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Faculty of Health Sciences

Description of disordered eating among female athletes in Norway

A comparative cross-sectional study

Mimmi Meiju Susanna Vedenpää

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Abstract

Background: Disordered eating behavior (DEB) is more prevalent among female athletes compared to both male athletes and non-athlete women. This behavior can significantly compromise both the performance and overall health of athletes. However, it has been almost two decades since previous research reported DEB prevalence in the athletic Norwegian population, making an update on the subject necessary.

Aim: To assess the prevalence of DEB among Norwegian female athletes compared to their non-athlete counterparts. Further, to assess and describe factors that are associated with DEB.

Method: Data used in this study were collected via an online survey conducted between September 2022 and March 2023. Analyses was conducted on a total of 565 participants, of which 189 were athletes and 376 non-athletes. DEB prevalence was considered when surpassing the 2,5 EDE-Q global score clinical cutoff point and severity was assessed on the EDE-Q global score scale and four subscales. Associations between global score and BMI, training hours per week, mental and physical health and sports categories were explored.

Results: More than a quarter (28%) of the athletes and 45% of the non-athletes exhibited DEB. However, there was no significant difference in DEB severity between the groups for the mean EDE-Q global score or in any of the subscale. Both the amount of training hours per week and well as BMI category had a positive correlation to the global score. The global score was found to correlate negatively with an increased competitive level and both mental and physical health. The study also discovered that there was a significant association between DEB and sports category. Athletes participating in ball sports and endurance sports were found to be less likely to display DEB.

Conclusion: This study highlights the importance of examining DEB in athletes on multiple levels rather than as a uniform group. This approach would contribute to more comprehensive understanding of DEB within specific athletic subgroups and to tailoring interventions accordingly. Future research should focus on developing improved screening tools targeting athlete specific DEB thus identifying and describing the contributing factors in more detail.

Sammendrag:

Bakgrunn: Forekomsten av forstyrret spiseatferd (DEB) er hyppigere blant kvinnelige idrettsutøvere sammenlignet med mannlige utøvere og kvinner som ikke driver med idrett. Denne atferden kan påvirke både prestasjonen og den generelle helsen til utøverne betydelig. Det har imidlertid gått nesten to tiår siden DEB ble undersøkt i denne befolkningen, noe som gjør en oppdatering om emnet nødvendig.

Mål: Å undersøke forekomsten av DEB blant norske kvinnelige idrettsutøvere sammenlignet med kvinner som ikke driver med idrett. Videre, å vurdere og beskrive faktorer som er assosiert med DEB.

Metode: Dataen som ble brukt i denne studien ble samlet inn via en nettbasert undersøkelse gjennomført mellom september 2022 og mars 2023. Analysen ble utført på totalt 565 deltakere, hvorav 189 var utøvere og 376 ikke-utøvere. Forekomsten av DEB ble målt ut fra om den kliniske grenseverdien for EDE-Q global score på 2,5 ble overskredet, og alvorlighetsgraden ble vurdert på EDE-Q global score-skalaen og fire subskalaer. Sammenhengen mellom EDE-Q global score og kroppsmasseindeks (KMI), treningstimer per uke, mental og fysisk helse og idrettskategorier ble undersøkt.

Resultater: Over en fjerdedel (28%) av utøverne og 45% av ikke-utøverne viste tegn på DEB. Imidlertid var det ingen statistisk signifikant forskjell mellom gruppene i gjennomsnittlig EDE-Q global score eller noen av subskalaene. Både antall treningstimer per uke og KMI-kategori hadde en positiv sammenheng med EDE-Q global score. EDE-Q global score ble funnet å ha en negativ sammenheng med økt konkurranse- og prestasjonsnivå, samt både mental og fysisk helse. Studien fant også at det var en betydelig sammenheng mellom DEB og type idrett utøverne rapporterte. Utøvere som deltok i ballidretter og utholdenhetsidretter hadde mindre sannsynlighet for DEB.

Konklusjon: Fremtidig forskning bør fokusere på å utvikle bedre screeningsverktøy som retter seg spesifikt mot utøvere for å identifisere og beskrive mer detaljert hvilke faktorer som bidrar til å øke risiko for DEB. Videre understreker funnene i denne studien viktigheten av å undersøke DEB blant utøvere innenfor ulike typer idretter, heller enn å behandle dem som en ensartet gruppe. Denne tilnærmingen vil bidra til en mer omfattende forståelse av DEB innenfor spesifikke idrettslige undergrupper og til å tilpasse tiltakene deretter.

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Abbreviations

AA – Anorexia Athletica

AN – Anorexia Nervosa

ANCOVA – Analysis Of Covariance

ANOVA – Analysis of Variance

BITE – Bulimic Investigatory Test Edinburgh

BMD - Bone Mineral Density

BMI – Body Mass Index

BN – Bulimia Nervosa

BSQ – Body Shape Questionnaire

BUILT-R – Bulimia Revised Test

DEB – Disordered Eating Behavior

DMS – Drive For Muscularity Scale

DSM-5 – Diagnostic and Statistical Manual of Mental Disorders, 5th edition

EAT-26 – Eating Attitudes Test-26

EAT-40 – Eating Attitudes Test-40

ED – Eating Disorder

EDE-Q – Eating Disorder Examination Questionnaire

EDI-2 – Eating Disorder Inventory-2

EDI-3 – Eating Disorder Inventory-3

EDI-3 SC – Eating Disorder Inventory-3 Symptom Checklist

EDNOS – Eating Disorder Not Otherwise Specified

EHQ – Eating Habits Questionnaire

FAST – Female Athlete Screening Tool

FFQ – Food Frequency Questionnaire

IPAQ – International Physical Activity Questionnaire

LEA – Low Energy Availability

MBRSQ-AS – Multidimensional Body and Self Relations Questionnaire-Appearance Scales

ON – Orthorexia Nervosa

ORTO-15 – Orthorexia Nervosa Screening Tool

QUEDD – Questionnaire for Eating Disorder Diagnoses

RED-S – Relative Energy Deficiency in Sport

REK – Regionale Komiteer for Medisinsk og Helsefaglig Froskningsetikk

SCL-5 – Hopkins Symptom Checklist

SCOFF – Sick Control One Fat Food

SD – Standard Deviation

TEFQ – Three-Factor Eating Questionnaire

1 Background

1.1 Eating behavior

Eating behavior is a broad term that can be used to describe the type, amount, and frequency of food items consumed and the motives behind the choices (1). It also encompasses parental feeding practices, dieting behavior, and eating-related problems (1). The mechanisms behind the formation of eating behavior are complex and multi-faceted (1). Decisions concerning food and eating behavior are influenced by individual traits, namely psychological and physiological processes, contributing to aspects such as food responsiveness, self-regulation, taste preferences, and feeling of satiety (1). An individual's sociocultural background molds their eating behavior both directly, by passing on knowledge, values, and traditions, as well as indirectly, via passive observation of others' eating behaviors (1). Lastly, socioeconomic status, as well as both the physical, and the political, environments play a big role in the formation of one's eating behavior (1). These factors influence food safety and availability, thus dictating largely what the individual can eat (1).

It can be said that healthy eating behavior provides an individual with the optimal nutrition to support their body's basic physiological functions, as well as physical and mental health (2). However, when defining healthy eating behavior, it is not enough to only consider the quality and the amount of nutrition consumed (3, 4). Ethics, ideologies, social dining, and appearances, especially the size and shape of the body, can considerably influence the state of one's relationship with food. Therefore, these factors must be considered and accounted for when evaluating an individual's eating behavior (3, 4).

1.2 Disordered eating behavior and eating disorders

Eating behaviors can be described to exist along a spectrum, where healthy eating behavior is situated at one side while eating disorders (ED) are on the other (2). In between these two opposing behaviors, lies disordered eating behavior (DEB) (5). The terms, disordered eating behaviors (DEB) and eating disorders (ED), are often used interchangeably in the literature, which can be misleading as these terms should be considered distinctly separate (6). DEB can consist of different combinations of the following: suboptimal or excessive nutrition intake, pathogenic weight control behavior, and increased frequency of intruding thoughts about food, eating, and body (7). At this stage of eating behavior, an individual can continue to perform

daily tasks and maintain their personal relationships (7). It is important to note that an individual can potentially manage to meet their body's nutritional requirements, even though their relationship with food and their body has become disturbed (7). In contrast, an ED is a clinically diagnosed condition that meets specific behavior and symptom criteria, as defined by the American Psychiatric Association (8). Individuals suffering from DEB or an ED are found to struggle more with concerns about their weight and body image (9). It has been observed that an individual can migrate and oscillate along the eating behavior spectrum, moving between the different forms of DEB and EDs (2, 5). Unsurprisingly, DEB has been reported as a significant risk factor for the future development of an ED (10, 11)

1.3 DEB and ED in athletes

The development of DEB in athletes has been described as a continuum that might start with healthy, purposeful dieting, such as weight loss to improve athletic performance, but slowly progresses into more extreme measures of weight control and dieting (5). This type of DEB can increase in frequency and severity over time, and if not detected early on, may lead to the development of a clinical ED (5). It is not uncommon for an athlete to move back and forth along the eating behavior spectrum, a phenomenon that can be affected by the different stages of the training season or career, as well as injuries and illness (2). In athletes, DEB is typically focused on weight control and obtaining an "optimal sport-specific" body composition (5). Often this means that the aim is to lose fat mass, without losing lean body mass or more specifically, without losing muscle mass (9).

The type and severity of the adverse effects can vary depending on the duration of DEB and the type of weight control measures the athlete has used. Restricting energy intake can be done by skipping meals and fasting, or by reducing portion size (5). Some athletes may also use dieting pills to suppress their appetite (5). Compulsive exercising beyond the scope of an athlete's training plan, with the sole intention to achieve negative energy balance as opposed to improving athletic performance, can also be considered part of DEB (2). Athletes might also engage in episodes of binge eating, usually followed by some form of purging (5). Use of laxatives, enemas, vomiting, and excessive exercising are commonly used methods (5). Additionally, both active and passive dehydration, have been found to be a part of the athlete-specific DEB (2). Some studies have also suggested that athletes might be more susceptible for Orthorexia Nervosa (ON) (12, 13). ON is not currently recognized as a clinical diagnosis in the DSM-V, but it is considered a type of disordered eating behavior (DEB) characterized by an

excessive preoccupation with consuming only healthy foods (9, 12). People with ON may not necessarily be focused on losing weight, but rather on achieving optimal health by avoiding foods they consider to be impure or unhealthy. This often leads to eliminating whole food groups from their diets, spending an excessive amount of time choosing and preparing food, and even developing ritualistic behaviors around mealtimes (13). This rigid eating behavior often leads to social isolation, as individuals with ON may be unable to enjoy meals prepared by others (12). As a result, individuals with ON often suffer from malnourishment and deficiencies, weight loss and mental health issues such as anxiety and depression (12).

The human body is well adapted to survive periods of time with little to no food (3). In negative energy balance, the body will initially utilize fats and proteins as the main source of energy (instead of carbohydrates) to compensate for the reduced energy intake and is, therefore, able to maintain normal physiological functions (9, 14). Due to the combination of reduced weight yet an optimally-functioning body, athletic performance may temporarily increase, or indeed, peak (9). However, this temporary positive outcome is a crux that might promote a continuation in dieting and the formation of DEB (9). A low energy intake, particularly when combined with exercise, rapidly depletes muscle and liver glycogen storages, resulting in a detrimental effect on endurance performance and muscle recovery (7). Endurance performance will be further impaired over time by anemia, which may arise from iron, B12, or folate deficiency due to insufficient intake (9, 15). If energy requirements are not met for a prolonged period of time, the body will catabolise muscle proteins to release amino acids that can be used as a stopgap solution to maintain other, critically important physiological functions (16). This catabolic process results in muscle atrophy and consequently leads to a loss of athletic strength and power (9).

Purging and resultant dehydration can quickly lead to mineral deficiencies and electrolyte imbalances (5, 9). This may have a negative effect on nerve functions, resulting in the deterioration of motor skills and coordination, prolonged muscle recovery time, and cardiac arrhythmia (5, 9). Dehydration also causes a reduction in blood plasma volume, which decreases sweat capacity and therefore impairs thermo-regulation (9). Thus, training and competing in hot developmental conditions can be compromised (9). The athlete also runs a risk of testing positive for doping since some of the medicaments, laxatives, diuretics, and diet pills, are prohibited for athletic use and may be classified as doping (5).

Excessive exercising (beyond what is required for athletic training) increases the risk of overuse injury, overtraining syndrome, recovery time, muscle weakness, and general fatigue (9, 17). Due to the increased energy consumption, it also increases the risk of insufficient energy intake (9). Low energy levels are also associated with anxiety, irritability, and concentration difficulties (5). These in combination with overall poorer performance can cause an increased risk of depression for an athlete suffering from DEB or an ED (5). There lies a consensus that the negative health and performance consequences of DEB are to be taken seriously even if the behavior doesn't advance to the point of being a clinical ED, especially if present simultaneously with LEA (2, 7, 18).

Detecting an individual suffering from DEB or an ED is difficult due to a variety of reasons. Among athletes, the use of excessive exercise as a form of purging can go unnoticed for a prolonged time, and a low body fat percentage is often considered both normal and desirable (7). It must be acknowledged that an individual can suffer from DEB or an ED without displaying any visible signs usually connected to these illnesses, namely significant loss of, or fluctuations in, weight (5, 9). It is often the case that an individual afflicted by DEB or an ED either doesn't consider themselves having a problem, or does, but refuses to seek help (7, 9). The stigma and shame associated with DEB and EDs also increases the threshold to seeking help, thus increasing the importance of early detection by an external entity, such as a coach, a healthcare professional, a teammate, a parent (9, 19, 20). Without early detection of DEB, there is an increased risk of progression and development into an ED, along with the increased risk of serious long-term health consequences and mortality (2, 21).

1.4 Eating disorders definition

The fifth, and updated, edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) by APA considers eating disorders an umbrella term that covers the following seven subcategories (8):

- Anorexia Nervosa (AN),
- Bulimia Nervosa (BN),
- Binge Eating Disorder,
- Rumination Disorder,
- Pica,
- Avoidant or Restrictive Food Intake Disorder,
- Other Specified Feeding or Eating

Before the latest update in DSM-5**,** the last category, Other Specified Feeding or Eating Disorders and Unspecified Feeding or Eating Disorders was known as one diagnosis category; Eating Disorder Not Otherwise Specified (EDNOS) (22). EDNOS diagnosis was used when the patient presented a slightly less severe form of an ED (8, 22). This could, for example, be an individual meeting all the other criteria for AN diagnosis but didn't present with amenorrhea, or an individual with less frequent binging episodes than would've been necessary to qualify for a BN diagnosis while fulfilling all the other symptom requirements (22). After the revision in May 2013 EDNOS was split into the two currently used categories and, the criteria for AN and BN diagnoses was broadened causing a sudden increase in the more severe ED diagnoses compared to the previous years (22).

The most prevalent EDs among the different athlete groups seem to be the disorders that are focused on weight control i.e., AN and BN (7, 23)**.** Additionally**,** Anorexia Athletica (AA) has been suggested as a special diagnosis for an athlete presenting a lot of AN symptoms but not meeting all of the DSM-V criteria for AN diagnosis (24, 25).

The ED types commonly observed in athletes are characterized by extreme dissatisfaction and obsessive thoughts over body weight and shape (8). The patients also present pathologically disturbed behavioral and thought patterns related to food, eating, and training (7, 8). In order to support, and often conceal, this pathogenic behavior, the patient begins to isolate and devote continuously more of their time to the ED (7, 8). This leads to disruption of normal life and can severely damage the patients' personal relationships as well as work, school, or athletic performance (8, 10). DSM-V diagnostic criteria concerns aspects such as body mass index (BMI), recent changes in weight, psychopathology as well as duration, frequency, and type of disturbed eating behavior to define the ED type (8). The core characteristics of AN are an intense fear of weight gain and restrictive energy intake, either alone or combined with some form of purging, which has led to the emaciation of significantly low body weight (8). For adults this means BMI below 18,5 $kg \cdot m^{-2}$ according to the DSM-5, or below 17,5 $kg \cdot m^{-2}$ if diagnosed by ICD-10 code work for the diagnoses, which is currently in use in Norway (8, 22, 26). This is one of the main distinctions between AN and BN since these patients can often be at a normal weight (BMI: 18,5-24,9 $kg \cdot m^{-2}$) or even overweight (BMI: >25 $kg \cdot m^{-2}$) (8, 9). The main characteristic of BN is the reoccurring episodes of uncontrolled binge eating followed by some form of purging, such as vomiting or extreme exercising (8)**.**

Athletes form a unique population group where the normal parameters of measuring aspects such as their pathophysiological profile, "excessive" exercising and healthy body weight with the help of BMI and fat percentage don't apply as intended for the normal population (24, 27). This is one of the main reasons behind the suggested diagnosis of anorexia athletica (27). Formulation of the criteria for AA has proven to be a difficult task, due to the heterogeneity of the athletic population (25, 28). Optimal body composition and training can vary vastly between different sports and individuals (24). As of now, AA has yet to become an officially recognized diagnosis (8).

The mortality rates given to different EDs vary slightly in the literature but on average the crude mortality rate for AN is 5% per decade where 1 in 5 (20%) patients die by suicide (29, 30). The mortality rate for BN and EDNOS is approximately 2% per decade (30, 31). What makes AN particularly difficult to treat is that the patients rarely realize that they have a problem (9). Patients with AN often believe they are 'in control' of their dieting, whereas BN and/or EDNOS patients seem to experience less control and more guilt around their eating behavior, increasing the possibility of being receptive to clinical interventions (9, 11). In athletes, it has been found that the promise of improved athletic performance is a powerful motivator for the patient to agree to treatment (7).

1.5 Prevalence of Disordered Eating Behavor

Athletes appear to have a higher prevalence of DEB, and certain types of EDs, compared to the general population, although results vary widely (27, 32). Factors such as sex, sport type, and level of competition seem to play a role in the prevalence of DEB and EDs (10, 32, 33). Elite athletes are found to more likely to exhibit DEB than a clinically diagnosed ED (7).

To obtain up-to-date information on the current status of DEB and EDs in female athletes, a systematic search was conducted in PubMed on 9.12.2022 using the PICOS framework as a search strategy (Appendix 1**).** Eligibility criteria for the studies were: a) written in English, b) conducted within the past 10 years, c) conducted on humans, d) conducted on female athletes with or without non-athletic controls, or on athletes from both gender groups with or without non-athletic controls, and e) conducted on populations aged between 15 and 40 years. The exclusion process is detailed in the PRISMA flow chart (Appendix 2). Across three tables, a total of 32 studies provided prevalence data of DEB and EDs in female athletes, with or without male or non-athletic control groups. Specifically, table in Appendix 3 summarizes 18 cross-sectional and longitudinal studies on DEB prevalence, table in Appendix 4 includes 11 studies

on both DEB and ED prevalence, and table in Appendix 5 features 3 systematic reviews on DEB and ED prevalence.

