The effects of a 16-week nutritional intervention program on reducing risk of exercise addiction and disordered eating symptoms in female endurance athletes at risk of Relative Energy Deficiency in Sports

RASMUS FJELD

SUPERVISORS

Monica Klungland Torstveit
Ida Lysdahl Fahrenholtz
Tommy Haugen

University of Agder, 2022
Faculty of Health- and Sports Science
Department of Sports Science and Physical Education

Forord

Jeg har alltid selv vært fysisk aktiv og interessert i trening. Jeg har og vært meget så fascinert av andres mennesker fasinasjon og lidenskap til det samme, på både godt og vondt. Når jeg startet på masterløpet på UiA så fikk jeg dyrket min interesse, og jeg ble utfordret i mange aspekter av idrettsvitenskapen med spennende emner med temaer som dekket store fagfelt. Flinke og velutdannede forelesere som sammen med medelever skapte et godt læringsmiljø. I en tid hvor pandemi, nedstengning, restriksjoner, krigskonflikter i verden og usikkerhet har preget mye av hverdagsbildet, så har faglig interesse og stressende eksamenstider vært en fin avledning.

Det siste året med arbeiding av masteroppgaven har bydd på enorme mengder frustrasjon, kunnskap og liten smak av akademia. Jeg startet med å prøve og gjennomføre mitt eget prosjekt, med litt hindringer i veien så fikk jeg tilbudet om å bli med på FUEL-prosjektet hvor jeg kunne arbeide med ett meget spennende tema som har motivert meg gjennom det siste halvåret.

Jeg vil rette en stor takknemlighet til mine veiledere, Monica Klungland Torstveit, Ida Lysdahl Fahrenholtz og Tommy Haugen. E-poster fra dere og Zoom-samtaler har berolighet med gode råd og faglig kunnskap ett ellers stresset hjerte.

Rasmus Fjeld, 2022.

Abstract

Background: Exercise addiction, eating disorders and disordered eating behavior are mental deviations that can underpin low energy availability and risk for Relative Energy Deficiency in Sports (RED-S). There is a lack off studies which have investigated how a nutritional educational programme can reduce risk for exercise addiction and symptoms of disordered eating.

Purpose: This thesis' purpose was to evaluate if a 16-week practice orientated sports nutrition education and counselling program can reduce risk for exercise addiction and symptoms for disordered eating in female endurance athletes with risk of RED-S and low risk for eating disorders.

Method: A total of 33 competitive female endurance athletes participated in an intervention where they were enrolled in a course where the focus was on nutritional education through online learning videos every week. The participants received nutritional counseling every other week, totaling eight during the intervention. The participants answered the Exercise Addiction Inventory (EAI) and the Eating Disorder Examination Questionnaire (EDE-Q) at pre- and posttest..

Results: The total score for the Exercise Addiction Inventory saw a significant reduction by 1.4% from pre- to posttest and the subscales *Mood Modification*, *Tolerance, Withdrawal Symptoms* and *Relapse* had significant increases. The Eating Disorder Examination Questionnaire Global score revealed a significant reduction by 27.3% from pre- to post with significant reductions in all subscales. Additional analysis showed a significant and moderate correlation between the exercise addiction and disordered eating at pretest, and a non-significant moderate correlation at posttest.

Conclusion: This thesis has shown that a reduction in risk of exercise addiction and symptoms of disordered eating can be achieved through a 16-week intervention aimed at increasing sports nutrition knowledge among female athletes at risk for RED-S.

Keywords: RED-S, Exercise Addiction, Eating Disorders, Disordered Eating, Sports Nutrition

Sammendrag

Bakgrunn: Treningsavhengighet, spiseforstyrrelser og forstyrret spiseatferd er mentale avvik som kan underbygge som kan underbygge lav energitilgjenglighet og dermed risko for Relativ Energimangel i idrett. Det er mangel påstudier som har undersøkt om effekten av et ernæringsbasert læringsprogram kan redusere risiko for treningsavhengighet og symptomer på forstyrret spiseatferd.

