 times/d (3)	1 time/d (4)	5-6 times/wk (5)	2-4 times/wk (6)	1 time/wk (7)	1-3 times/mo (8)	Rarely or never (9)
Milk (any kind) - Quantity: 1 cup (1)	•	•	•	•	•	•	•	•	•
Yogurt (any kind) - Quantity: 1 container or 1/2 cup (2)	•	•	•	•	•	•	•	•	•
'Feta' cheese - Quantity: Size of 1 matchbox (3)	•	•	•	•	•	•	•	•	•
'Graviera' cheese - Quantity: Size of 1 matchbox (4)	•	•	•	•	•	•	•	•	•
'Kaseri' cheese - Quantity: Size of 1 matchbox (5)	•	•	•	•	•	•	•	•	•
Mozzarella - Quantity: Size of 1 matchbox (6)	•	•	•	•	•	•	•	•	•
Emmenthal, cheddar, gouda, or edam: Quantity - Size of 1 matchbox (7)	•	•	•	•	•	•	•	•	•

Parmesan or 'kefalotiri' cheese (plain or with pasta): Quantity - 1 tablespoon (8)	•	•	•	•	•	•	•	•	•
'Anthotiro' cheese: Quantity - 1 tablespoon (9)	•	•	•	•	•	•	•	•	•
Mashed cheese (isoft, cream, cottage, etc.): Quantity - 1 tablespoon (10)	•	•	•	•	•	•	•	•	•
Cheese pie: Quantity - 1 serving (11)	•	•	•	•	•	•	•	•	•
Cream pie: Quantity - 1 serving (12)	•	•	•	•	•	•	•	•	•
'Leafy vegetables' pie: Quantity - 1 serving (13)	•	•	•	•	•	•	•	•	•
Spinach pie with cheese: Quantity - 1 serving (14)	•	•	•	•	•	•	•	•	•

Bread (or similar bakery products, e.g. cracker, bread-stick; any kind): Quantity - 1 slice or 1 piece (15)	•	•	•	•	•	•	•	•	•
Cereals (any kind): Quantity - 1/2 cup (16)	•	•	•	•	•	•	•	•	•
Peanuts or almonds: Quantity - 1 handful (17)	•	•	•	•	•	•	•	•	•
Other nuts (hazelnuts, chestnuts, walnuts, etc): Quantity - 1 handful (18)	•	•	•	•	•	•	•	•	•
Spinach (plain or with rice): Quantity - 1 cup (19)	•	•	•	•	•	•	•	•	•
Salad vegetables (any kind, raw): Quantity - 1/2 cup (20)	•	•	•	•	•	•	•	•	•

Green vegetables (any kind, cooked): Quantity - 1/2 cup (21)	•	•	•	•	•	•	•	•	•
Potatoes: Quantity - 1 medium (22)	•	•	•	•	•	•	•	•	•
Legumes: Quantity - 1 cup (23)	•	•	•	•	•	•	•	•	•
Sardines: Quantity - 10 small (24)	•	•	•	•	•	•	•	•	•
Scallops (any kind): Quantity - 1 serving (25)	•	•	•	•	•	•	•	•	•
Shrimps: Quantity - 1 serving (26)	•	•	•	•	•	•	•	•	•
White fish or salmon: Quantity - 1 serving (27)	•	•	•	•	•	•	•	•	•
Eggs: Quantity - 1 egg (28)	•	•	•	•	•	•	•	•	•
Ice cream (any kind except sorbet): Quantity - 2 scoops (29)	•	•	•	•	•	•	•	•	•
Chocolate (any kind except bitter): Quantity - 5 squares (30)	•	•	•	•	•	•	•	•	•

Q10 Do you take any calcium or multivitamin supplements?

- Yes (1)
- No (2)

Q11 Do you, for any reason, avoid eating dairy products?

- Yes (1)
- No (2)

Q12 What discipline of figure skating do currently compete?