1.5.1 Prevalence of DEB and ED in female athletes

The selected studies shown in Appendix 3 and 4, utilized more than 21 different validated questionnaires, most collecting data only by self-reporting, although three studies included an additional interview. DEB prevalence in female athletes was reported as a percentage by 21 cross-sectional and longitudinal studies (Appendix 3 and 4), and by one of the systematic reviews (see Appendix 5) for relevant studies)(12, 34-54). The prevalence reported by these cross-sectional and longitudinal studies ranged from 0%-74,4% of DEB in female athletes, with a median of 18,3% and an average of 26,5% (Appendix 3 and 4). Additionally, eight studies reported prevalence of either a current or a past ED ranging from 6,2% to 25,5%, with a median of 13% and an average of 13,4% (36, 49-53, 55). Additionally, the systematic review by Gibbs et al. (Appendix 5) found 31 studies out of 65 reporting DEB and ED prevalence in exercising women (33). Out of these, 17 reported a clinical ED prevalence to range between 0-48%, 17 studies reported a combined clinical and subclinical DEB prevalence to range in between 7,1%-89,2%, and six studies reporting it to range between 2,9% and 60% (33).

Aesthetic and weight dependent sports are generally associated with higher risk and prevalence of DEB and ED (10, 32, 33). Most of the studies presented in tables tables shown in Appendix 3, 4 and 5 support this conclusion, with the exception of the studies conducted by Petisco-Rodríguez et al. and Smith et al. (40, 46)**.** According to by Petisco-Rodríguez et al. the prevalence of DEB in female gymnasts was 2,5% and 5%, as measured by the Eating Attitudes Test (EAT-40) and Sick Control One Fat Food (SCOFF), respectively. Similarly, the prevalence of DEB in football players and non-athletes was 5% and 12,5%, and 20 and 16%, respectively (40). Smith et al. study was conducted on college cheerleaders using Eating Disorder Inventory (EDI-3) and an additional EDI-3 checklist identifying DE patterns. By only using EDI-3, the investigators did not discover any occurrence of DEB. However, when using the EDI-3 SC, the prevalence of DEB was found to be 42,1% and when analyzing the combined results from both questionnaires the prevalence was 10,2% (46). These findings indicate that the absence of standardized and athlete-specific questionnaires for identifying DEB in athletes leads to significant uncertainty in this field of research.

According to a study by Muia et al. (Appendix 4), the highest prevalence of DEB was found among Kenyan adolescent elite middle and long-distance athletes (≥1500m), with a rate of

75,4% as measured by the EDI-3 questionnaire (54). Notably, there was no significant difference in EDI-3 scores between athletes and non-athletes (54). The study also reported DEB prevalence rates of 71% based on the Three-Factor Eating Questionnaire (TEFQ), 16,1% based on a BMI < 17,5 $kg \cdot m^{-2}$, and a clinical ED rate of 4,9% based on the EDI-3 (54). These results further highlight the variability in results due to the lack of standardized measurement methods for DEB, and also indicate that DEB is more commonly found than clinical EDs.

Alongside Muia et al., two Norwegian studies listed in Appendix 3 have provided data on both prevalence of DEB and a current diagnosis of an ED (37, 51, 54). Both studies detected a higher DEB prevalence than ED (37, 51). For example, DEB prevalence was found to be 45,2% in female junior elite athletes, and EDs at 14% (51). Mathisen et al. found DEB in 8% of national female physique athletes and ED in 7,7%, with a reported history of ED at 34,6% (37). These findings reinforce the conception that DEB is frequently observed among female athletes, even more so than the diagnosis of a clinical EDs.

Most of the studies presented in Appendix 3 and 4, were conducted either on elite or professional athletes or college athletes. Among the elite or professional athletes, the mean DEB prevalence was 25%, with a median of 16% (39). The prevalence of DEB among college athletes was found to be similar, at 22% and 18% respectively. Three of the studies also compared DEB prevalence in elite or professional athletes and recreational athletes (34, 36, 39). All three studies discovered a higher prevalence of DEB in elite athletes than recreational, although the difference was only 0,1% in the study conducted by Ravi et al. (36).

1.5.2 Prevalence of DEB and ED in female athletes compared male athletes

The systematic search included eight cross-sectional studies and two systematic reviews which examined the prevalence of DEB in male and female athletes, and potential gender differences. Of the cross-sectional studies, five found that female athletes had a higher prevalence of DEB than males (41, 51, 55-57), while three found no differences in DEB between the genders (55, 58, 59), and only one study found males to present slightly higher ON tendencies than females (12). Consistent findings were reported across all studies, except for the study by Martinez et al. (2015), which showed a higher prevalence of DEB in female athletes participating in contact sports who were not following a diet plan. However, no significant difference in the prevalence of DEB was observed between male and female athletes in contact sports who were following a diet plan (55).

The systematic review conducted by Bratland-Sanda and Sundgot-Borgen included 20 studies, of which six reported a higher prevalence of DEB in female athletes compared to male athletes (10). One study found no significant difference between the sexes. The review article by Rice et al. reported evidence from five studies suggesting females had a higher risk of ED, while a single meta-analysis concluded that there was a difference in ED risk between sexes (32). Overall, the evidence suggests that female athletes are more likely to experience DEB than their male counterparts.

1.5.3 Prevalence of DEB and ED in athletes and non-athletes

Through the systematic search, twelve cross-sectional studies (Appendix 3 and 4) and one systematic review article (Appendix 5) were identified, which included a non-athletic control group alongside an athletic population. The studies revealed varying results, with most reporting multiple findings on different scales regarding the prevalence of DEB between the two groups. In seven of the studies, the prevalence of DEB was higher in athletes for one, or several, scales (13, 37, 42, 43, 51, 54, 58). In contrast, the remaining six studies did not report any significant differences between the groups for at least one scale utilized (12, 38, 43, 54, 58, 59), and in five of the studies, at least one of the scales presented higher DEB prevalence in the non-athletic control group (38, 40, 42, 48, 58). Most of the studies shown in Appendix 3 and 4 utilized either multiple different questionnaires, or evaluated the various subscales (e.g., EDE-Q subscales: restraint, eating concern, shape concern, and weight concerns) of the questionnaires when trying to determine the prevalence of DEB and EDs leading to the varying findings within studies. Additionally, the athletic populations represented multiple types of sports, and five of the studies had a mixed-gender population, which further contributed to the heterogenic findings.

The outcome of the review article by Rice et al. was similar (32). It reported that ten studies had examined ED prevalence and body image (32). Out of these ten, three reported a higher prevalence of EDs and body dissatisfaction in mixed gender elite athlete groups compared to non-athletes, while two found no significant differences in either ED prevalence or body dissatisfaction between athletes and non-athletes (32). The review also found 5 studies that had identified several sport-specific risk factors for EDs and body dissatisfaction (32). These were young age, female sex, sport-specific body type requirements i.e., leanness, dieting, and a significant injury (32).

Despite the inconsistent results there seems to be more evidence stating that athletes, and especially female athletes, have a higher risk for DEB and EDs when compared to the non-athletic population.

1.5.4 Prevalence in Norway

Out of the aforementioned selected studies, only two were undertaken on a Norwegian population. Martinsen and Sundgot-Borgen conducted a study on athletes from elite sports high schools and non-athletic controls, while Mathisen et al. studied national-level female physique athletes and non-athletic controls (Appendix 4) (37, 51). Both studies found a higher prevalence of DEB and ED in the female athletes compared to the controls (37, 51). These studies are consistent with a large-scale cross-sectional study that was conducted on Norwegian elite athletes from multiple sports disciplines in 2004 (27). This study revealed that a higher proportion of Norwegian athletes (13,5%) had a subclinical or a clinical ED compared to non-athlete controls (4,6%) (27). The study also found that EDs were more common in Norwegian female athletes (20%) than male athletes (8%), and in weight dependent sports compared to non-weight dependent sport disciplines (27).

1.5.5 Higher prevalence of DEB after the Covid-19 pandemic

The COVID-19 pandemic resulted in a substantial increase in the incidence of DEB and ED, as well as exacerbated ED severity due to the deterioration in general mental health of affected individuals (60, 61). This increase was observed in both non-athletic and athletic communities (60-63). For example, a large national study in the USA found a 15,3% increase in the incidence rate of EDs in the general population, in the one year after the Covid-19 pandemic had started (61). A systematic review found similar trends in other studies across the globe (60).

A recent study examining the experiences of current and former Olympic-level athletes discovered that 18% of the current athletes struggled with DEB during the pandemic (62). The same study revealed that nearly 43% of female athletes reported a decline in their body image and nearly 47% reported a deterioration in their relationship with food during the pandemic (62). Similar numbers were also reported for male athletes, at 14,3% and 14,3%, respectively. Respondents described that they attempted to gain back a sense of control that the pandemic had robbed them of via a more rigid control over their diet. Others stated they felt that they lost control over their diet because more time at home had increased their food access and reduced energy due to lack of stimulation. Due to reduced training hours caused by pandemic

restrictions, this was followed by elevated feelings of guilt and worsened relationship with both food and their body (62).

1.6 Higher DEB and ED prevalence among female athletes – potential causes and risk factors

1.6.1 Performance

The reasons for increased DEB and ED risk for female athletes are not clear but it is believed that they are multifactorial (64). In most sports, there is a strong association between improved athletic performance and body composition high in muscle and low in fat (65). This leads to an increased focus on the athletes' diet, weight, and body composition when chasing improved performance (5). Since the female body naturally has a higher fat-to-muscle ratio than the male physique, acquiring and maintaining the optimal body composition might be more challenging for women than for men (5). This can lead women to become more preoccupied with weight control and becoming more susceptible to DEB (18, 65).

1.6.2 Appearances

Females face greater societal pressure concerning their appearances, especially when it comes to their body figure, than men (65, 66). For female athletes, this pressure often doubles due to sport-specific aesthetic expectations (18, 65). The source of these expectations can be both internal and external (64). The athletes themselves might have an image of what the optimal body for their sport looks like, or the expectations can be implemented by coaches, teammates, a judging panel, or even by the society (64, 66). These risk factors have been found to be especially high in aesthetic sports, such as gymnastics and ballet, but most of the factors still exist in non-weight-dependent sports as well (18).

1.6.3 Early start of an athletic career

An early start of an athletic career and sport-specific training pose several risk factors for a young female athlete for developing DEB and an ED (64, 66). A comprehensive study of more than 600 young female athletes in Norway, discovered that those with EDs were found to have begun sport-specific training at a significantly earlier age (11,2 ± 2,4 years) than athletes without EDs, whose respective age at the start of training was 13 ± 1,5 years (64). The changes in body composition and hormonal functions during puberty are far more drastic in females than males (64). In light of the previous topics concerning performance and appearances, the natural increase in body fat percentage during puberty can trigger a young female athlete to struggle with their weight and body shape (64, 66).

Starting sport-specific training at an early age can lead an athlete to select a sport that is not well-suited to their natural physique and genetics, thus forcing them to pursue the body characteristics optimal for their sport through strict dietary and training regimes (5, 66). According to the Sundgot-Borgen study, the athletes who had started sport-specific training early and developed an ED, also started dieting earlier (14 ± 3,5 years) compared to the athletes without EDs (6,3 ± 1,9 years) (64). The onset of menstruation and the accompanying weight fluctuation was also found to exacerbate the desire for dieting and weight loss (64). The absence of a dietitian's guidance, insufficient understanding of nutrition and health, and reliance on untrustworthy sources for diet advice may all contribute to an increased risk of DEB in young athletes who start dieting (64, 66).

1.6.4 Personality traits

It has been suggested that the same personality traits that make an athlete excel in their field also make them more vulnerable to developing DEB (9, 65). Elite athletes are strongly associated with traits such as perfectionism, goal orientation, competitiveness, and compulsiveness which have also been linked to DEB (9, 65, 67). Furthermore, some research has shown that women often display elevated levels of perfectionism and experience heightened stress due to the demands of balancing their professional and personal lives, thereby amplifying the likelihood of developing DEB (67, 68). Due to the lack of athlete-specific research on the matter, it can only be speculated that this may also apply to the athletic population (68).

1.7 Female athlete specific consequences

1.7.1 The Female Athlete Triad Model and Relative Energy Deficiency in Sports

The Female Athlete Triad is a spectrum disorder consisting of three interrelated components: low energy availability (LEA) with, or without ED; menstrual dysfunction; and low bone mineral density (BMD). Energy availability is defined by the American College of Sports medicine as surplus energy that can be utilized for normal body functions after physical activity (69). LEA results from insufficient nutrition intake relative to the body’s energy expenditure (70). LEA can occur without DEB or an ED, but they do increase the risk, especially in athletes whose energy expenditure is high (69). LEA has a negative effect on the reproductive system promoting menstrual dysfunction (71). Both low energy availability and a decrease in estrogen levels alone have a negative effect on BMD which can significantly

increase the risk of stress fractures and the development of osteoporosis (72). The triad can be described to lie on a spectrum where one end is optimal energy availability, eumenorrhea (regular menstrual cycle), and optimal bone health, and on the other end low energy availability with or without ED, amenorrhea (the absence of menstruation), and osteoporosis (72). In the 2014 Consensus Statement of The International Olympic Committee it was acknowledged that the repercussions of LEA affect also on male athletes suggesting a term Relative Energy Deficiency in Sports (RED-S) to include athletes in both genders (69). However, this has been contradicted by The Female Athlete Triad Coalition claiming that RED-S model does not recognize that the Female Triad Model has been thoroughly researched and is an established tool in optimizing female athlete health (69).

1.7.2 Low Energy Availability

As mentioned above, LEA occurs when the dietary energy intake is not balanced with the body's energy expenditure (70). It can arise from a sudden increase in training volume or intensity without adjusting the nutrition intake to match the increased energy expenditure (70). LEA can occur accidentally due to a change in the training plan (e.g., increase in exercise volume or intensity) or intentionally as a result of excessive exercise, which can be a symptom of disordered eating behaviors (DEB) or eating disorders (ED) (70). It can also result from a reduction in energy intake that fails to meet the current energy expenditure (70). Consequently, both DEB and EDs significantly increase the risk of LEA (70).

1.7.3 Menstrual Health

The typical age for onset of menstruation is between the age of 11 and 14 years, although it can vary by ethnicity and race (5). Primary amenorrhea is diagnosed if menstruation hasn’t begun by the age of 16 (5). Menstrual cycle is calculated from the first day of menstrual bleeding to the last day before next bleeding begins. In an adult woman, a cycle between 24-38 days is considered normal (5). Normal menstrual flow is usually 2-7 days and accounts to about 30ml blood loss (5). Menstrual dysfunctions can manifest as abnormal bleeding or cycle length (5). Bleeding lasting over 7 days or blood loss over 80ml is considered excessive and referred to as menorrhagia (5). Sources may vary regarding to the definition of oligomenorrhea (5, 70). Generally, if menstrual cycle regularly exceeds 35-45 days it can raise a suspicion of oligomenorrhea (5, 70). Secondary amenorrhea is diagnosed when menses are absent for more than three consecutive months following the initial onset (70).

Menstrual dysfunctions may be caused by hormonal imbalances, physical abnormalities, illnesses (e.g., ovarian cancer) or developmental defects (5). However, the most common reason among female athletes is LEA (5, 70). Menstrual cycle is mainly controlled by the hormones from the hypothalamic-pituitary-gonadal axis (5). When the excess energy after physical activity is scarce, the body adapts and prioritizes only the most vital functions for survival and disrupts the hormonal secretion in this axis (5). If LEA persists, it can lead to amenorrhea and infertility (5). However, with a correction of energy balance nearly all cases are reversable (5). It must be acknowledged that the athletes bodyfat percentage seems to determine when the energy availability becomes too low to maintain menstruation but there seems to be individual variation (5, 70). Thus, lower body fat percentage increases the risk of both oligomenorrhea and amenorrhea.

1.7.4 Bone health

Bone tissue consists of living cells, proteins and two types of minerals, calcium and phosphorous. It is a metabolically active tissue that undergoes a continuous process of formation and breakdown throughout an individual's lifespan. The strength of a bone is influenced by numerous factors, with approximately 70% attributed to BMD. A lowered BMD increases the risk of bone fractures. The World Health Organization has defined osteopenia to be that a lowered BMD between 1,0 and 2,5 standard deviations below normal as osteopenia and BMD below 2,5 standard deviations as osteoporosis.

BMD influenced by a combination of intrinsic factors, that one cannot control as well as lifestyle related extrinsic factors. These include genetics, age and gender, women having a naturally lower BMD, as well as diet, body weight, smoking, physical activity, and hormonal balance. While physical activity is associated with increased BMD, athletes have a higher risk of stress fractures caused by repetitive training compared to the non-athletic population.

Both LEA and menstrual dysfunctions have a detrimental effect on BMD(70). As a result of the disrupted hormonal secretion in the hypothalamic-pituitary-gonadal axis, estrogen production in the ovaries is compromised (5). Estrogen is an anabolic hormone that promotes bone formation (5). Consequently, an imbalance occurs where bone breaking down exceeds bone formation(5) . Furthermore, LEA is often accompanied by insufficient intake of calcium, the building blocks of bone, and vitamin D which is needed for calcium absorption (5). If this state is prolonged it can lead to osteopenia progress into irreversible osteoporosis (70). Early

detection and intervention are crucial to prevent the triad from progressing to its three endpoints (72).

2 Study purpose overview

The most recent data is limited to high-school aged elite athletes or adult female physique athletes (37, 51). More comprehensive data on DEB and ED prevalence in Norwegian athletes is almost two decades old (27). Additionally, previous data shows that DEB and ED prevalence has been higher in Norwegian female athletes compared to male athletes and non-athlete females (25, 27). Therefore, there is a need for more extensive and up-to-date data on DEB and ED prevalence especially in Norwegian female athletes. Before the Covid-19 pandemic, the prevalence of AN in the general Norwegian population (including both genders) had stabilized over a six-year period, while the BN rate had declined (73). However, it is unknown whether these trends reflected the rates in athletes (73). With the onset of the pandemic, there has been a global increase in DEB and ED prevalence, and studies from other countries have shown an increase in female athletes specifically (60, 62). However, there is currently a lack of data on the impact of the pandemic on DEB and ED prevalence among Norwegian athletes.

Early detection of DEB is crucial for prompt treatment and recovery, as well as for preventing the development of EDs and reducing the risk of long-term health consequences and mortality (2). Therefore, obtaining current data on DEB among female athletes is necessary for prevention, treatment, and further research (18). A better understanding of DEB prevalence in the female athlete population can help develop screening tools for detection of individuals at risk and those who have already fallen ill (18). Particularly because DEB is more prevalent in this group, and detecting DEB is known to be challenging (18). Therefore, this study aims to provide current knowledge of DEB prevalence among Norwegian female athletes from various sports compared to non-athletes.

3 Aim

The aim of this study was twofold. The primary aim of this study was to assess the prevalence of DEB among Norwegian female athletes compared to their non-athlete counterparts. The secondary aim was to assess and describe factors that are associated with DEB.