Hensikt: Denne oppgavens hensikt er å undersøke om et 16-ukers ernæringsbasert læringsprogram can redusere risiko for treningsavhengighet og symptomer for forstyrret spiseatferd hos kvinnelige utøvere.

Metode: Totalt 33 kvinnelige konkurranseutøvende utholdenhetsutøvere deltoki et 16 ukers digitalt læringaprogram innen idrettsernæring som inkluderte læringsvideoer hver uke. Deltagerne mottok ernæringsbasert rådgivning annenhver uke, totalt åtte gjennom intervensjonen. Deltagerene svarte på spørreskjemaene Exercise Addiction Inventory (EAI) og Eating Disorder Examination Questionnaire (EDE-Q) før og etter intervensjonen.

Resultater: En 1.4% reduksjon i treningsavhengighet ble funnet fra pre-til posttest og underkategoriene *Mood Modification, Tolerance, Withdrawal Symptoms* and *Relapse* hadde en liten significant økning. Forstyrret spiseatferd hadde en significant reduksjon på 27.3% fra før til etter intervensjonen med significant reduksjon i alle underkategorier. Tilleggsanalyser vise en signifikant og moderat korrelasjon mellom Exercise Addiction Inventory og Eating Disorder Examination Questionnaire før intervensjonen, men en ikke-significant moderat korrelasjon etter.

Konklusjon: Denne oppgaven har vist at en reduksjon i risiko for treningsavhengighet og symptomer på forstyrret spiseforstyrrelse can oppnås gjennom en 16-ukers intervensjon med formål å utdanne kvinnelige utøvere ved risiko for relativ energi tilgjengelighet i idrett.

Nøkkelord: RED-S, Treningsavhengighet, Spiseforrstyrelser, Forstyrret Spiseatferd., Idrettsernæring

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List of Abbreviations

Abbreviations	Meaning
AN	Anorexia Nervosa
BED	Binge Eating Disorder
BEDA-Q	Brief Eating Disorder in Athletes Questionnaire
BMI	Body Mass Index
BN	Bulimia Nervosa
CET	Compulsive Exercise Test
CM	Centimeters
CON	Control Period
DE	Disordered Eating
DR	Dietary Restraint
DSM-5	Diagnostic and Statisical Manual of Mental Disorders - 5
EA	Exercise Addiction
EAI	Exercise Addiction Inventory
EC	Eating Concerns
ED/EDs	Eating Disorders
EDE-Q	Eating Disorder Examination Questionnaire
EDI	Eating Disorder Inventory
EDNOS	Unspecified Feeding or Eating Disorders
EDS	Exercise Dependent Scale
EEE	Exercise Energy Expenditure
EI	Energy Intake
FFM	Fat Free Mass
FUEL	Food and Nutrition for Endurance Athletes – a Learning Program
GI	Gastrointenstinal
HPG	Hypothalamic-Pituirary-Gonadal
IC	Individual Counseling
IOC	International Olympic Comitee
Kg	Kilograms
LEA	Low Energy Availability
LEAF-Q	Low Energy Availability in Females Questionnaire
MD	Menstrual Dysfunction
OSFED	Other Specified Feeding or Eating Disorders
PEA	Primary Exercise Addiction
RED-S	Relative Energy Defiency in Sports
SC	Shape Concern
SCOFF	Sick, Control, One, Fat, Food
SEA	Secondary Exercise Addiction
SNL	Sports Nutrition Lectures
Triad	Female Athlete Triad
WC	Weight Concern

1.0 Introduction

In elite sports, athletes may be present with low energy availability (LEA) which can occur secondary to inadvertent inadequate energy intake or from disordered eating (DE) (Reardon et al., 2019). LEA which underpins the concept of Relative Energy Deficiency in Sports (RED-S) has several negative effects on health and performance for elite athletes (Mountjoy et al., 2018), and recent research confirms that female endurance athletes are at high risk of LEA (Fahrenholtz et al., 2022). RED-S is a relatively new concept defined from what is known as the female athlete triad (Triad) in which females are present with one of the components; LEA, menstrual dysfunction and decreased bone mineral density (BMD) (De Souza et al., 2014; Mountjoy et al., 2018). The Triad, which were only defined for females until recently, was by the IOC statement incorporated into a more comprehensive concept which also included male athletes (De Souza et al., 2014)