1. Singles (1)
2. Pairs (2)
3. Ice Dance (3)

Q13 What is the level you have or will compete during the 2017 Qualifying Season?

4. Pre-Preliminary (1)
5. Preliminary (2)
6. Pre-Juvenile (3)
7. Juvenile (4)
8. Intermediate (5)
9. Novice (6)
10. Junior (7)
11. Senior (8)

Q14 On average, how many hours a week do you:
_____ Train on the ice (1)
_____Train off the ice (e.g. ballet/dance, weight lifting, running, pilates, yoga, cycling, etc.) (2)

Q15 Have you ever experienced a skeletal injury, such as a bone break or stress fracture, during the years in which you competed at a United States Figure Skating regional, sectional, or national competition?

- Yes (1)
- No (2)

If No Is Selected, Then Skip To Are you female?

Q16 If you have broken a bone or a experienced a stress fracture injury, please indicate the type and number of past injuries.
_____ Bone break (1)
_____ Stress fracture (2)

Q17 Where was the location of your past skeletal injuries?

12. Back/Lumbar region (1)
13. Ribs/Sternum (2)
14. Arms/Shoulders/Clavicle (3)
15. Wrist/Hand (4)
16. Hip/Pelvis region (5)
17. Leg/Knee (6)
18. Ankle/Foot (7)
19. Fingers/Toes (8)

Q18 Are you female?

- Yes (1)
- No (2)

If No Is Selected, Then Skip To End of Block

Q19 How old were you when you had your first period?

- I have not had my first period yet. (1)
- < 8 years old (2)
- 9 (3)
- 10 (4)
- 11 (5)
- 12 (6)
- 13 (7)
- 14 (8)
- 15 (9)
- 16 (10)
- 17 (11)
- 18 (12)
- 19 (13)
- 20 > years old (14)

Q20 Have you ever missed your period for greater than 3 months (excluding pregnancy)?

- Yes (1)
- No (2)

Thank you for completing this survey.
If you are interested in obtaining additional resources regarding the topics relevant to this study, please utilize the following:

- https://www.eatingdisorderhope.com/, http://www.teamusa.org/About-the-USOC/Athlete-Development/Sport-Performance/Nutrition/Resources-and-Fact-Sheets.aspx

APPENDIX H

PERMISSION TO USE THE FOOD FREQUENCY QUESTIONNAIRE (FFQ) FOR CALCIUM INTAKE

← Reply ⟵ Reply all → Forward Archive Delete Set flag •••

LS Labros Sidossis
9/25/2016 1:39 AM ←

Re: Permission to use your calcium FFQ
To: Dana Sivak Cc: lsidossis@hua.gr

Hi Dana. You have my permission. Good luck. Best. LS

Sent from my iPhone.

On Sep 24, 2016, at 18:46, Dana Sivak <Z1751248@students.niu.edu> wrote:

> Hi Dr. Sidossis,
>
> My name is Dana Sivak, and I am currently a graduate student at Northern Illinois University in pursuit of my Masters in Nutrition and Dietetics.
>
> I am in the process of completing my thesis, currently titled: The impact of adverse eating attitudes and inadequate calcium intake on the
> prevalence of skeletal fracture injuries amongst elite American figure skating athletes.
>
> To complete my research, I anticipate my participants completing an Eating Attitudes Test (EAT-26) and a calcium-specific FFQ.
> Throughout my extensive literature research, I have come across your published article titled, "Development and validation of a food frequency questionnaire for assessing dietary calcium intake in the general population."
>
> I am very interested in utilizing the calcium FFQ you and your colleagues created and tested. In your published study, the FFQ's content and scoring system is readily available for readers and researchers. I am therefore writing to you in hopes of obtaining your approval to utilize it for my research. May I have your permission?
>
> Thank you for your time and attention regarding this very important matter.
> I look forward to hearing from you.
>
> Best regards,
> Dana Sivak
> *NIU Nutrition and Dietetics Graduate Student*
> *NIU Dietetic Intern*
>
> Sent from Mail for Windows 10