4 Methods

4.1 Study design and data collection

This study was a comparative cross-sectional study. Participants were recruited between29th of September 2022 and 1st of March 2023. Athletes of any sport, who were living in Norway, were invited to participate, in addition to non-athletes of similar age range (i.e., control participants). Recruitment of the athletes occurred via e-mail invites sent to coaches, teachers, and support staff at Norwegian sports associations (*særforbund*), sports clubs and high schools with possibility to specialize in elite level sports (*toppidrett*). The control population was recruited via social media posts and word-of-mouth. Eligible participants were female, aged between 17 and 40 and, currently residing in Norway. However, those who reported being pregnant or planning to become pregnant within the forthcoming six months were excluded from the study.

Participants were asked to anonymously complete an online survey using a platform developed by University of Oslo (Nettskjema) in Norwegian. Survey is presented in Appendix 6. Answering the survey took approximately 10 minutes. The survey consisted of three parts: 1) general background information relevant to the research objectives; 2) Eating Disorder Examination Questionnaire (EDE-Q 6.0); and 3) an International Physical Activity Questionnaire (IPAQ).

4.2 Ethics

Potential participants were provided with a general information letter containing an overview of the study's purpose and methodology. Participants were then asked to sign an informed consent form, with the understanding that their participation in the study was completely voluntary. Due to the survey anonymity (i.e., no identifiable data was stored), individual data was unable to be deleted for any participants who wished to withdraw from the study after completing the survey completion, however this restriction was highlighted to participants, prior to requesting consent. The Regional Ethics Committee for Medical and Health Research (REK) assessed that this project did not fall under the Health Research Act (Helseforskningsloven, 2008, §9)(74), hence it did not require ethical approval from REK. Similarly, since this study did not handle any personal information that could have been used for reidentification, it did not require approval of personal data from the Norwegian Centre for Research Data (SIKT).

4.2.1 Data management plan

Only the student and the supervisors were able to accessto the raw survey data. All data downloaded from Nettskejma were stored on UiT's OneDrive; a secure access server that required two-step identification for login. As previously mentioned, data was collected anonymously, with no possible identifying information (e.g., name) recorded. Although the master's thesis is to be submitted mid-2023, project data will be stored for potential future publication purposes.

4.3 Survey methods

4.3.1 Section 1 – Background

In the background section of the survey, participants were asked to report the following information: age group category (17-20, 21-25, 26-30, 31-35, 36-40 years), height (cm), weight (kg), locality/county, and average hours spent training per week during past half a year (categories: < 2,5h, ≥ 2,5h, ≥ 4h, ≥ 8h, ≥ 10h/week). In cases where the height information could be potentially misconstrued due to unconventional unit representation (e.g., 1.60), we defaulted to the assumption that the measurement was intended in meters. BMI ($kg \cdot m^{-2}$) was calculated based on the given height and weight measurements. Participants were divided into their respective BMI categories according to the World Health Organization's classifications(75). The BMI categories were as follows: <18,5 kg/m^2 underweight, ≥ 18,5 – 24,9 kg/m^2 normal weight, ≥ 25 – 29,9 kg/m^2 overweight, ≥ 30 kg/m^2.

Additionally, participants were asked whether they currently participated in sports competitions. An affirmative answer to this question led to the following sport-specific questions: sports discipline, training history with their main sports discipline (given in years of consistent training), and athletic competition level (categories: recreational/unofficial, regional, national, and international/Olympic games).

Participants were asked to assess and provide information regarding their current physical and mental health. The assessment was conducted using a 7-point Likert scale, with the following grading system: 0 - "very bad," 1-2 - "bad," 3-4 - "good," and 5-6 - "very good". Additionally, participants were asked whether they were currently diagnosed with an ED or, had they received an ED diagnosis in the past but since recovered. Two questions using similar wording were also asked concerning any other mental health disorders.

The four questions concerning past and current diagnoses of ED or other mental health disorders were omitted due to a technical error. The online survey platform (Nettskjema) had created a condition where it didn't display the first question asking whether the participant was currently diagnosed with an ED, unless it first received a negative answer on the subsequent question asking whether the participant had received an ED diagnosis before, but since recovered. The subsequent question had been designed on purpose not to be displayed unless the first question had received a negative answer thus creating circular argument omitting both of the questions (See appendix 6, section 1, question 14 and 14.1). The two following questions concerning other mental health disorders encountered the same issue (See appendix 6, section 1, question 15 and 15.1). The Nettskjema online survey platform was contacted to confirm that this indeed was due to a technical issue.

Participants were also provided an open comment box (i.e., free textbox) to report if they were currently recovering from a physical injury or other illness (e.g., COVID-19). If they were, they were asked to provide information whether they felt that the illness/injury had an effect on their training, eating habits, or mental health. See Appendix 6 for more detail on the variables collected in section 11 of the survey.

Participants were also be asked questions regarding their menstrual cycle (e.g., average length of cycle), pregnancy and whether they use hormonal contraception. See Appendix 6 for more detail on the variables collected in sections 17-20 of the survey. This information is pertinent as menstrual cycle irregularities are a possible symptom arising from ED and DEB. Menstrual dysfunction was categorized based on an affirmative answer on "Normal menstruation cycle over 35 days but shorter than 3 months" and/or an affirmative answer on "Have you missed a period during the past 3-4 months".

4.3.2 Section 2 – Eating Disorder Examination Questionnaire 6.0

The Eating Disorder Examination Questionnaire (EDE-Q 6.0) (Appendix 6, Section 2), was used for measuring prevalence of DEB (76). The Norwegian translation of the EDE-Q 6.0 has shown satisfactory internal consistency for the global score (Cronbach's $\alpha = 0,94$) and for the subscales (Cronbach's $\alpha = 0,75$ to $0,90$), as well as good test-retest reliability when evaluating the psychopatophysiology and severity of an ED among Norwegian female university students ($24,8 \pm 6,9$ years) (77). Furthermore, it has shown great convergent validity with the original EDE interview (78).

EDE-Q 6.0 is a 28-item questionnaire designed for self-reporting information concerning the range and severity of features associated with EDs using the following subscales: restraint, eating concern, shape concern, and weight concern (76). The subscales consist of five or more question items that are measured on a 7-point Likert scale (0 to 6) in which the higher score means higher psychopathology and severity of disordered eating behavior (76). A global score is produced from the average of the four subscales which can be used for comparison (79). The clinical cutoff point for ED has been derived from the original EDE interview recommendations and been set at global score > 4. It has since been found to be too high and to underestimate the prevalence of EDs (80). Currently there are multiple different cutoff points at use validated by their respective populations(42, 43). Cutoff score > 2,5 has been validated among adult Norwegian female population and is utilized in this study (80).

4.3.1 Section 3 – International Physical Activity Questionnaire

The International Physical Activity Questionnaire (IPAQ) shown in Appendix 6, Section 3, was used to assess participants' physical activity level (81). This questionnaire has been validated internationally on adult population and translated into Norwegian by the Norwegian Directorate of Health (81, 82). In order to give exact answers, participants were given a free textbox.

Due to excessive number of missing and incomprehensible responses received for the IPAQ questionnaire it was found not to be reliable enough to utilize in further analysis.

4.3.2 Missing data

In order to minimize the occurrence of missing answers in the online survey, compulsory responses were implemented throughout the survey, thus requiring participants to complete all closed answer options. Free text options were only provided for height, weight and the IPAQ questionnaire to facilitate exact answers. Prior to data analysis, a visual inspection for commonality across the dataset was conducted. Data was assumed to be missing at random. Answers such as "I don't want to answer" or "I don't know" regarding their weight or height lead to inability to calculate BMI and lead it be considered missing. "I don't know", and "*" were considered missing variables for the IPAQ because they lead to inability to calculate MET scores. Additionally, if the response failed to answer the question (e.g., estimation of walked distance given as "I walk from the bus stop to the stables") they were interpreted as missing.

4.4 Participants

The categorization of the participants was loosely based on proposed criteria for athletes and exercisers by McKinney et al. (83). Because majority of the participants were unable to be categorized based on the aforementioned criteria, participants were divided into subcategories employing the following criteria: participation in sports competitions resulted in categorization as athletes, if not, then they were categorized as non-athletes. Athletes were further divided into recreational, regional, national, and international/Olympic-level athletes. They were also divided into six sports categories, based on their sports disciplines. The classification system incorporated six distinct categories of sports disciplines, namely aesthetic, ball, endurance, power, technical, and weight-dependent sports. This categorization (Table 1) was formulated using the framework proposed by Martinsen et al. in their study (51).

Table 1 - Classification of sports disciplines into six main categories

Aesthetic	Ball	Endurance	Power	Technical	Weight dependent
Diving	Ice hockey	Swimming	Short distance running	Dressage	Taekwondo
Cheerleading	Football	Triathlon	Short-track speed skating	Horseback riding	Karate
Rhythmic gymnastics	Handball	Cross-country skiing		Sailing	Brazilian jiu jitsu
	Floorball	Running			Olympic weightlifting
	Volleyball	Long-track speed skating			Powerlifting
	Lacrosse				
	Badminton				
	Basketball				

4.5 Statistical method

The statistical analyses were performed by using Stata version 17 (StataCorp., Texas, United States). Due to the large data sample (565 participants), normal distribution was assumed. Shapiro-wilk test and histogram analyses were employed to confirm the normal distribution of the data.

4.5.1 Descriptive statistics

Descriptive statistics of the study participants are presented in frequency counts and percentages. The prevalence of DEB was determined by calculating the percentage of participants who exceeded the clinical cutoff of 2,5 on the EDE-Q 6.0 global score.

4.5.2 ANOVA, ANCOVA and Tukey Honest Significance Difference

An unadjusted analysis of variance (ANOVA) was used to compare the difference in DEB symptom severity between the athletes and non-athletes. The crude mean values for global score and the subscale scores for the athletes were compared to those of the non-athletes.

After, an analysis of covariance (ANCOVA) was employed to compare the difference in symptom severity by comparing the mean global score and subscale scores between the two groups when adjusted for the following covariates: training hours per week, BMI category, self-evaluated mental health, self-evaluated physical health, highest education level, age groups and recovering from an injury/illness.

Thereafter I utilized an ANCOVA to examine interactions between the global score and the subscale scores with each individual covariate used in the previous model. After, a Tukey Honest Significance Difference post-hoc was conducted to further explore whether there were significant differences on the scales within the athletes and non-athletes as well as between the groups when stratified by the variables that showed significant interaction effects. The Tukey Honest Significance Difference was adjusted for self-evaluated mental health.

4.5.3 Linear regression

A multiple linear regression analysis was conducted to analyze the association between the global score and the following characteristics: competitive level, training history, BMI category, age group, highest education level, self-evaluated mental health, and self-evaluated of physical health.

4.5.4 Pearson-Chi square and adjusted residual analyses

Pearson chi-square tests was performed to assess the association between surpassing the clinical cutoff, 2,5, on the EDE-Q global score scale and sports categories (non-athletes were included "no sports category"), competitive levels (non-athletes were included "not competing") and being injured or ill. Additionally, similar test was conducted to explore the association between self-evaluated mental health and the different competitive levels.

If the Pearson chi-square test showed significant association, an adjusted residual post-hoc was conducted to explore the differences were significant within the subgroups. If the test statistic for a residual was ≥ 1.96 or < -1.96 the association was interpreted to be significant. A negative residual indicated that the observed count was lower than expected assuming independence, while positive count indicated a higher count.

4.5.5 Power calculation for sample size

To determine the required sample size for the present study, a power calculation was performed with G*Power (version 3.1.9.7,)(84). Assuming α=.05 and an allocation ratio of 1:1 for athletes:controls, an estimated minimum total sample size of n = 309 was calculated as

necessary to achieve appropriate (i.e., β=0,20) statistical power to detect a small-to-moderate effect size (Cohen's f = 0,16), as previously reported by Sundgot-Borgen & Torstveit (2004)(27).

5 Results

5.1 Participant characteristics

Data analyses was completed on 565 participants, of which 189 were categorized as competing athletes and 376 as non-athletic controls shown in Table 2. The athletic population consisted of 16 participants competing at the recreational level, 56 at the regional level, 94 at the national level, and 23 at the international or Olympic level. Ball and endurance sports were the predominant sport categories, accounting for nearly 90% of the athletes, with 89 participants in ball sports and 75 in endurance sports. The remaining athletes participated in weight-dependent sports (15 participants), aesthetic sports (5 participants), technical sports (3 participants), and power sports (2 participants). Swimmers comprised the majority of the endurance athletes (57 participants) while handball was most represented ball sport with 50 participants (see Appendix 7)

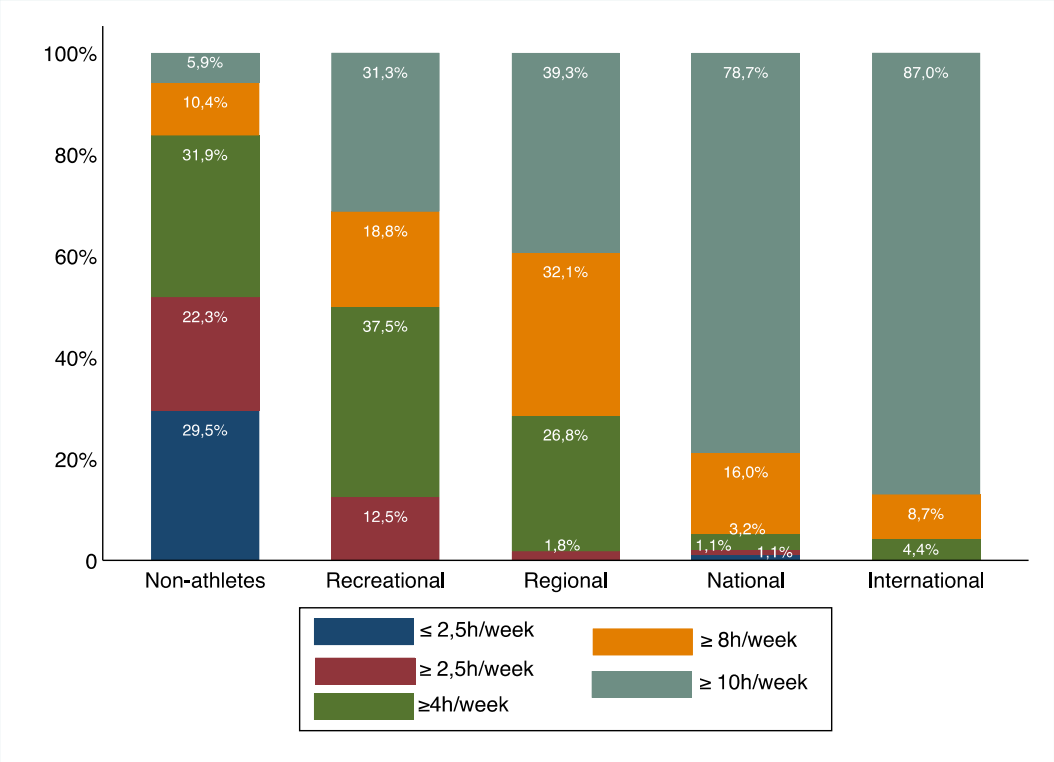

Figure 1 - Training frequency in hours per week in non-athletes and in athletes at the different competitive levels

In the population of athletes, the most common age group was 17-20 years, comprising 52,4% of the sample. In contrast, the non-athlete group featured two prominent age groups: 21-25 years (34,3%) and 26-30 years (33,2%), as shown in Table 2. A higher percentage of athletes

(72,4%) exhibited normal weight compared to non-athletes (58,3%). Meanwhile, all other BMI categories were more prevalent in the non-athlete group. Nearly half of the athletic population had high school as their highest level of education, whereas 40,4% of the non-athletes had undergone over 4 years of higher-level education. Most of the athletes, 64,0%, reported training for more than 10 hours per week during the past six months. In comparison, only 5,9% of the non-athlete population trained for an equivalent duration**.** Among non-athletes, the two most prevalent training categories were those engaging in less than 2,5 hours of training and those participating in at least 2,5 hours of training per week, with 29,5% and 31,9% of individuals in each category, respectively (Figure 1). Approximately 60% of participant in both groups used hormonal contraception and 53,4% of athletes and 47,6% on non-athletes reported having some form of menstrual dysfunction. Nearly 30% of athletes and close to 10% of non-athletes reported being in recovery from an injury or illness when they completed the survey.

Table 2 – Participant characteristics

Demographic information	**Athletes** **n = 189**	**Non-athletes** **n = 376**
Age group, n(%)		
17-20 years	99 (52,4)	57 (15,2)
21-25 years	45 (23,8)	129 (34,3)
26-30 years	30 (23,8)	125 (33,2)
31-35 years	12 (15,9)	58 (15,4)
36-40 years	3 (1,6)	7 (1,7)
BMI group, n (%)		
≤18,4 kg·m^{-2} (underweight)	4 (2,1)	20 (5,3)
18,5-24,9 kg·m^{-2} (normal weight)	137 (72,4)	220 (58,3)
25-29,9 kg·m^{-2} (overweight)	32 (16,9)	87 (23,1)
≥ 30 kg·m^{-2} (obese)	13 (6,0)	44 (11,7)
missing	3 (1,6)	5 (1,3)
Highest level of education, n (%)		
Elementary school	18 (9,5)	16 (4,3)
Highschool	89 (47,1)	106 (28,2)
University level education < 4years	40 (21,2)	102 (27,2)
University level education ≥ 4years	42 (22,2)	152 (40,4)
Using hormonal contraception, n (%)	113 (59,8)	231 (61,4)
Menstrual dysfunction, n (%)	101 (53,4)	179 (47,6)
Currently recovering from an injury or an illness, n (%)	52 (27,5)	33 (8,8)
Hours of training per week (last 6 months)		
< 2,5h	1 (0,5)	111 (29,5)
≥ 2,5h	4 (2,1)	84 (22,3)

≥ 4h	25 (13,2)	120 (31,9)
≥ 8h	38 (20,1)	39 (10,4)
≥ 10h	121 (64,0)	22 (5,9)
Sport categories, n (%)		
Aesthetic	5 (2,6)	-
Ball	89 (47, 1)	-
Endurance	75 (39,7)	-
Power	2 (1,1)	-
Technical	3 (1,6)	-
Weight dependent	15 (7,9)	-
Competitive levels, n (%)		
Recreational/unofficial	16 (8,5)	-
Regional	56 (29,6)	-
National	94 (49,7)	-
International/Olympic	23 (12,2)	-

5.2 Prevalence and severity of disordered eating behavior

Table 3 shows the prevalence of participants exceeding the 2,5 clinical cutoff score, indicating disordered eating behavior. A larger portion on the non-athletes had a score over the clinical cutoff, than athletes (45,0% versus 28,%). An unadjusted analysis of variance (ANOVA) revealed a significant difference in DEB severity on the EDE-Q global score and all the subscales ($p < ,001$). However, when adjusting for covariates, the ANCOVA model ($R^2 = 0,3766$, $F(15, 541) = 21,78$, $p < ,000$) found no significant differences in the EDE-Q global score ($p = ,277$). Training hours per week, BMI category, self-evaluated state of mental and physical health and recovering from an injury were found to be significant factors. Education level and age group were found not to be significant factors but age improved the model fit so it was kept in the final model.