Eating disorders (EDs) are serious psychiatric disorders characterised by abnormal eating or weight-control behaviours (Treasure et al., 2020). EDs can occur independently of gender, age, ethnicity, cultural background and weight (Samuels et al., 2019). EDs contain a cluster of mental disorders which are characterized with an abnormal eating pattern, purification and overestimation of shape and weight. There are mainly three diagnosis of EDs: Anorexia nervosa (AN) is seen as a psychiatric illness which is marked by an inability to maintain a normal healthy bodyweight which can drop to below 85% of normal bodyweight (Berkman et al., 2007). Disordered eating is viewed and understood as a continuum model, starting with appropriate eating and exercise behaviours including healthy dieting and the occasional use of more extreme weight loss methods (Karrer et al., 2020). Both Eating Disorders and Disordered Eating behaviour is estimated to be prevalent in 0% to 19% in male athletes and 6% to 45% in female athletes (Reardon et al., 2019) and recent research found a prevalence rate of 21% in female endurance athletes (Fahrenholtz et al., 2022). Exercise addiction (EA) is reported to be prevalent in 30.5% of triathletes, 3.4% of ultramarathon runners and 12.9% of endurance athletes (running, triathlon, swimming and cycling) (Di Lodovico et al., 2019; Juwono, Tolnai, et al., 2021) For female athletes, DE behaviours and EDs are known to occur frequently in elite female athletes, and especially among those competing in weight class or leanness-demanding sports (Logue et al., 2020). Exercise addiction (EA) was first dubbed "running addiction" by (Glasser, 1976) and has since been conceptualized into several terms such as *compulsive exercise, exercise addiction or exercise dependence* and is described as a morbid pattern of behavior in which the individual loses control over his or her exercise habits

and acts compulsively, exhibits dependence, and exeperience negative consequences to health as well as in his or her social life (Szabo, Griffiths, Marcos, Mervó, Demetrovics, et al., 2015).

EA is described as being associated with DE in both female and male long distance runners and athletes may be at greater risk of negative health outcomes associated with LEA (Logue et al., 2020). Some research report elevations in certain biochemical markers which are indicative of LEA, and EA behavior could potentially increase vulnerability to negative health and performance outcomes (Kuikman et al., 2021). It is important for athletes to recognise signs and behaviors that may be associated with EDs and RED-S and to properly educate both athletes, coaches, members of the entourage and sports organisations to improve awareness and prevention of RED-S (Mountjoy et al., 2018; Reardon et al., 2019). Intervention studies which have investigated the effects of nutritional education programs for athletes have shown positive results on bone health and race performance in males (Keay et al., 2019), and improved knowledge about the female athlete triad concepts using educational 10-minute videos and interventions that can prevent and recover females from EDs (Krick et al., 2019; Martinsen et al., 2014). A possibility to prevent EDs lies in promoting self-acceptance, healthy eating and reasonable training (de Oliveira Coelho et al., 2014). Removing barriers to accessing care, the harmful effect of pathogenic weight control methods and healthy nutritional practise to ensure adequate energy availability and increase health literacy and removing stigma revolving around EDs (de Oliveira Coelho et al., 2014; Gulliver et al., 2012).

1.1 Aims

This masters thesis is a part of a bigger multicenter study based at the Institute of Sports and Physical Education at the University of Agder (www.uia.no/fuel). The aim of the FUEL projects (**F**ood and n**U**trition for **E**ndurance athletes – a **L**earning program) is to develop, implement and evaluate a 16-week practice orientated sports nutrition education and counselling program to improve symptoms of LEA in female endurance athletes.

The main aim of this thesis was to investigate if a 16-week nutritional educational programme can reduce the risk of exercise addiction and symptoms of disordered eating in female endurance athletes at risk of RED-S. It was also of interest to investigate wether there was a relationship between exercise addiction and disordered eating in the same sample.

1.2 Research Questions

This thesis adresses mainly two research questions that are presented by the FUEL project.

Can the FUEL recovery program:

1. Can a 16-week nutritional educational programme reduce the risk of exercise addiction and symptoms of disordered eating in female endurance athletes at risk of RED-S?