Similar ANCOVA models were built to analyze the subscales; restraint ($R^2 = 0,2663$, $F(25, 531) = 7,71$, $p < ,000$), eating concern ($R^2 = 0,3114$, $F(25, 531) = 9,60$, $p < ,001$), shape concern ($R^2 = 0,3809$, $F(25, 531) = 13,07$, $p < ,000$) and weight concern ($R^2 = 0,3865$, $F(25, 531) = 13,38$, $p < ,000$). No found significant difference between athletes and non-athletes was found on any of the subscales.

Table 3 - The prevalence of participants scoring above 2,5 clinical cutoff score for DEB. Values for EDE-Q global score and subscales given as mean and standard deviation. P-value from the adjusted ANCOVA analyses for the difference between athletes and non-athletes.

EDE-Q scores	Athletes	Non-athletes	p-value, adjusted
Global score >2,5 cutoff, n (%)	53 (28,0%)	169 (45,0%)	-
Global score, mean (SD)	1,73 (±1,44)	2,31 (± 1,52)	,277
Restraint, mean (SD)	1,26 (±1,51)	1,77 (± 1,61)	,551
Eating concern, mean (SD)	1,08 (±1,39)	1,50 (± 1,53)	,191
Shape concern, mean (SD)	2,38 (±1,72)	3,10 (± 1,77)	,247
Weight concern, mean (SD)	2,19 (±1,72)	2,86 (± 1,74)	,413

EDE-Q - Eating Disorder Examination Questionnaire

The greatest variation between groups can be attributed to the self-assessed mental health status, which significantly impacted the global score and all subscale scores. This factor demonstrated a highly significant effect ($p < ,001$) and the largest effect on the variation, with partial sum of squares ranging from 160 to 293. Consequently, this factor contributed the most to enhancing the model fit for all the scales.

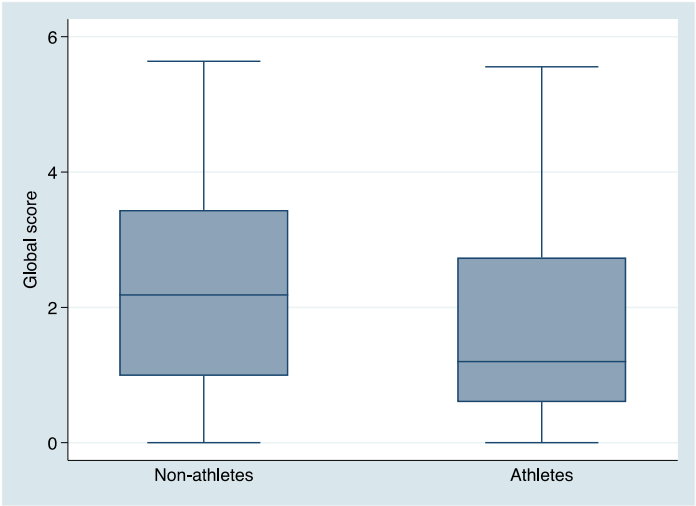

Figure 2 - The distribution of global score in non-athletes and athletes

Sensitivity analyses of factor interactions identified several significant interactions that enhanced the model fit. Notable interactions included BMI categories with global score ($p = ,002$), eating concern ($p = .115$, and shape concern ($p = ,034$), as well as an interaction between

age and the restraint subscale (p = ,009). However, no significant interactions were observed for weight concern.

A subsequent post hoc Tukey HSD analysis indicated that underweight athletes had significantly higher EDE-Q global scores, mean 4,26, CI 95% [3,04, 5,47] compared to underweight non-athletes, mean 1,88, CI 95% [1,33, 2,44], (p < ,001). This result was based on 4 athletes and 20 non-athletes.

Additionally, higher mean scores on the eating concern subscale were identified among underweight athletes relative to non-athletes who were underweight, mean difference 2,82, CI 95% [0,69, 4,95], (p = .002), normal weight, mean difference 2,49, CI 95% [0,52, 4,45], (p = ,003), and overweight, mean difference 2,19, CI 95% [020, 4,18](p = ,020), as well as athletes who were normal weight, mean difference 2,68, CI 95% [0,70, 4,66] (p = ,010 and overweight, mean difference 2,28, CI 95% [0,21, 4,35] (p = ,020). On the same subscale, obese non-athletes registered significantly higher scores than non-athletes who were underweight, mean difference -1,22, CI 95% [-2,27, -0,17], (p = ,011) and normal weight, mean difference -0,89, CI 95% [-1,54, -0,21],(p < ,001), and normal weight athletes, mean difference -1,82 CI 95% [-1,77, -0,39], (p < 001).

Both overweight and obese non-athletes exhibited greater shape concern compared to normal weight athletes mean differences of -1,22 CI 95% [-1,84, -0,60] and -1,46 CI 95% [-2,24, -0,67], (p < ,001) and normal weight non-athletes, -0,95 CI 95% [-1,51, -0,39] and -1,19 CI 95% [-1,92, - 0,45], (p < ,001, respectively. Additionally, they displayed higher shape concern than underweight non-athletes, with obese non-athletes showing a more pronounced difference, -1,39 CI 95% [-1,92, -0,45] (p = ,010) than overweight non-athletes, -1,15 CI 95% [-2,25, -0,05], (p = ,032).

The analysis also showed that athletes aged between 31-35 years scored higher on the restraint scale than athletes aged 21-25, mean difference -1,82 CI 95% [-3,27, -0,38],(p = ,003) and any of the participants from the youngest age group (17-20 years), with a mean difference of -1,72 CI 95% [-3,09, -0,36], (p = ,003) to the younger athletes and -1,56 CI 95% [-2,98, -0,14], (p = ,018) to the respective non-athletes. Moreover, athletes in the oldest age group (36-40 years) exhibited a higher mean restraint score than those aged 21-25 years with a mean difference of -2,68 CI 95% [-5,35, -0,00], (p = ,049).

Despite the absence of significant interactions for the weight concern subscale, a Tukey post hoc test was conducted to compare different BMI groups composed of both athletes and non-athletes. This analysis revealed that when contrasted with normal weight participants, there was a higher weight concern among the overweight, mean difference -1,14 CI 95% [-1,55, -0,68]. ($p < ,001$) and obese, mean difference -1,57 CI 95% [-2,20, -0,95], ($p < ,001$) participants.

5.3 Correlations between participant characteristics and DEB

The study conducted a multiple linear regression analysis to investigate the relationship between several variables and the severity of DEB measured on the EDE-Q global score scale. The analysis revealed that the overall regression was statistically significant ($R2 = .35$, $F(5,551) = 59.99$, $p < ,001$), indicating that the model explained a considerable proportion of the variance in the global score. The initial model included age groups and training history in years, but they were not significant and did not improve the model fit. Therefore, they were excluded from the final model. The marginal effect plots for the final model are presented in Appendix 8, showing the results of each predictor on the global score while holding the other predictors constant.

The analysis showed that an increase in training hours per week and an increase from a lower BMI category to a higher one, were correlated positively with the global score ($\beta = 0,15$, $p = ,006$ and $\beta = 0,44$, $p < ,001$, respectively). The BMI categories ranged from underweight to obese (1 to 4). Conversely, the global score was negatively correlated with an increase in competitive level category ($\beta = - 0,13$, $p =,019$), which ranged from non-athletes to athletes competing at recreational, national, and international or Olympic levels 0 to 4).

The final model also found a significant relationship between global score and self-evaluated mental and physical health. It was observed that as mental health increased, global score decreased more drastically ($\beta = -0,49$, $p < ,001$) than it did a similar size increase in physical health ($\beta = -0,20$, $p < ,001$). The evaluation was done on a 7-point Likert-scale ranging from very bad to very good (0 to 6).

5.4 Associations between DEB and sports categories, and competitive levels

Table 4 displays the frequencies of participants who scored above or below the clinical cutoff, 2,5, for disordered eating, grouped by their respective sports categories and competitive levels. A significant association between DEB and sports categories ($p = ,004$) and different competitive levels ($p = ,002$) was discovered by Pearson-chi square test.

Further analysis using adjusted residual post-hoc test showed a significant association between global score and being a non-athlete, ball, and endurance sports. More precisely, an individual having a global score over 2,5 was found more likely to be a non-athlete (adjusted residual 3,840) and less likely to practice ball (adjusted residual -2,372) or endurance sports (adjusted residual -2,417). There were no significant findings for aesthetic, technical, power or weight-dependent sports.

The residual post hoc conducted over the not competing and the different competitive levels found that participants scoring over 2,5 cutoff were more likely to not compete in sports at all (adjusted residual 3,882) and less likely to compete on a national level (adjusted residual -3,223). There were no significant associations between recreational, regional, or international/Olympic competitive levels and the global score.

A Pearson chi-square test was also conducted to test the association between DEB and being in the process or recovering from an injury or an illness. No significant association was discovered when testing for the whole sample both athletes and non-athletes included (p = ,289), nor when testing for athletes only (p = ,880).

Association between the self-evaluated mental health and the different competitive levels also discovered to be significant (p = ,027) by the Pearson chi-square test. The evaluation of mental health was done on a 7-point Likert scale where 0 meant “very bad”, 1-2 “bad, 3-4 “good and 5-6 “very good". The residual post hoc found nine significant associations. The non-athletes not competing were found to be more likely to report their mental health to be very bad (adjusted residual 1,864) or bad (adjusted residual 2,735) and they were less likely to give it a very good score 5 (adjusted residual -2,288) or 6 (adjusted residual -2,600). Recreational athletes were more likely to rate their mental health to be good (adjusted residual 2,000) and regional athletes were found less likely to report their mental health to be bad (adjusted residual -1,318). Athletes competing on a national level had a higher likelihood of reporting very bad mental health (adjusted residual -1,564) and more likely to report their mental health to be good (adjusted residual 1,349). Athletes competing on the highest, international, level had a higher likely hood to report their mental health to be 5, very good (adjusted residual 1,814).

Table 4 - Prevalence of athletes scoring above the 2,5 clinical cutoff score based on competing levels and sport categories

	Recreational	Regional	National	International/ Olympic	Global score > 2,5 cutoff, n (%)
Aesthetic sport, n (%)	-	-	3 (3,2)	2 (8,7)	1 (20)
Ball sport, n (%)	4 (26,7)	34 (60,7)	42 (44,7)	9 (39,1)	25 (28,1)
Endurance sport, n (%)	11 (73,3)	18 (32,1)	41 (43,6)	5 (21,7)	20 (26,7)
Power sport, n (%)	-	-	-	2 (8,7)	-
Technical sport, n (%)	-	2 (3,6)	-	1 (4,4)	-
Weight dependent sport, n (%)	-	2 (3,6)	8 (8,5)	4 (17,4)	7 (50)
Total, n (%)	15 (100)	56 (100)	94 (100)	23 (100)	-
Global score > 2,5 cutoff, n (%)	5 (31,3)	20 (35,7)	23 (24,5)	5 (21,7)	5 (21,7)

6 Discussion

6.1 Summary of main findings

The primary aim of this study was to investigate the current prevalence of DEB in Norwegian female athletes in comparison to their non-athletic counterparts, using the validated EDE-Q 6.0 questionnaire. More than a quarter (28%) of the athletes and 45% of the non-athletes exhibited DEB, as indicated by surpassing the 2,5 global score clinical cutoff point. However, there was no significant difference between groups for the mean EDE-Q global score or in any of the subscale scores measuring the DEB severity.

The secondary aim of the study was to explore possible predictors for DEB. Both the amount of training hours per week and well as BMI category had a positive correlation to the global score. The global score was found to correlate negatively with an increased competitive level and both mental and physical health.

The study also discovered that there was a significant association between DEB and sports category. Athletes participating in ball sports and endurance sports were found to be less likely to display DEB.

6.2 Discussion

6.2.1 DEB Prevalence

Directly comparing the current results (28,0%) against the overall average (26,5%) of previous DEB data is both challenging and non-informative. For example, there was considerable variability in the prevalence rates reported across these previous studies, ranging from 0% to 74,4%, which indicates that DEB prevalence is strongly influenced by the choice of the athletic population (i.e., sport) under investigation, as well as choice of tool for studying this potentially sensitive subject matter. To gain a better perspective on the results of the current study, it is beneficial to compare them with studies that have a similar design.

There were two previous studies that employed the same means (self-reported EDE-Q) to measure DEB as the current study and had a study population similar to this one (42, 43). Carvalhais et al. (2019) reported a DEB prevalence of 17,7% in athletes and 20,0% in non-athletes, while Kampouri et al. (2019) found the prevalence rates to be 5,1% and 1,1%, respectively. The observed prevalence rates in the current study (28% and 45%), were substantially higher, both for athletes and non-athletes. These results imply that DEB prevalence is elevated in Norway.

This notion is further supported by inspecting the clinical cutoff points for DEB employed in these studies. The current study used a cutoff point of 2,5 was employed, while the previous studies used cutoff points of 2,12 and 2,30 (42, 43). These cutoff points are derived from the scales of the EDE-Q, where higher scores indicate a higher degree of DEB severity. As a result, it becomes more demanding to categorize individuals as having DEB when the cutoff point is higher. Nevertheless, this study identified a greater number of participants exhibiting DEB compared to the previous studies.

Evaluating the development in DEB prevalence in Norway proves to be a challenging task. The previous study used a two-phase approach revealing that 21% of the athletes and 14% of the non-athletes at-risk for ED based on the results from self-report questionnaire Eating Disorder Inventory (EDI)(27). Subsequently, interviews were conducted on the at-risk participants concluding that 20% of the athletes and 9% of the non-athletes were either suffering from a subclinical or a clinical ED (27). It is difficult to evaluate exactly to what extent the DEB prevalence discovered by the current study compares to the previous findings due to the

considerable methodological differences. However, the results do indicate a rise in the DEB prevalence in both athletes and non-athletes.

This proposition is reinforced when comparing the EDE-Q scores from this study to the norms found in the scoring manual used by the Norwegian healthcare (85). In the current study, the mean global score for athletes was 1,73 (±1,44) and 2,31 (±1,52) for non-athletes. In comparison, the equivalent means in the scoring manual were 1,3 (± 1,1) for healthy females and 4,0 (± 1,3) for women diagnosed with an ED (85). The global score was found to be slightly higher in athletes and nearly two-fold in the non-athletes compared to the average score among the healthy female population. Because the prevalence is based on these scores, the increase in the global score means implies an increase in DEB behavior.

The increase in the mean global score and prevalence can be caused by various factors, although these can only be speculated upon. One potential factor could be the COVID-19 pandemic. Several studies have reported an upsurge in disordered eating behaviors (DEB) and eating disorders (EDs), as well as a general decline in mental health during the pandemic (60, 62). Given the complex nature of these issues, it is conceivable that even though the initial causes, such as loneliness resulting from isolation, may no longer be prevalent in society, it takes longer for these disorders to subside. This raises the possibility that the higher prevalence of DEB observed in the present study could be partly attributed to the impact of the pandemic or simply reflect an ongoing trend of increasing DEB prevalence over time.

6.2.2 DEB prevalence between athletes and non-athletes

The studies comparing DEB between athletes and non-athletes are inconsistent. Seven studies have found DEB to be higher in athletes, six found DEB to be higher in athletes, six did not discover significant difference and five found the prevalence to be higher in non-athletes on at least one of the scales they utilized (12, 13, 37, 38, 40, 42, 43, 48, 51, 54, 58, 59). Although the DEB was more prevalent among non-athletes in the current study, there was no significant difference in the mean global score between these two groups, after adjusting for relevant confounders: training hours per week, BMI category, self-evaluated state of mental and physical health, recovering from an injury, education level and age group. Consequently, the initial differences in DEB prevalence between athletes and non-athletes may be confounded by the aforementioned factors.

However, there is evidence that other factors might contribute into the varying results. Out of the two similar studies utilizing EDE-Q, one found a higher portion of athletes to surpass the clinical cutoff for DEB, and the other made opposing findings (42, 43). Even though neither of these studies adjusted for confounders neither discovered a significant difference in the mean global scores between the two groups (42, 43). This could suggest that the observed differences cannot alone be attributed to confounders.

Another aspect that needs to be considered, are the questionnaires and other tools that are employed. It has been shown that despite the self-report questionnaires being issued anonymously, athletes tend to underreport their DEB symptoms in fear of jeopardizing their career (41, 56). This could potentially bias the results, creating an impression that the prevalence of DEB in athletes is lower than it truly is.

This argument is supported by the prior Norwegian study that employed a two a two-phase approach initially screening potential ED risk candidates using the self-reported EDI questionnaire, followed by an interview diagnosing subclinical or clinical ED (27). In their study, only 4% of athletes and 28% of non-athletes were identified as false positives post-screening. Thus, although the prevalence and severity of DEB in both groups based self-reported questionnaire was exaggerated, the amount of additional non-athlete DEB cases was 7-fold compared to the athletes. While after the interview the study found the prevalence of DEB to be higher in athletes (20%) than among non-athletes (9%). These findings indicate that interviews may be a more effective method for comparing DEB and ED prevalence between athletes and non-athletes.

Moreover, the questionnaires can be criticized for their inability so consider the underlying motivations behind certain behaviors or concerns. A study found that in athletes not showing signs of DEB, 93,8% attributed their weight and shape concerns to be sports performance related, while the corresponding percentage for those with DEB was 81,3% (56). Indeed, in the study, ED diagnosed athletes were more likely to be motivated by body appearances and had lower self-confidence than athletes who was not diagnosed with ED (56). When using a self-reported questionnaire these underlying factors cannot be differentiated potentially leading to wrongful categorization.

Furthermore, the manifestation of DEB may not only differ between athletes and non-athletes, but can also vary among athletes themselves based on their specific sports discipline, and these

questionnaires may not be equally adept at identifying all manifestations of DEB. For instance, one study discovered that dieting was significantly more prevalent among non-athletes compared to athletes in ball sports, while another study highlighted that weight control methods, such as dehydration techniques (e.g., water restrictions), are most typically employed by weight class athletes (43, 55). In contrast, a third study highlighted the importance to acknowledge that certain dietary habits, which could be considered disordered in the general population, may not be deemed as such if they are executed in a controlled manner by athletes (e.g., rapid weight loss before a competitive season) (56). This variation in DEB can further exacerbate the variability in the results measured with self-reported questionnaires.

6.2.3 Menstrual dysfunction

The findings regarding menstrual dysfunction must be considered. The prevalence of menstrual dysfunction was noticeably high in both groups, 53,4% among athletes and 47,6%, in non-athletes. Although it is widely acknowledged that the use of hormonal contraceptives can contribute to irregularities in the menstrual cycle, it is unlikely that all cases of menstrual dysfunction were caused by contraceptives. In fact, it has been found that menstrual dysfunction is more common among women with DEB (33). Considering the high prevalence of DEB found in this study, these results appear to align with existing findings.

Furthermore, as the number of non-athletes scoring over the clinical cutoff (45,0%) correlated with the observation of those reporting some form of menstrual dysfunction, it raises a question to why these numbers were in noticeable discrepancy among athletes. Another factor that highly correlated with menstrual dysfunction is, low energy availability. This condition can be observed in both athletes and active exercising women and it can present with or without DEB (33). This condition can disturb the female hormonal cycle and this can further lead into reduced bone mineral density. If these factors contribute to the high prevalence of menstrual dysfunctions, it is indeed alarming.

However, must be underscored that the information concerning menstrual dysfunction was gathered only by self-report and forced-choice questions. Gibbs et al. (2013) highlight the difficulty to draw any firm conclusions about the prevalence of menstrual disturbances solely based on self-report methods (33). While it also raises some concerns, because they suggest there would rather be a bias toward underreporting due to the sensitive nature of the topic and only clearly recognizable cases of menstrual disturbances being identified. To establish more

robust conclusions further exploration of menstrual disturbances together with low energy availability are warranted.

6.2.4 EDE-Q subscale scores

No significant difference between the athletes and non-athletes was found in the overall EDE-Q global score, however the sensitivity analyses revealed certain distinctions within smaller subgroups. Notably, it was detected that BMI had a significant interaction between the EDE-Q global score and the eating and shape concern subscales. Additionally, a significant interaction was identified between age and restraint. To this authors knowledge, similar interaction tests have not been conducted in the studies using EDE-Q reviewed for this paper.

High BMI was discovered to correlate positively with three of the subscales, eating, shape, and weight concern. More specifically, concerns regarding eating and body shape were significantly higher among overweight and obese non-athletes, while concerns about weight were more severe among all overweight and obese participants, irrespective of whether they were athletes or not. These findings align with a previous study, which reported significantly higher levels of shape and weight concerns among obese and overweight women (86). This elevation is presumably linked to overweight generally being associated with higher body dissatisfaction as found in the study by McLean et al. (2023)(87)

Nonetheless, an interesting aspect of these findings should be highlighted. These concerns were found significantly higher mainly in overweight and obese non-athletes as opposed to athletes in the same BMI categories. Conversely, significantly higher scores for eating concern were identified among underweight athletes. Since the BMI calculation is solely based on height and weight (kg/m2), it fails to consider body composition. Athletes often have a higher muscle to fat mass ratio and, muscle being heavier, an elevated BMI often doesn't represent their body figure accurately. These results imply that high BMI among athletes does not correspond with DEB the same manner as it does among non-athletes.

Moreover, the mean EDE-Q global score for the underweight athletes was 4,26, which was over twice as high as in the non-athletes, (1,88) and significantly above the set clinical cutoff point, 2,5. In fact, it has been suggested that a cutoff for underweight population to be set at 1,62 (80).The identification of such a high global score among underweight athletes is concerning, especially considering that the EDE-Q appears to be biased towards detecting DEB better among overweight and obese individuals. Although, it is important to note that this finding was

based on a small sample size of only four athletes and 20 non-athletes suggesting that the result may not be reliable.

Surprisingly, restraint scores were found to be higher among older participants in both athletes and non-athletes. This contradicts general findings that typically show higher restraint among younger women, as reported by Mond et al.(2004) (88). However, Rø et al. (2012) discovered no elevated restriction among younger women either (86). It could be speculated, that especially among older athletes, the increased restriction of food could be due to lowered metabolism and desire to keep in shape for competing, rather than restriction being a symptom of DEB.

These findings highlight the overall necessity to inspect DEB both in athletes, as well as in non-athletes in smaller subgroups and adjusting the research methods and tools for these groups in order to detect DEB more accurately on an individual level.

6.2.5 DEB predictors and associated factors

A counterintuitive pattern was observed between DEB, training volume and competitive levels. A negative correlation was observed between the EDE-Q global score and competitive levels, indicating that the risk of DEB decreased as the level of competition increased. Conversely, there was a positive correlation between DEB and training volume, indicating that higher training volume was associated with an increased risk of DEB. Considering the existing evidence indicating a higher prevalence of DEB among elite athletes at higher competitive levels attributed to both increased pressure to perform as well as increased intensity and duration of training, it was anticipated that both competitive level and training volume would correlate positively with the EDE-Q global score (27, 89). These findings suggest that the rise in training hours poses a greater risk for DEB compared to the increased pressure associated with higher competitive levels.

A closer examination of the distribution of training hours among the recreational athletes revealed that 50% trained very large quantities. This would align with some previous studies finding higher DEB prevalence among the recreational athletes (34, 39). It has been proposed that this could be caused by the lack of nutritional knowledge and guidance since there isn't as extensive support network (e.g., personal trainers and dietitians) around these individuals (39, 59). A combination of high workout volume and insufficient knowledge in nutrition, recovery and training poses a serious risk for DEB.

However, to better assess the correlation between training and DEB, further information regarding to the intensity, type and purpose of training would be needed. Due to the poor data quality of the IPAQ section (i.e., insufficient response rate), none of these were further analyzed in the current study. Furthermore, their nutritional intake was not evaluated. Therefore, it is not possible to further assess whether the recreationally athletes have an increased risk for DEB due to excessive training and insufficient nutrition intake or something else.

These results can be further explained by inspecting the distribution of different sports categories across the competitive levels. Most of participants were engaged with ball sports on both national and international levels. It was discovered that scoring over the clinical cutoff was less likely. These findings are consistent with previously established evidence of lower DEB prevalence among ball sports athletes (43). Considering that in this sports discipline it may even be beneficial to have a higher body mass, the findings indicate that reaching higher competitive levels does not necessarily impose additional pressure on body image on women in ball sports.

Another category strongly represented among the higher competitive levels was endurance sports. In contrast to the prior research, endurance athletes were also found less likely display DEB (10, 54). Adding to the intrigue, majority (76%) of the endurance athletes in our study were swimmers, a group that has been found to be at a high risk for DEB in previous studies (43, 50). Based on these findings, it is plausible to theorize that perhaps there is a healthy atmosphere among the Norwegian swimming club that promotes healthy eating and body. The significant presence of these athletes at the higher competitive levels offers additional insights into the lower prevalence of DEB observed within those levels.

Lastly, the other two sports categories, namely aesthetic, and weight dependent sports, strongly associated with increased risk of DED accounted for only 10,5% of the athletic sample in the current study (10). The underrepresentation of these two sports categories in this study has potentially introduced bias not only to the findings regarding the association between the competitive levels and DEB, but also to the overall DEB prevalence discovered in this study. It is highly probable that the prevalence may have been higher had these two categories been more adequately represented in the current study.

The study revealed a significant correlation between self-evaluated mental health and disordered eating behaviors (DEB), which was expected since DEB is inherently a behavioral

disorder and a risk factor for the development of eating disorders (ED)(41). Thus, it was not surprising to find that non-athletes, when compared to athletes across all levels of competition, were more inclined to rate their mental health lower. This finding aligned with the overall pattern observed in this study.

In fact, this study identified a pattern indicating that the likelihood of reporting a good mental health increased with higher levels of competition. While some studies have suggested that engaging in sports can enhance self-esteem and body image and, consequently, reduce the likelihood of DEB, others have found that the specific pressures associated with sports, especially on elite level, increase the risk of developing DEB (10, 41, 59). Although it must be taken into consideration that the low participation of aesthetic athletes has most likely caused a bias in the results of the current study, it does lend further evidence to the suggestion that sports participation, in all competitive levels, positively influence self-perceived mental health.

Nonetheless, it is crucial to highlight that these findings were only based a self-evaluated score on a 7-point likers scale. No additional information regarding the individuals' current or past mental health was collected due to a technical error caused by the Nettskjema data gathering service. It is important to note that even if these questions had been included, the study lacked a validated questionnaire specifically addressing mental health, as acknowledged by the author. Consequently, the quality of these findings is compromised.

6.3 Method discussion

6.3.1 Limitations

It must be acknowledged that the present study had several limitations. Firstly, the use of a cross-sectional study design precluded any further analysis on a causal relationship between DEB and sports. As such, we were unable to identify if certain sports attract personality types with a higher risk of DEB, or if instead it the nature that certain sports increases DEB. Additionally, the cross-sectional study design did not permit a further investigation of the changes in dietary and exercising habits over a competitive calendar year. Also, more detailed analyses over the relationship between various activity levels, training intensity, and DEB, was compromised due to the insufficient and indecipherable responses to the IPAQ portion of our questionnaire. Further, the order of the questionnaire sections was not randomized, with all respondents answering each section consecutively (e.g., the EDE-Q followed by the IPAQ)

which could have potentially resulted in a question order bias. This bias might have contributed, at least in part, to the observed incoherent answers related to the IPAQ (90, 91).

The assessment of DEB and its prevalence was based on self-reporting, and no further clinical evaluation, such as clinical dietary interviews, was conducted. However, relying exclusively on self-reporting to identify DEB without a subsequent 'clinical interview' for confirmation, may result in false positives and negatives (27, 51). Additionally, the EDE-Q utilized for DEB detection was not originally designed for athletes and can therefore fail to detect DEB symptomology specific to this population (55, 86). The current study also failed to analyze the pathologic behavior subscales that could have revealed more information about the use of laxatives, vomiting, or excessive exercise as means of weight control and binge-eating behavior. Analyzing these scales would have provided more detailed information about specific behavioral patterns that have been associated with increased risk of ED (43).

There is also a possibility of sampling bias in the study. Firstly, the varying levels of activity among the contact people responsible for distributing the questionnaire resulted in an uneven representation of different sport types in the study sample (91). Moreover, the presence of shame, taboo, and fear surrounding DEB and EDs, as well as concerns about potential complications in their athletic careers upon diagnosis, may have further discouraged athletes who suspect they have DEB from participating (43). This type of selection bias may have also affected the non-athlete controls, as individuals who were concerned about this issue might have been less inclined to participate. As the recruitment primarily relied on social media posts, there was no effective way to control for this factor. Furthermore, individuals with no social media accounts were automatically excluded by this recruiting method. Recruiting the two groups using different could have led to selection bias (91). Different recruit methods attract different types of people thus using different recruiting methods could reduce the similarity between these two groups (91).

The aforementioned factors could contribute to a biased sample and impact the generalizability of the study findings (90, 91). Furthermore, sample sizes in the sub-analysis for the various sports categories were quite small so despite the statistically significant results, their practical significance is probably compromised to a certain degree(90, 91).

The sensitive nature of the study theme and use of the Likert scale could have also introduced a risk of social desirability bias (91). People tend to answer in a way that makes them seem

socially more attractive or normal, thus when evaluating behaviours and thoughts on a scale, the answers tend to skew towards the more positive alternatives (90).

To maximize participation in the study, the questionnaire was intentionally kept as concise as possible. As a result, the decision was made not to utilize a validated questionnaire specifically addressing mental health. Unfortunately, due to the aforementioned technical error, also the four questions related to mental health were inadvertently omitted. Consequently, the information gathered on the relationship of mental health, sports and DEB remained superficial.

The utilization of predominantly closed questions, together with the requirement to answer questions before proceeding to the next one, ensured a high response rate and minimized data loss. However, it is important to note that this approach may have introduced response bias, as some participants may have missed the opportunity to provide a more accurate response and instead had to select the option that was closest to the truth. Additionally, this could have potentially led to participant dropouts. Furthermore, it must be noted that data was analyzed by a single investigator, and thus was vulnerable to human error bias during data cleaning, as well as confirmation bias when interpreting the results.

The study did not consider the influence of substance use, such as doping, drug consumption, smoking, and prescription medications. These factors can hugely affect appetite and consequently influence the relationship with both food and body (90). It was decided that despite including questions about these factors, would bring important information, asking about them could increase the likelihood of participant dropouts, since the participants might deem it to be too risky to answer despite the guaranteed anonymity.

6.3.2 Strengths

Despite the stated limitations, the present study also possesses a number of strengths. The sample size was sufficiently powered to produce statistically significant and generalizable information about the DEB prevalence among athletes and bringing it to perspective in comparison to the non-athletic populations. Despite there being a risk of sampling bias due to factors beyond the authors control, as mentioned in limitations, a random recruiting method was employed to minimize the sampling bias (91).

The anonymous nature was chosen to minimize the risk of social desirability bias (91). Furthermore, this allowed the participants to provide sensitive and personal information without the fear of being judged, or having to deal with repercussions if they were to present DEB. This

is a strength compared to the two-phase method where participants would be further interviewed based on their responses on the questionnaire.

By including various sports categories and competitive levels and conducting separate analyses, the study was able to facilitate a more comprehensive examination of the associations between DEB and sports. Moreover, the research was strengthened by adjusting the analyses to account for interactions and confounding factors, which has not been done to the same extent in the previous studies reviewed for this study. This approach ensured a more accurate and comprehensive understanding of the relationship between DEB and sports, minimizing the influence of potential confounders and enhancing the reliability of the findings.

Although the EDE-Q has certain limitations, the utilization of the 2.5 clinical cutoff has been validated specifically on a Norwegian female population(80). This validation demonstrated a strong ability to discriminate between participants with and without ED, thereby establishing its suitability as a tool for estimating the prevalence of DEB (80). Despite the drawbacks associated with the EDE-Q, the use of the validated cutoff enhances its reliability and is thus considered a suitable instrument for estimating DEB prevalence.

Although the choice of closed questions and forced option questionnaire style posed some limitations, it was intended to reduce the need for interpretation of free-text answers. This choice was deemed appropriate as the section of the IPAQ questionnaire that allowed free-text responses turned out to be too unreliable for use. Secondly, it successfully minimized the occurrence of missing answers and partially filled-out responses, leading to fully completed responses and increasing the statistical power of the tests conducted during the analysis.

The author declares no conflict of interest, and the presence of unexpected results against some presumptions serves as a testament to the author's integrity. This can be considered to alleviate the risk of confirmation bias and increase the credibility of the results of this study.

6.4 Implications for future research

The current gold-standard method for assessing DEB in athletes is via a two-phase approach, i.e., self-reported DEB questionnaire with subsequent verification for clinical dietary interview. However, it must be recognized that implementation of this two-step method is both expensive and time consuming, requiring trained clinical dietetics to conduct the interview step. This study emphasizes the urgent requirement for questionnaires specifically designed for athletic populations, aiming to improve the quality of questionnaire-based research of DEB. By

employing tailored questionnaires, a more precise comparison of DEB prevalence between athletes and the general population can be achieved, ultimately leading to more accurate and meaningful insights.

The findings from this study also highlight the importance of examining the athletic community in smaller subgroups rather than as a large homogeneous population as well as the necessity of finding a consensus over the definition of an athlete. By conducting analyses within specific sports categories and competitive levels, the study revealed the need for a nuanced understanding of the relationships within the athletic community. Additionally, more longitudinal studies would provide valuable information on the causal relationships between DEB and various aspects of sports as well as account for variations over the different phases of competitive season.

The results from the current study also imply that mental health aspect in any research related to DEB and EDs should be more deeply integrated. This could contribute to gaining a comprehensive understanding of the broader context of DEB development, improve the validity of DEB research, and help both design and implement interventions that would prevent the development of DEB.

6.5 Conclusion

In summary, this study aimed to investigate the current prevalence of DEB in Norwegian female athletes in comparison to their non-athletic counterparts. One in four (28%) of the athletes and about half of the non-athletes (45%) were classified as having DEB. However, there was no difference between groups using the EDE-Q continuous global score, which measures the severity of DEB. Future research should focus on developing improved screening tools targeting athlete specific DEB thus identifying and describing the contributing factors in more detail. Furthermore, findings of this study highlight the importance of examining DEB in athletes on multiple levels rather than as a uniform group. This approach would contribute to more comprehensive understanding of DEB within specific athletic subgroups and to tailoring interventions accordingly.

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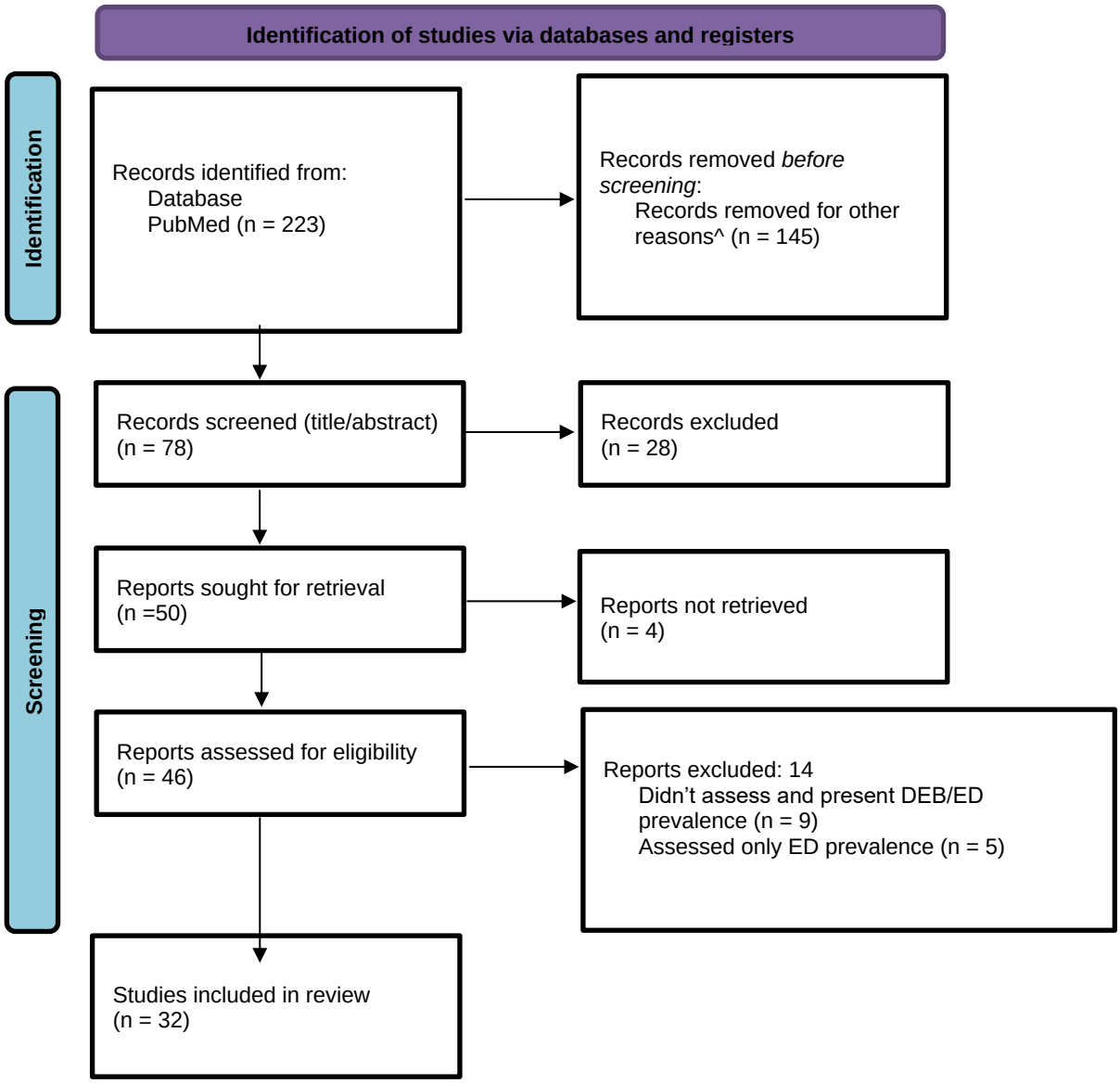
Appendix 1 – PubMed search

Search: ((((((eating disorder*[MeSH Terms]) OR (eating disorder*[Title/Abstract])) OR (disordered eating[MeSH Terms])) OR (disordered eating[Title/Abstract])) OR (subclinical eating disorder[Title/Abstract])) AND ((prevalence[Title/Abstract]) OR (prevalence[MeSH Terms]))) AND ((athlete*[MeSH Terms]) OR (athlete*[Title/Abstract])) Filters: in the last 10 years, Humans, English

Appendix 2 – Flow chart over study selection process



Appendix 3 – Table of included cross-sectional and longitudinal studies presenting the prevalence of DEB in athletes.

Study (year), study population country	**Population (n)**	**Age in years**	**Screening instrument and type of DEB**	**Grouping (group ratio)**	**Prevalence**
Petisco-Rodríguez C. et al. (2020), Spain (40)	Female professional athletes & non-athletes (120)	Range: 15-25	Self-report: EAT-40[1] (cut-off ≥ 20 for risk of DEB) & SCOFF[2] (≥ 2 positive questions for possible risk of ED) Measured: BMI	3 groups: rhythmic gymnastics, football, sedentary control (1:1:1)	**EAT-40 ≥ 20:** Gymnasts: 2,5% Footballers 12,5% Non-athletes 20% **SCOFF ≥ 2 positive:** Gymnasts: 5%; Footballers: 5%; Non-athletes: 15%.
Kristjánsdóttir H. et al. (2019), Iceland (41)	Elite athletes, both sexes (755)	Mean: 24,8±3,5	Self-report: BSQ[3] (cut-off points for concern with shape: < 80 none, 80-110 mild, 111-140 moderate, >140 marked), BUILT-R[4] (cut-off ≥98 at risk for bulimia EDE-Q[4] (cut-off ≥ 4 for DEB)	20 sports divided in 5 groups: aesthetic, endurance, weight-class, fitness & ball sports.	**BSQ ≥ 110** Females: 25,3% Men: 3,9% **BSQ > 140** Highest prevalence in aesthetic sports: 16,3%

					BSQ < 80 Highest prevalence endurance sports: 76,7% **BUILT-R ≥ 98** Females: 2,7% Men: 1,8% **EDE-Q ≥ 4** Females: 10,7% Men: 6,8%
Meng K. et al. (2020), China (34)	Female elite athletes (52) & recreational athletes (114) in aesthetic sports	Mean: 20±3 & 20±2	Self-report: EDI-3[6] Measured: BMI Risk of DEB/ED based on BMI only. BMI plus responses to EDI-3[6] questions about excessive eating concerns; and, responses to behavioral questions pertaining to eating disorder pathology.	6 sports: trampolining, rhythmic gymnastics, aerobics, dance sport, cheerleading & dance	**ED risk:** Elite athletes: 51,9% Recreational athletes: 59,6%
Carvalhais A. et al. (2019), Portugal (42)	Female elite athletes (372) & non-athletes (372)	Mean: 20,8 ±5,2 & 20,9±5,4	Self-report: EDE-Q[5] global score for DEB and 4 subscales analyzed; cut-off points reported for young Portuguese women: cut-off ≥2,12 for DEB, >1,49 restraint, >1,37	Low impact sports & high impact sports	**Global score for DEB ≥2,12:** Athletes: 17,7% Non-athletes: 20,0%

			eating concern, >2,12 shape concern, >2,63 weight concern)		**Restraint >1,49:** Athletes: 38,2% Non-athletes: 24,7% **Eating concern >1,37:** Athletes: 14,6% Non-athletes: 12,9% **Shape concern >2,12:** Athletes: 25,3% Non-athletes: 28,5% **Weight concern >2,63:** Athletes: 22% Non-athletes: 25,5% **No statistically significant difference in DEB between low and high impact spots groups**
Kampouri D. et al. (2019), Greece (43)	Female elite basketball (53), volleyball (42), water polo (34) players & non-athletes (46)	Range: 18-40	Self-report: EDE-Q[5] 4.0 (Likert scale 0-6, absence of pathology to severe pathology. Global score threshold for DEB ≥2,30. Subscales for restraint, eating, shape and weight concern.	3 sports: basketball, volleyball, water polo & non-athlete control	**EDE-Q Global score for DEB ≥2,30** Athletes: 5,1% Non-athletes: 1,1% No differences found in **other subscales** between athletes and non-athletes (P>0,05)

			Bulimic tendencies analyzed on 4 subscales: Objective and subjective bulimic episodes, binge eating, compulsive exercise		**Eating concern subscale** in water polo > basketball and volleyball players (P<0,05) **Overall DE symptoms on bulimic tendency subscales:** Athletes: 56,5% Non-athletes: 50,4% Frequency of binge eating episodes (P<0,001), objective (P>0,001) and subjective (P>0,01) bulimic episodes water polo > basketball and volleyball players
Abbott W. (2021), UK (58)	Elite female (70) and male (137) soccer players and non-athlete controls (179)	Mean: Female soccer players 23±4 & non-athletes 26±6 Male soccer players 21±5 & male non-	Self-report: EAT-26[7] (cut-off point >20 indicative of DEB = at risk for ED)	Elite female soccer players & male soccer players & non-athlete controls	**Overall higher EAT-26 score:** **Male** non-athletes < male soccer players (p=0,001) **Female** non-athletes > female soccer players (p=0,027 **Female** soccer players = **male** soccer players (p=0,865) **EAT-26 score > 20:** **Male** non-athletes = male soccer players (X^2=p=0,079)

		athletes 25±6			**Female** non-athletes > female soccer players (X^2=0,001) **Female** soccer players = **male** soccer players (p=0,595)
Borgelt S. et al. (2022), USA (45)	Female college equestrian athletes; aesthetic (216) & non-aesthetic (105)	Mean: 20±2,8 & 21,5±0,7	Self-report: EAT-26[7] (cut-off point >20 indicative of DEB) Equestrian specific problems with eating: (relevant: I feel I would place higher in my discipline if I lost weight; 1 strongly agree – 5 strongly disagree)	Aesthetic & non-aesthetic	**EAT-26 > 20:** Aesthetic: 34,89% Non-aesthetic: 35,10% **I feel I would place higher in my discipline if I lost weight – strongly agree:** Aesthetic: 50,5% Non-aesthetic: 29,5% Over all sample: 43,6%
Jankauskiene R. et al. (2019), Lithuania (59)	Total females (437), total males (295), leisure sports (293), competitive (220), controls (273)	Range: 16-19	Self-report: EAT-26[7] cut-off point >20 at risk of ED = DEB), MBSRQ[8] & DMS[9]	Competitive sport, leisure sport; weight-sensitive sport, less-weight-sensitive sport & controls	**EAT-26 score < 20** Competitive = leisure = control **DEB, drive for muscularity, body image:** Competitive weight-sensitive sport = competitive less-weight-sensitive sport. No sig. difference between sexes. **Drive for muscularity:** Sports involved > controls.

					DEB & body image concern: Female leisure weight-sensitive sport > Female leisure less-weight-sensitive sport **Overweight preoccupation:** Female leisure weight-sensitive sport > Female leisure less-weight-sensitive sport
Rousselet M. et al. (2017), France (56)	Registered high-level athletes; female (108) & male (232)	Mean: 16,8±3,5	Interview: Sports physician – somatic assessment; psychologist – psychological assessment; Dietitian dietary consultation, tools used: The EDI[9], 24h dietary recall interview, FFQ[1o], competition diet, ED family history, BMI measured. "DE detected" if one of the interviewers considered the athlete to have a DE	37 sport types: leanness sports (37,6%) & non-leanness sports (63,4%)	**DE detected:** Total: 112 athletes (32,9%) **Of which:** Female: 47,3% Leanness sport: 50% BMI >10th percentile for age & sex: 4,5% EDNOS most prevalent detection (97.2% by psychologists, 92.6% by dieticians, and 88.0% by sports physicians).

Smith A.B. et al. (2022), USA (46)	College female cheerleaders (19)	Mean: 20,3±1,2	Self-report: EDI-3[6] (12 subscales, classification based on percentiles: 1st-24th low, 25th-66th typical & 67th-99th elevated clinical ranges. "At risk for ED" if 2 or more composite subscale scores in typical or elevated class). EDI-3 SC[12] (additional screening tool for identifying ED risk patterns e.g., frequency of binge eating, self-induced vomiting etc. "At risk for ED" if meeting criteria for one or more pathogenic behavior). BMI	Female cheerleaders	**At risk for ED by only EDI-3:** None **At risk for ED by only EDI-3 SC:** 42,1% **At risk for ED by both EDI-3 & EDI-3 SC:** 10,2% **EDI-3 SC:** 21,1% demonstrating 2 pathogenic behaviors **EDI-3 SC:** 21,6% demonstrating 1 pathogenic behavior **Restricting behavior:** 52,6%
Poucher Z.A. et al. (2022), Canada (57)	Elite athletes in Canadian summer-22 OL team; Females (113) & males (73)	Mean: 26 Range: 18-40	Self-report: EAT[1] (nr N/A). Measured at 4 time points (T). Additionally generalized anxiety disorder and depression assessments.	Females & males	**Athletes meeting only DE cut-off points:** T1 3,1%, T2 0,7%, T3 0,8%, T4 1,9% **Females** had higher baseline DE scores (p<0,001) **Anxiety & ED sig. correlated** (r=0,68, p<0,001)

					Depressions & ED sig. correlated (r=0,35, p<0,001) **Higher stress** strong predictor for anxiety (p<0,001), depression (p<0,02) and ED (p<0,02)
Prather H. et al. (2016), USA (44)	Elite female soccer players (220); Grade school (75), high school (81), collegiate (28), professional (36)	Mean: 16,4±4	Self-report: EAT-26[7] (cut-off points: >20 at high risk, 10-19 at intermediate risk, 0-10 low risk of ED), BMI	Grade school, high school, collegiate & professional	**EAT-26 >20:** 1 (5%) **EAT 10-19:** 17 (7.7%) **Mean EAT-26 score:** 4,4±4 **Most at risk athletes in collegiate group** (17,8%) > professionals (8,3%) > high school, (6.1%) > grade school (5.3%)
Bert et al. (2019), Italy (13)	Female (139), male (407). Sport<150min/week (47); >150min/week (320); inactive control (182)	Range: 18-40	Self-report: BMI, ORTO-15[13] (cutoff < 40 believed to have ON); EHQ[14] (cognition, feeling and behavior concerning healthy eating)	No sport, sport >150', sport <150'. Sport ≥ further divided into endurance ≥150', endurance <150'.	**Had been on a diet in the previous 24months:** Sport ≥150': 31,6% Sport <150': 25,5% No sport: 17% **ORTO-15 < 40** Sport ≥150': 72,8%

					Sport <150': 71,1% No sport: 68,8% **Adjusted ORTO-15 <35** Sport ≥150': 21,5% Sport <150': 24,4% No sport: 19,9%
Alwan N. et al. (2022), USA (35)	Female physique athletes (158); Fitness novice (62), fitness experienced (53), figure novice (19), figure experienced (24)	Mean: 29 ± 7 Range: 18–45	Self-report: Rapid weight loss questionnaire & EAT-26[7] (cut-off point >20 indicative of DEB or risk of ED)	Fitness novice, fitness exp., figure novice & figure exp.	**EAT-26 ≥20** Overall: 37,0% No sig. difference between novice (19,2±2) or exp. (17,1±13,9, p>0,05) No sig. difference between fitness (18.8±13.9) or figure (16.5±10.2; p>0.05) **Bulimia & food preoccupation subscale scores:** Figure (4.7±3.7) > Fitness (3.8±3.7; p = 0.01). **Use of pathogenic weight control methods (EAT-26 behavioral subscale):** 42,4% used 2 out 3; 13,3% used all types **Weight loss practices during the pre-competition phase**

					Gradual dieting (94%); Food restriction (64%); Excessive exercise (84%); Body water manipulation via water loading (73%)
McLester C.N. et al. (2014), USA(47)	Female collegiate athletes (439)	N/A	Self-report: EDI-2[15] (3 subscales utilized, considered susceptible for ED if: drive for thinness ≥10, body dissatisfaction ≥12 or bulimia 12), Rosenberg Self-Esteem Scale, Body Cathexis Scale	Not differentiated in results	**Susceptible to anorexia:** 6,8% **Susceptible to bulimia:** 1,8% **Body image satisfaction:** Very dissatisfied: 0,2% Dissatisfied: 12,3% Satisfied: 64,5% Very satisfied: 23,0%
Coelho G.M. (2013), Brazil (38)	Adolescent female tennis players (24) & sedentary controls (21)	Mean: 14,77±2,16 & 15,41±1,86	Self-report: EAT-26[7] (cut-off point >20 indicative of DEB = at risk for ED), BITE[16] (cut-off point >10 indicative of bulimic tendencies), BSQ[3] (cut-off point >80 indicative of elevated body concern). DE if positive results in >1 of the questionnaires.	Athletes & controls	**DE based on 1 positive result in one of the questionnaires:** Athletes (50%) = controls (71,4, p=0,22) **BSQ total:** Athletes (7%) < controls (15% p=0,007) **Positive results in all tests:** Athletes (4,2%) = controls (9,5% p=0,59)

			Body composition (fat percentage, lean & fat body mass).		
Clifford T. et al. (2019), UK (12)	Female & male student athletes (116) & non-athlete controls (91)	Mean: 21 ± 1 & 21 ± 2	Self-report: ORTO-15[13] (cutoff < 40 believed to have ON)	28 sports represented (mixture of team, aesthetic and technical sports), weight dependent & non-weight dependent, males & females, athletes & controls	**Mean ORTO-15 score:** All students (36.9 ± 3.9) All males (36.4 ± 4.3) vs. all females (37.2 ± 3.8, p>0.05) Males playing sport (36.8 ± 4.0), not-playing sport (37.1 ± 4.0), females playing sport (36.8 ± 4.0) & females not-playing sport (36.9 ± 3.9, p>0.05) **ORTO-15 < 40** All: 76% Females: 75% Males: 78% **ORTO-15 score:** Weight dependent sports (37.1 ± 3.9) = not-weight dependent (36.3 ± 3.9, p=0.414) Exercise ≥ 10 h week (35.6 ± 4.3) < exercise ≤ 10 h/week (37.2 ± 3.9, p=0.008)

Martínez Rodríguez, A. et al. (2015), Spain (55)	University national-level contact sport athletes; females (86) & males (158)	Mean: 20.8 ± 2.4 & 21.2 ± 2.8	Self-report: EAT-26[7] (cut-off point >20 indicative of DEB = at risk for ED; 3 sub-scales: dieting, bulimia & food preoccupation, oral control)	Judo, karate-kumite & taekwondo, females & males, following a diet plan & diet free control group	**EAT-26 scores:** Female control > male control (p=0,022, sig. difference in all sub-scales) Female diet = male diet (ns.) Karate female control > judo female control > taekwondo female control (sig.) **EAT-26 >20** Female judo (n=2) Male judo (n=1) Female taekwondo (n=1) Male taekwondo (n=2)

Table only includes studies presenting the prevalence for DEB and risk for ED, which is interpreted as DEB. These studies have not investigated past or current clinical ED status.

DEB = disordered eating behavior, ED = eating disorder, DSM-IV = Diagnostic and Statistical Manual of Mental Disorders IV, EAT-40[1] = Eating Attitudes Test 40, SCOFF[2] = Sick Control One Fat Food, BSQ[3] = Body Shape Questionnaire, BUILT-R[4] - Bulimia test revised, EDE-Q[5] = Eating Disorder Examination Questionnaire, EDI-3[6]= Eating Disorder Inventory-3, EAT-26[7] = Eating Attitudes Test 26, MBSRQ-AS[8] = Multidimensional Body and Self Relations Questionnaire-AS, DMS[9] = Drive for Muscularity Scale, The EDI[10] = The Eating Disorder Inventory, FFQ[11] = Food Frequency Questionnaire, EDI-3 SC[12] = Eating, Disorder Inventory-3 Symptom Checklist, ORTO-15[13] = Orthorexia Nervosa (ON) screening tool, EHQ[14]= Eating Habits Questionnaire, EDI-2[15] = Eating Disorder Inventory-2, BITE[16] = Bulimic Investigatory Test Edinburgh

Appendix 4 – Table of cross-sectional and longitudinal studies presenting the prevalence of both DEB and ED in athletes

Study (year), country	Population (n)	Age (years)	Screening instrument and criteria for ED	Grouping (ratio)	Prevalence
Melin. A et al. (2015), Denmark. (53)	Female endurance athletes (40)	Mean: 26,2±5,5%	Self-report: EDI-3[1] (DEB cut-off drive for thinness ≥ 14 and/or body dissatisfaction risk ≥ 19 Semi structured interview: EDE-16[2] to determine whether subjects met the DSM-IV ED criteria	**N/A?**	EDI-3: No differences between the optimal, reduced or low energy availability groups EDE-16: 10 subjects diagnosed with an ED; 1 AN, 1 BN, 8 EDNOS.
Walsh M. et al. (2020), USA (52)	Female collegiate rowers; lightweight (76) & open weight (80)	Mean: 20±2,8 & 21,5±0,7	Self-report: Part B related to the energy-deficiency component of the female athlete triad, using screening guidelines from the Female Athlete Triad Coalition. Participants were asked about dietary habits, weight, and body image on a scale of never, almost never, sometimes, fairly often, and very often. ED diagnosis history (current/past).	Lightweight & open weight	**History of ED:** Lightweight (25,7%) > Open weight: (13,0%) **Worry about weight/body composition fairly/very often:** Lightweight (48,6%) < Open weight (49,4%) **Limit or carefully control foods fairly/very often:** Lightweight (41,9%) > Open weight (29,9%) **Induce vomiting or use diuretics/laxatives after eating never/almost never:** Lightweight (94,6%) > Open weight (96,1%)
Ravi. S. et al. (2021), Finland. (36)	Female athletes, both elite & non-elite (846)	Range: 15-45, divided into young (15-24) & old (25-45)	Self-report questions from female athlete triad screening questionnaire (Mountjoy et al., 2015), to classify into: Restrictive group = limit/control eaten foods. ED group = currently, or previously, have had ED.	67 different sports: Young & old, lean & non-lean sports, elite & non-elite	**Restrictive eating:** Elite: 24,6% Non-elite: 24,7% Younger: 23,5% Older: 26,2% Lean: 26,9% Non-lean: 20,4% **ED:** Elite: 18,5% Non-elite: 18,1% Younger: 14,6%

					Older: 23,5% Lean: 20,6% Non-lean:14,3%
Wollenberg et. al. (2015), USA (48)	College female athletes (151) & non-athlete controls (376)	Mean: 19.50±1 & 19.83±3	Self-report: EAT-26[3] (cutoff total global score > 20 for DEB with subscales for dieting, bulimia and food preoccupation & oral control). ED diagnosis history (current/past) BMI based on self-report measurements	Athletes & non-athletes	**EAT-26 >20** Athletes: 6.6% Non-athletes: 16,5% **All EAT-26 subscales:** Non-athletes > athletes
Brook E.M.et al. (2019), USA (92)	Elite para-athletes; female (110), male (150)	Mean: 31.7±11.5 y	Self-report: BMI, ED diagnosis history, EDE-Q[4] (2 subscales utilized; dietary restraint score ≥3 & pathologic behavior score ≥1 was considered elevated)	Males & females	**History of ED:** 3,1% **EDE-Q restraint ≥3** 18,5% **EDE-Q pathologic behavior ≥1** 32,4% **Currently attempting to lose weight/change body composition to improve performance:** Overall: 61,5% Male: 63,3% Female: 59,1% **Considered themselves overweight:** 46,7%, **of which** 55% **had BMI >25kgm^2**
Sharps F. R. J. et al. (2022), UK (39)	Female athletes (112); Recreational (69), competitive (34), professional (9). Age groups; 18-24 (50), 25-30 (31) & 31-40 (31)	Range: 18-40	Self-report: FAST[5] (33 questions, score 74-94 risk of subclinical ED = DEB, score >94 risk of ED)	Recreational, competitive, professional. Age groups; 18-24, 25-30 & 31-40	**FAST 74-94:** Overall: 44% Recreational 64% Competitive: 26% **FAST ≥ 94:** Overall: 16% Recreational: 29,4% Competitive 65% **No sig. difference between age groups**

Thompson A. et al. (2021), USA (50)	Collegiate female athletes (194); gymnasts(122) & swimmers (71)	Mean: N/A	Self-report: QEDD[6] (50 item questionnaire based on DSM-IV criteria)	Longitudinal study, comparison done between active and retired athletes. Data on retired athletes excluded in this table due to irrelevance to study.	**Subclinical ED:** 18,7% **Clinical ED:** 6,7%
Thompson A. et al. (2017), USA (49)	Female collegiate gymnasts (219) & swimmers (106)	Mean: 19,24±1,14	Self-report: twice in 5 months: QEDD[6] (50 item questionnaire based on DSM-IV criteria); BUILT-R[7] (cut-off ≥98 at risk for bulimia. Time 1: beginning of the athletic seasons & Time 2: two weeks prior to conference championships	Time 1 & 2	**Subclinical ED:** Time 1: 25,5% Time 2: 15,7% **Clinical ED:** Time 1: 6,2% Time2: 7,2% Of the 83 subclinical ED athletes at Time 1, by Time 2, 40 remained either subclinical or developed a clinical ED.
Martinsen M. & Sundgot-Borgen J. (2013), Norway (51)	Athletes from Norwegian Elite Sports High Schools (611) & controls (355)	First year students, birth year 1992	Part I - Self-report: EDI-2[8] & SCL-5[9]. At risk for ED, must meet one of following criteria: a) drive for thinness (DT) score Q15 for girls and Q10 for boys; b) body dissatisfaction (BD) score Q14 for girls and Q10 for boys; c) body mass index (BMI) corresponding to the underweight value (8); d) trying to lose weight now; e) tried to lose weight before three times or more; f) current and/or previous use of pathogenic weight control methods: use of diet pills, laxatives, diuretics, or vomiting to reduce weight; g) self-reported menstrual	Female & male, athletes & control, weight-sensitive sports & non-weight sensitive sports	**Part I - At risk for ED:** Athletes (50,7%) < controls (25,0%, p<0,001) Female athletes (46.2%) > male athletes (13.1%, p<0.001) Female controls (72.4%) > male controls (33.7%, p<0.001) Weight-sensitive (26.4%) = less weight-sensitive sports (24.6%, p=0.65) **Part II - ED prevalence:** Athletes (7,0%) > controls (2,3%, p=0,001) Female athletes (14,0%) > male athletes 3,2%, p>0,001) Female controls (5,1%) > male controls (0%, p<0,001) Weight sensitive female athletes (19,7%) = less weight sensitive sports (11,9%, p=0,139)

			dysfunction: primary amenorrhea or secondary amenorrhea (previous 6 months). Part II – Interview: EDE[2] & EDE-Q[4] (DSM-IV criteria for ED diagnoses)		
Mathisen T. F. et al. (2020), Norway (37)	Female physique athletes (25) & controls (26)	Mean: 28,1±5,5 & 29,8±6,0	3 measuring points: Baseline, Pre-competition & Post-competition. Self-report: EDE-Q[4] (Global cut-off 2,5 for increased probability of ED, validated for Norwegian female athlete population) & history of ED	Physique athletes & controls	**History of ED:** Athletes: 34,6% Controls: 12,0% **Current ED:** Athletes: 7,7% Controls: 4,0% **Baseline EDE-Q score:** Athletes: 1,4 Controls: 1,1 **Estimated EDE-Q >2,5 at baseline:** Athletes: 8% Controls 8% **No within-group or between-groups changes by time**
Muia E.N. et al. (2016), Kenya (54)	Female middle and long-distance athletes (≥1500m) ((61) & non-athletes (49)	Median age: 16 & 17	Self-report: EDI-3[1] (Subclinical DE/clinical ED cutoff points: drive for thinness ≥7/≥15 and/or dissatisfaction ≥9/≥14); TFEQ[10] (Subclinical DE cutoff point: cognitive dietary restraint subscales ≥9) & BMI <17.5 kgm^2 cutoff for subclinical DE	Athletes & non-athletes	**Subclinical DE based on EDI-3:** Athletes (75,4%) = non-athletes (71,4%, p=0,56) **Clinical ED based on TFEQ:** Athletes (4,9%) = non-athletes (10,2%, p=0,56) **Clinical ED based on EDI-3:** Athletes (4,9%) = non-athletes (10,2%, p=0,56) **BMI <17.5 kgm^2:** Athletes: 16,1% Non-athletes: 0%

Table presents studies that have investigated DEB as well as past or current status of clinical ED.

DEB = disordered eating behavior, ED = eating disorder, DSM-IV = Diagnostic and Statistical Manual of Mental Disorders IV
EDI-3[1] = Eating Disorder Inventory, EDE-16[2] = Eating Disorder Examination 16, EAT-26[3] = Eating Attitudes Test 26, EDE-Q[4] = Eating Disorder Examination Questionnaire, FAST[5] = Female Athlete Screening Tool, QEDD[6] = Questionnaire for Eating Disorder Diagnoses, BULIT-R[7] = Bulimia Test-Revised, EDI-2[8] = Eating Disorder Inventory-2, SCL-5[9] = Hopkins Symptom Checklist, TFEQ[10] = Three-Factor Eating Questionnaire

Appendix 5 – Table of included meta-analyses and review articles presenting the prevalence of DEB and ED

Study (year), country	Study type	Population	Age in years	Number of studies included	Described findings on DEB/ED prevalence
Bratland-Sanda S. & Sundgot-Borgen J. (2013), Norway (10) (international studies)	Systematic review	Athletes of both sexes competing in college, national, or international level	Adolescent to adult	20	6 studies: ED prevalence males < females. 1 study: ED prev. male elite = female elite, 1 study: sex differences between different sports in adults – Highest overall in female endurance & aesthetic & in males highest in weight-class sports, 1 study: sport specific variation in adolescent elite, 2 studies: high school non-athletes > high school athletes
Rice S.M. et al. (2016), Australia (32) (international studies)	Systematic review (mental health study)	Athletes of both sexes competing in Olympic, international, national or professional level	>18	60	**10 of the studies examined eating disorders and body image** 3 studies: ED incidence and body dissatisfaction mixed sex non-athletes < elite athletes (especially in sports emphasizing lean body) 1 study: ED incidence and body dissatisfaction in female non-athletes = elite athletes 1 meta-analysis: no differences in body dissatisfaction between non-athletes and athletes, gender, or BMI groups. 5 studies: identified sports-specific risk factors for ED and body image dissatisfaction; young age, female sex, sport-specific body type requirements i.e., leanness, dieting, significant injury
Gibbs J. C. Et al. (2013), USA (33) (international studies)	Systematic review (Prevalence of individual and combined triad components)	Exercising women and women participating in lean and non-lean sports	Mean:21,8± 3,5	65	**31 studies reported on DEB/ED prevalence in exercising women:** 17 studies reported ED prevalence to range in between 0%-48% (n=2869) 17 studies reported combined clinical and subclinical DEB prevalence to range in between 7,1%-89,2% (n=2867) 6 studies reported combined clinical and subclinical DEB prevalence to range in between 2,9%-60% (n=1363)

					Prevalence of DE: Nr. Of studies not given. Non-lean sport athletes: 0,0-15,1% Lean sport athletes: 1,5-28,1% **Prevalence of DEB:** 12 studies (n=2186) Non-lean sport athletes: 2,9-89,2% Lan sport athletes: 6,9-89,2% **Prevalence of DE and low bone mineral density:** 1 study (n=186) Non-lean sport athletes: 1,0% Lean sport athletes: 5,6% **Prevalence of DE and menstrual disturbances:** 4 studies (n=987) Non-lean sport athletes: 5,4%-13,5% Lean sport athletes: 6,8%-57,8%

DEB = disordered eating behavior, ED = eating disorder

Appendix 6 – Nettskjema survey

Nettskjema

Undersøkelse om forstyrret spiseatferd hos norske kvinnelige

idrettsutøvere og ikke-idrettsutøvere kopi

Undersøkelse

Dette er invitasjon til en studie om forstyrret spiseatferd hos norske kvinnelige idrettsutøvere og ikke- iderettsutøvere. Studien er en del av masteroppgave i klinisk ernæring ved UiT Norges Arktiske Universitet.

Formål med prosjektet er å:

kartlegge forekomst av forstyrret spiseadferd hos norske kvinner mellom 17-35 år
sammenligne forekomst av forstyrret spiseatferd hos norske kvinnelige idrettsutøvere og ikke-idrettsutøvere beskrive faktorer som kan ha en sammenheng med forstyrret spiseatferd

Hvem er ansvarlig for studien?

Mimmi Meiju Susanna Vedenpää Masterstudent, John Owen Osborne PhD, Postdoktor, Edvard Hamnvik Sagelv PhD student begge Idrettshøgskolen og Kristin Benjaminsen Borch, Førsteamanuensis, Institutt for samfunnsmedisin, det Helsevitenskapelige fakultetet.

Hvis du har spørsmål om studien, vennligst kontakt:

Mimmi Meiju Susanna Vedenpää - Det helsevitenskapelige fakukultet ved UiT Norges arktiske universitet. E-post: mve036@uit.no
John Owen Osborne -Idrettshøgskolen ved UiT Norges arktiske universitet. E-post: john.owen.osborne@uit.no
Edvard Hamnvik Sagelv - Idrettshøgskolen ved UiT Norges arktiske universitet. E-post: edvard.h.sagelv@uit.no
Kristin Benjaminsen Borch - Det helsevitenskapelige fakukultet ved UiT Norges arktiske universitet. E-post: kristin.benjaminsen.borch@uit.no

Hvorfor blir du bedt om å delta?

Du blir bedt om å delta i dette prosjektet fordi du er kvinne som bor i Norge og er mellom 17 og 35 år

Hva innebærer det for deg å delta?

Dersom du velger å delta i prosjektet betyr det at du vil svare på spørsmål knyttet til din spiseadferd, kroppsbilde, menstruasjonssyklusen, bruk av hormonelle prevensjonsmidler, helse tilstand og fysisk aktivitetsnivå. Spørsmålene besvares i et digitalt spørreskjema ved å trykke 'Jeg samtykker til å delta i denne studien'.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. På grunn av anonymitet er det ikke mulig å trekke svarene dine etter at spørreskjemaet er sendt inn

Ditt personvern – hvordan vi lagrer og bruker informasjonen din

Alle data vil være helt ***anonyme***, og du vil ikke bli pålagt å oppgi identifiserbar informasjon (som fødselsnummer, navn eller eksakt alder: kun innenfor en 5-års kategori av alder). Vi vil kun bruke informasjonen du gir her til de formålene vi har beskrevet. Dette prosjektet utføres i tråd med personvernregelverket. Dataene vil bli lagret i tre år for eventuell publisering.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler informasjon om deg basert på ditt samtykke.

Samtykkeerklæring

Jeg sier ja til å delta i prosjektet '*Undersøkelse om forstyrret spiseatferd hos norske kvinnelige idrettsutøvere og ikke-idresuttsøvere*'. Jeg forstår at dataene mine vil være helt ***anonyme*** og at det vil være umulig å identifisere meg fra dataene jeg sender inn.
Hvis du er enig, trykk på knappen nedenfor.

Jeg samtykker til å delta i denne studien

Dette spørreskjemaet består av tre deler. I første del ber vi om generell bakgrunnsinformasjon, andre del kartlegger forholdet ditt til mat og kropp og tredje del kartlegger aktivitetsnivået ditt.

DEL 1 - BAKGRUNN

1) Hva er din aldersgruppe?

Velg en

17-20 år 21-25 år 26-30 år 31-35 år 36-40 år

2) Hvor høy er du (cm)?

Vennligst estimer så godt som mulig

3) Hvor mye veier du (kg)?

Vennligst estimer så godt som mulig

4) Hva er din høyeste utdannelse?

Velg en

Grunnskole
Videregående skole
Universitetsutdannelse mindre enn 4år
Universitetsutdannelse mer enn 4år

5) Hvilket fylke bor du i?

Velg en
Agder
Innlandet
Møre og Romsdal Nordland
Oslo
Rogaland
Vestfold og Telemark Troms og Finnmark Trøndelag

Vestland
Viken

6) I gjennomsnitt, hvor mange timer per uke har du trent i løpet av de siste 6 månadene

10t eller mer
8t eller mer
4t eller mer
2,5t eller mer mindre enn 2,5t

7) Deltar du i idrettskonkurranser?

Ja Nei

8) På hvilket nivå konkurrerer du på?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «7) Deltar du i idrettskonkurranser?»

Svar det høyeste nivået Rekreasjonalt/uoffisielle konkurranser Regionalt
Nasjonalt
Internasjonalt/OL

9) Hva er ditt hovedidrett?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «7) Deltar du i idrettskonkurranser?»

10) Hva er treningshistorikken din?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «7) Deltar du i idrettskonkurranser?»

Oppgi hvor mange år har du trent konsekvent hoved idretten din?

11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning

på kostholds- og/eller treningsrutinene dine?

Dette elementet vises kun dersom alternativet «10t eller mer eller 8t eller mer eller 4t eller mer» er valgt i spørsmålet «6) I gjennomsnitt, hvor mange timer per uke har du trent i løpet av de siste 6 månadene»

Ja Nei

11.1) Hvilken type skade/sykdom?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

F. eks brukket ben/Covid-19/overtrenings lidelse/tendonitis

11.2) Hvor lenge siden ble du skadet/syk?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

noen dage eller 1 uke siden
2-4 uker siden
5-12 uker siden
13 - 24 uker siden
over 24 uker siden

11.3) Hvor lang er estimert restitusjonstid?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

1 uke eller mindre 2-4 uker
5-12 uker
13 - 24 uker
over 24 uker

11.4) Har skadet/sykdom påvirket din trening?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

Ja Nei

11.5) På hvilken måte har du endret trenings øktene dine sammenlignet når du var frisk?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11.4) Har skadet/sykdom påvirket din trening?»

Jeg kan ikke trene noe i det hele tatt
Jeg trener mindre (timer per uke)
Jeg trener mer teknikk enn stryrke
Jeg må holde trenings intensiteten lavere Ingen av de ovennevnte

11.6) Har skadet/sykdom påvirket matvanene dine?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

F.eks. Spiser du større eller mindre mengder? Har det endret måltids rytme ditt? Spiser du mer eller mindre snacks/godteri?

Ja Nei

11.7) På hvilken måte har du endret matvanene dine sammenlignet når du var frisk?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11.6) Har skadet/sykdom påvirket matvanene dine?»

Jeg spiser mindre per døgn
Jeg spiser mer per døgn
Jeg spiser mer uregelmessig
Jeg spiser mer regelmessig

Jeg spiser sunnere (mindre godteri, snacks, junkfood) Jeg spiser mer usunt (mer godteri, snacks, junkfood) Jeg kontrollerer matinntaket mer

Jeg har mindre kontrol over matinntaket Ingen av de ovennevnte

11.8) Har det hatt en negativ effekt på din mentale helse? (ja/nei)

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «11) Er du i ferd med å komme deg etter en skade/sykdom som har hatt innvirkning på kostholds- og/eller treningsrutinene dine?»

Ja Nei

12) Hvordan vurderer du din nåværende fysiske helsetilstand?

veldig dårlig: 0
dårlig: 1-2
god: 3-4
meget god: 5-6

13) Hvordan vurderer du din nåværende mentale og emosjonelle helsetilstand?

veldig dårlig: 0
dårlig: 1-2
god: 3-4
meget god: 5-6

14) Er du for tiden diagnostisert med spiseforstyrrelse?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «14.1) Har du fått spiseforstyrrelse diagnosen før men blitt frisk?»

Husk at svaret ditt er helt anonymt

Ja Nei

14.1) Har du fått spiseforstyrrelse diagnosen før men blitt frisk?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «14) Er du for tiden diagnostisert med spiseforstyrrelse?»

Husk at svaret ditt er helt anonymt

Ja Nei

15) Er du for tiden diagnostisert med en psykisk lidelse (noe annen enn spiseforstyrrelse)?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «15.1) Har du blitt diagnostisert med en annen psykisk lidelse (noe annen enn spiseforstyrrelse) før men blitt frisk?»

Husk at svaret ditt er helt anonymt

Ja Nei

15.1) Har du blitt diagnostisert med en annen psykisk lidelse (noe annen enn spiseforstyrrelse) før men blitt frisk?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «15) Er du for tiden diagnostisert med en psykisk lidelse (noe annen enn spiseforstyrrelse)?»

Husk at svaret ditt er helt anonymt

Ja Nei

16) Er du gravid nå?

Ja Nei

16.1) Har du planlagt å bli gravid i løpet av de neste 6 månadene?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «16) Er du gravid nå?»

Ja Nei

17) Bruker du hormonell prevensjonsmiddel for øyeblikket?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «16.1) Har du planlagt å bli gravid i løpet av de neste 6 månadene?»

Ja Nei

17.1) Hvilken type hormonell prevensjon bruker du?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «17) Bruker du hormonell prevensjonsmiddel for øyeblikket?»

P-piller for prevensjon
Minipiller
Implantant i armen (P-staver)
Hormonspiral (intrauterint enhet/system; IUD/IUS) Vaginal ring (P-ring)

P-plaster
Injeksjon (P-sprøyte) Vet ikke

18) Hvor lang er din normale menstruasjonssyklus?

Hvor mange dager er det mellom den første dagen med menstruasjonsblødning og til neste blødning starter.

20 dager eller mindre
Mellom 21-25 dager
Mellom 26-30 dager
Mellom 30-34 dager
Mellom 35-39 dager
40 dager eller mer

19) Har du lagt merke til uregelmessighet i menstruasjonssyklusen i løpet av de siste 4 månedene

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «16) Er du gravid nå?»

Er menstruasjonsintervallene lengre enn 35 dager men kortere enn 3 måneder?

Ja Nei

20) Har noen menstruasjoner uteblitt de siste 3-4 månedene?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «16) Er du gravid nå?»

Ja Nei

20.1) Hvor mange menstruasjoner uteblitt de siste 3-4 månedene?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «20) Har noen menstruasjoner uteblitt de siste 3-4 månedene?»

1 2 3 4

Avvik i menstruasjonssyklusen er vanlige, men de kan være et tegn på hormonelle forstyrrelser. Hvis du svarte *ja* enten på spørsmål 19) eller 20), anbefaler vi at du konsulterer fastlegen din for videre utredning av mulig årsak og behandling.

DEL 2 - THE EATING DISORDER EXAMINATION QUESTIONNAIRE (EDE-Q 6.0)

Denne delen av spørreskjemaet handler kun om de siste fire ukene (28 dager). Les hvert spørsmål nøye. Svar på alle spørsmålene.
Spørsmål 1-12: kryss av i boksen på tallet du synes passer best.

På hvor mange av de siste 28 dagene ...

1) Har du bevisst prøvd å begrense mengden mat du spiser for å påvirke din figur eller vekt (uavhengig av om du har klart det eller ikke)?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

2) Har du i lengre perioder (8 våkne timer eller mer) ikke spist noe i det hele tatt for å påvirke din figur eller vekt?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

3) Har du prøvd å utelukke noen typer mat du liker, for å påvirke din figur eller vekt (uavhengig av om du har klart det eller ikke)?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

4) Har du prøvd å følge bestemte regler for hva eller hvordan du spiser (f.eks. en kalorigrense) for å påvirke din figur eller vekt (uavhengig av om du har klart det eller ikke)?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

5) Har du hatt et klart ønske om å ha tom mage for å påvirke din figur eller vekt?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

6) Har du hatt et klart ønske om å ha en helt flat mage?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

7) Har du opplevd at tanker om mat, spising eller kalorier har gjort det veldig vanskelig å konsentrere deg om ting du er interessert i (f.eks. å arbeide, følge en samtale eller lese)?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

8) Har du opplevd at tanker om figur eller vekt har gjort det veldig vanskelig å konsentrere deg om ting du er interessert i (f.eks. å arbeide, følge en samtale eller lese)?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

9) Har du hatt en klar frykt for å miste kontroll over spisingen din? ingen dager

1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

10) Har du hatt en klar frykt for at du kan gå opp i vekt? ingen dager

1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

11) Har du følt deg tykk?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

12) Har du hatt et sterkt ønske om å gå ned i vekt?

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

Spørsmål 13 til 18: Fyll inn passende antall. Husk at spørsmålene kun handler om de siste fire ukene (28 dager).

I løpet av de siste 28 dagene..

13) I løpet av de siste 28 dagene, hvor mange ganger har du spist det andre ville betraktet som en uvanlig stor mengde mat (omstendighetene tatt i betraktning)?

14) Ved hvor mange av disse episodene hadde du en følelse av å ha mistet kontrollen over spisingen din (mens du spiste)?

15) I løpet av de siste 28 dagene, hvor mange DAGER har slike episoder med overspising forekommet (dvs. der du har spist uvanlig store mengder mat og hatt en følelse av å miste kontrollen mens du spiste)?

16) I løpet av de siste 28 dagene, hvor mange ganger har du kastet opp for å kontrollere din figur eller vekt?

17) I løpet av de siste 28 dagene, hvor mange ganger har du brukt avføringsmidler for å kontrollere din figur eller vekt?

18) I løpet av de siste 28 dagene, hvor mange ganger har du følt deg drevet eller tvunget til å trene for å kontrollere din vekt, figur eller fettmengde, eller for å forbrenne kalorier?

Spørsmål 19 til 21: Kryss av tallet du synes passer best. Vær oppmerksom på at i disse spørsmålene brukes begrepet "overspisingsepisode" for å bety at det å spise det andre ville tro var en uvanlig stor mengde mat i den situasjonen du var i, samtidig som du føler at du har mistet kontrollen over spisingen.

I løpet av de siste 28 dagene..

19) I løpet av de siste 28 dagene, hvor mange dager har du spist i hemmelighet (i skjul)? ...tell ikke med overspisingsepisoder.

ingen dager 1-5 dager 6-12 dager 13-15 dager 16-22 dager 23-27 dager alle dager

20) Hvor mange av de gangene du har spist, har du hatt skyldfølelse (følt at du har gjort noe galt) fordi det kan påvirke din figur eller vekt?
...tell ikke med overspisingsepisoder.

ingen av gangene
noen få ganger
færre enn halvparten
halvparten
mer enn halvparten
de fleste gangene hver gang

21) I løpet av de siste 28 dagene, hvor bekymret har du vært for at andre mennesker ser deg spise? ...tell ikke med overspisingsepisoder.

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6

Spørsmål 22 til 28: Kryss av tallet du synes passer best. Husk at spørsmålene kun handler om de siste fire ukene (28 dager).

22) Har vekten din påvirket hvordan du tenker om (bedømmer) deg selv som person?

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6
vedig mye: 6

23) Har figuren din påvirket hvordan du tenker om (bedømmer) deg selv som person?

ikke i det hele tatt: 0-1

lite: 2-3
ganske mye: 4-5
vedig mye: 6

24) Hvor opprørt ville du bli hvis du ble bedt om å veie deg en gang i uken (ikke mer, ikke mindre) de neste fire ukene?

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6

25) Hvor misfornøyd har du vært med vekten din?

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6

26) Hvor misfornøyd har du vært med figuren din?

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6

27) Hvor mye ubehag har du følt ved å se kroppen din (f.eks. når du ser figuren din i speilet, reflektert i et butikkvindu, ved klesskift, eller når du bader eller dusjer)?

ikke i det hele tatt: 0-1
lite: 2-3
ganske mye: 4-5
vedig mye: 6

28) Hvor mye ubehag har du følt ved at andre ser figuren din (f.eks. i offentlige omkledningsrom, når du svømmer, eller når du har på deg trange klær)?

ikke i det hele tatt: 0-1

lite: 2-3
ganske mye: 4-5
vedig mye: 6

DEL 3 - INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

De følgende spørsmålene handler om fysisk aktivitet. Vi er interessert i å vite hvilke former for fysisk aktivitet du driver med i det daglige. Spørsmålene innbefatter tiden du har vært i fysisk aktivitet de siste 7 dagene. Svar på spørsmålene selv om du ikke anser deg for å være en aktiv person. Inkluder alle aktiviteter som både arbeid, når du beveger deg fra sted til sted, husarbeid, hagearbeid, fritidsaktiviteter og planlagt trening.

Når du svarer på spørsmålene:
Meget anstrengende – er fysisk aktivitet som får deg til å puste mye mer enn vanlig
Middels anstrengende – er fysisk aktivitet som får deg til å puste litt mer enn vanlig Det er kun aktiviteter som varer **minst 10 minutter i strekk** som skal rapporteres

1a) Hvor mange dager i løpet av de siste 7 dager har du drevet med meget anstrengende fysiske aktiviteter som tunge løft, gravearbeid, aerobics eller sykle fort?

Tenk bare på aktiviteter som *varer minst 10 minutter i strekk*

1 dager per uke
2 dager per uke
3 dager per uke
4 dager per uke
5 dager per uke
6 dager per uke
7 dager per uke
Ingen (gå til spørsmål 2a)

1b) På en vanlig dag hvor du utførte meget anstrengende fysiske aktiviteter, hvor lang tid brukte du da på dette?

Gi svar i timer og/eller minutter eller vet ikke/husker ikke

2a) Hvor mange dager i løpet av de siste 7 dager har du drevet med middels anstrengende fysiske aktiviteter som å bære lette ting, sykle eller jogge i moderat tempo eller mosjonstennis?

Ikke ta med gange, det kommer i neste spørsmål.

1 dager per uke
2 dager per uke
3 dager per uke
4 dager per uke
5 dager per uke
6 dager per uke
7 dager per uke
Ingen (gå til spørsmål 3a)

2b) På en vanlig dag hvor du utførte middels anstrengende fysiske aktiviteter, hvor lang tid brukte du da på dette?

Gi svar i timer og/eller minutter eller vet ikke/husker ikke

3a) Hvor mange dager i løpet av de siste 7 dager, gikk du minst 10 minutter i strekk for å komme deg fra ett sted til et annet?

Dette inkluderer gange på jobb og hjemme, gange til buss eller gange som du gjør på tur eller som trening i fritiden.

1 dager per uke
2 dager per uke
3 dager per uke
4 dager per uke
5 dager per uke
6 dager per uke
7 dager per uke
Ingen (gå til spørsmål 4)

3b) På en vanlig dag hvor du gikk for å komme deg fra et sted til et annet, hvor lang tid brukte du da totalt på å gå?

Gi svar i timer og/eller minutter eller vet ikke/husker ikke

4) Dette spørsmålet omfatter all tid du tilbringer i ro (sittende) på jobb, hjemme, på kurs, og på fritiden. Det kan være tiden du sitter ved et arbeidsbord, hos venner, mens du leser eller ligger for å se på TV. I løpet av de siste 7 dager, hvor land tid brukte du vanligvis totalt på å sitte på en vanlig hverdag?

Gi svar i timer og/eller minutter eller vet ikke/husker ikke

Hvis du, etter å ha fylt ut dette spørreskjemaet, mistenker at du kan lide av en udiagnostisert spiseforstyrrelse, vennligst kontakt fastlegen din. Spiseforstyrrelser er en alvorlig sak, og det er svært viktig å søke hjelp hvis du føler at matvanene dine kan skade deg. Mer informasjon og støtte kan du også finne fra nettros.no og mentalhelseungdom.no som tilbyr live chat med eksperter

Takk for at du deltar i dette spørreskjemaet!

Appendix 7 – Table of participant sports domains represented in different main sports categories

Aesthetic (n = 5)	**Ball (n = 89)**	**Endurance (n = 75)**	**Power (n = 2)**	**Technical (n = 3)**	**Weight dependent (n = 15)**
Diving (3) Cheerleading (1) Rhythmic gymnastics (1)	Ice hockey (13) Football (10) Handball (50) Floorball (5) Volleyball (3) Lacrosse (2) Badminton (5) Basketball (1)	Swimming (57) Triathlon (3) Cross-country skiing (6) Running (8) Long-track speed skating (1)	Short distance running (1) Short-track speed skating (1)	Dressage (1) Horseback riding (1) Sailing (1)	Taekwondo (3) Karate (3) Brazilian jiu jitsu (2) Olympic weightlifting (6) Powerlifting (1)

Appendix 8 – Figures over the linear association between the EDE-Q global score and participant characteristics

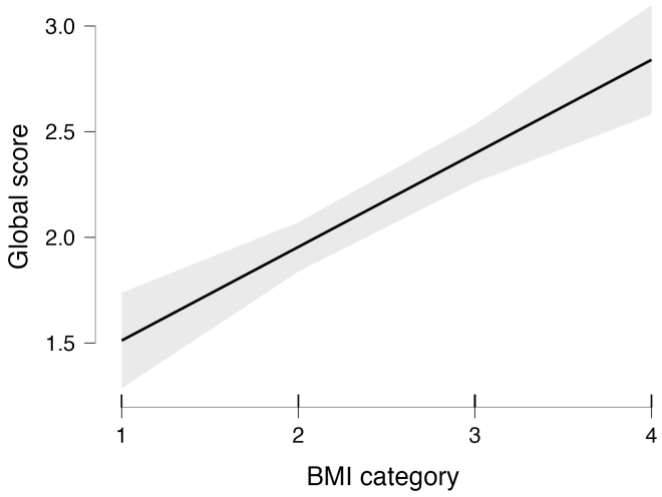


Figure 3 – Linear association between EDE-Q global score and BMI categories; 1 = underweight, 2 = normal weight, 3 = overweight and 4 = obese

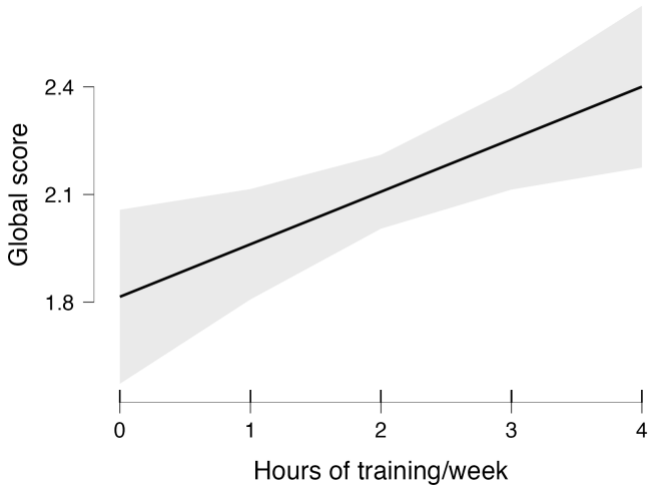


Figure 4 - Linear association between EDE-Q global score and hours of training per week (past 6 months)

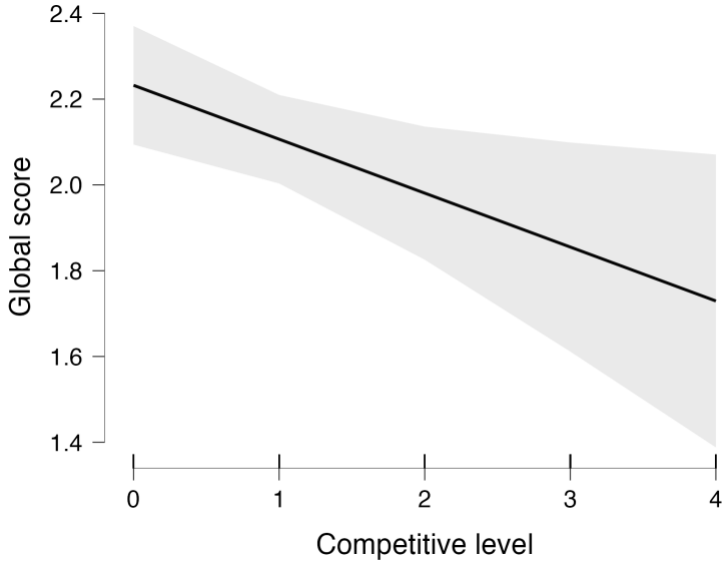


Figure 5 - Linear association between EDE-Q global score and competitive levels: 0 = not competing, 1 = recreational, 2 = regional, 3 = national, 4 =international/OL

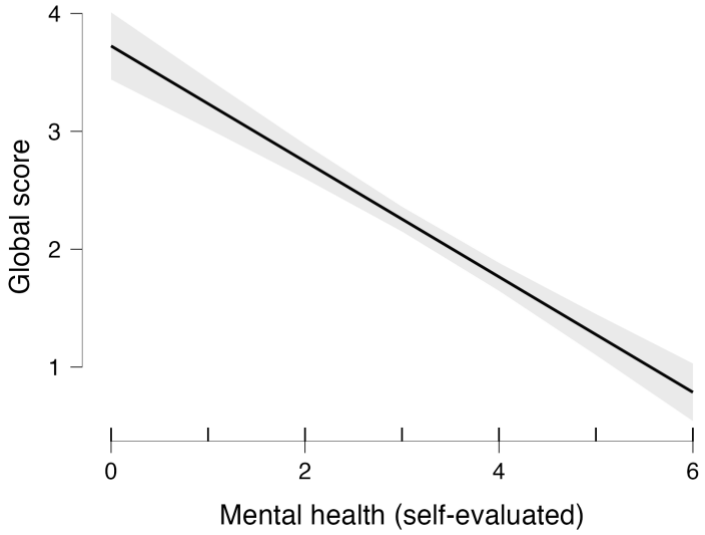


Figure 6 - Linear association between EDE-Q global score and self-evaluated mental health on a 7-point Likert scale ranging from very bad to very good (0-6)

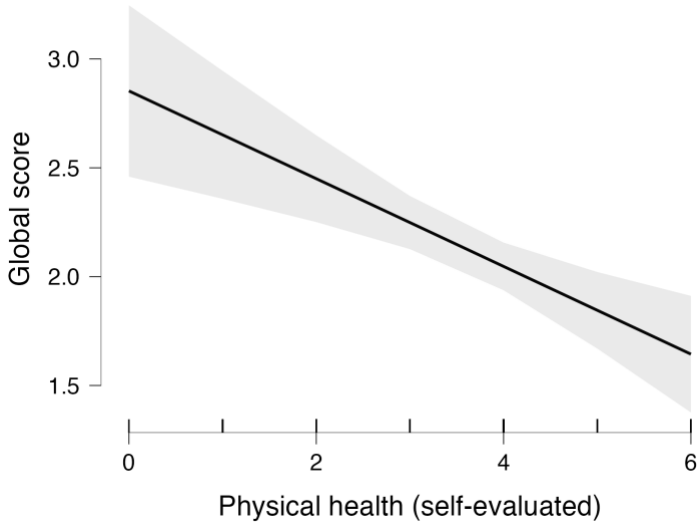


Figure 7 - Linear association between EDE-Q global score and self-evaluated physical health on a 7-point Likert scale ranging from very bad to very good (0-6)

Appendix 9 – REK evaluation

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord	Ragnhild Hageberg	77646140	11.05.2022	482938

Mimmi Meiju Susanna Vedenpää

Fremleggingsvurdering: Beskrivelse av spiseforstyrrelser blant norske idrettsutøvere
Søknadsnummer: 482938
Forskningsansvarlig institusjon: UiT Norges arktiske universitet

Prosjektet vurderes som ikke fremleggingspliktig

Søkers beskrivelse

This study aims to describe the current prevalence of disordered eating patterns among Norwegian athletes compared to the general population. Data will be gathered via online surveys fully anonymously.

Vi viser til forespørsel om fremleggingsvurdering for ovennevnte forskningsprosjekt. Forespørselen er behandlet av sekretariatet i REK nord på delegert fullmakt fra komiteen, med hjemmel i forskningsetikkforskriften § 7, første ledd, tredje punktum. Forespørselen er vurdert med hjemmel i helseforskningsloven § 10.

REKs vurdering

De prosjektene som skal framlegges for REK er prosjekt som dreier seg om *«medisinsk og helsefaglig forskning på mennesker, humant biologisk materiale eller helseopplysninger»* , jf. helseforskningsloven § 2. *«Medisinsk og helsefaglig forskning»* er i § 4 a), definert som *«virksomhet som utføres med vitenskapelig metodikk for å skaffe til veie ny kunnskap om helse og sykdom»*. Det er altså formålet med studien som avgjør om et prosjekt skal anses som framleggelsespliktig for REK eller ikke.

Formålet med prosjektet er ifølge prosjektbeskrivelsen å beskrive forekomst av spiseforstyrrelser blant norske idrettsutøvere i dag, sammenlignet med resten av befolkningen. Det er på bakgrunn av en knapp forespørsel og en noe uklar prosjektbeskrivelse vanskelig å ta stilling til om formålet er å fremskaffe ny kunnskap om helse og sykdom.

Det er opplyst at det skal forskes på anonyme data. Anonyme data faller utenfor definisjonen av *«helseopplysninger»,* jf. helseforskningsloven § 4 d). Helseforskningsloven vil da ikke komme til anvendelse på prosjektet. REK tar ikke stilling til om dataene i dette prosjektet er reelt anonyme.