2. Is there a relationship between exercise addiction and disordered eating among a group of female endurance athletes at risk of RED-S?

Secondary aims:

Will there be a relationship between the Eating Disorder Examination Questionnaire Global score and Exercise Addiction Inventory Total score in female endurance athletes with risk of RED-S?

1.3 Hypothesis

1. A 16-week nutritional educational programme reduces the risk of exercise addiction and symptoms of disordered eating in female endurance athletes at risk of RED-S.

2. There is a positive relationship between exercise addiction and disordered eating among female endurance athletes at risk of RED-S.

1.4 Important Note

It is important to note that this project is being conducted between the years of 2020/2021. During this period there is still a global COVID-19 pandemic which also affects Norway. The results presented from studies in this thesis might be very different during this time as a few studies already have reported a higher risk of both EA and EDs symptoms in individuals due to the situation the pandemic has caused on the global and national communities (Rodgers et al., 2020; Scharmer et al., 2020).

2.0 Theoretical Framework

2.1 The Female Athlete Triad

After the passage of federal law Title IX in 1972, female sports participation skyrocketed and it was estimated that 310.000 females participated in sports; in 2010, there were approximately 3.373.000 female participants in sports in the United States (Matzkin et al., 2015). The high incidence of amenorrhea and numbers of high stress fractures among professional ballet dancers was noted and researchers realized that the association between DE, amenorrhea and musculoskeletal injuries among female athletes was not coincidental (Matzkin et al., 2015).

The Triad was initially defined by the American College of Sports Medicine in 1992 and in 1997 the first position statement was released (Daily & Stumbo, 2018). The Triad is an intertwined relationship between energy availability, bone health and menstrual dysfunction (MD) that can be observed in physically active girls and women (Daily & Stumbo, 2018). The most recent definition of the Triad contains the following parameters: *Low energy availability with or without disordered eating*, *menstrual dysfunction* and *low bone mine density* (Daily & Stumbo, 2018; Mountjoy et al., 2018; Nazem & Ackerman, 2012; Statuta, 2020). Although not all three components need to be present for there be be a syndrom and within each component a spectrum of dysfunction exist such as functional hypothalamic amenorrhea (FHA) and osteoporosis (Mehta et al., 2018). The long-term consequences for these components of the Triad are far-reaching and can affect the cardiovascular, endocrine, reproductive, skeletal, gastrointenstinal (GI), renal and central nervous systems (Coelho et al., 2021; Mehta et al., 2018).

2.2 Relative Energy Deficiency in Sports

It has become evident that the clinical phenomenon of the Triad is not only three entities of energy availability, but rather a syndrome resulting from relative energy deficiency that affects many aspects of physiological functions (Mountjoy et al., 2018). Therefore new and comprehensive terminology was required and introduced by the IOC concensus group (Mountjoy et al., 2018). The syndrome of Relative Energy Defiency in Sports (RED-S) refers to impaired physiological functions caused by relative energy deficiency (**Figure 1**) (Mountjoy et al., 2018). The aetiological factor for this syndrom is LEA and can include, but is not limited to, impairements of metabolic rate, menstrual function, bone health, immunity, protein synthesis and cardiovascular health, endocrine, psychological, skeletal,

haemotological and immunological systems (Figure 2) (Mountjoy et al., 2018). In 2014, the International Olympic Comitee (IOC) published a consensus statement which was titled *Beyond the Female Athlete Triad: Relative energy Deficiency in Sports* (Mountjoy et al., 2014). The IOC expert group showed through scientific evidence and clinical experience that the aetological factor underpinning the Triad (See chapter "**2.1 The Female Athlete Triad"**) is an energy defiency relative to the balance between dietary energy intake (EI) and the energy expenditure required to supports homeostatis, health and the activities of daily living, growth and sporting activities (Mountjoy et al., 2014). RED-S are prevalent in female athletes (Mehta et al., 2018; Mountjoy et al., 2018), male athletes (De Souza et al., 2019; Fredericson et al., 2021) and para athletes (Brook et al., 2019; Mountjoy et al., 2018).

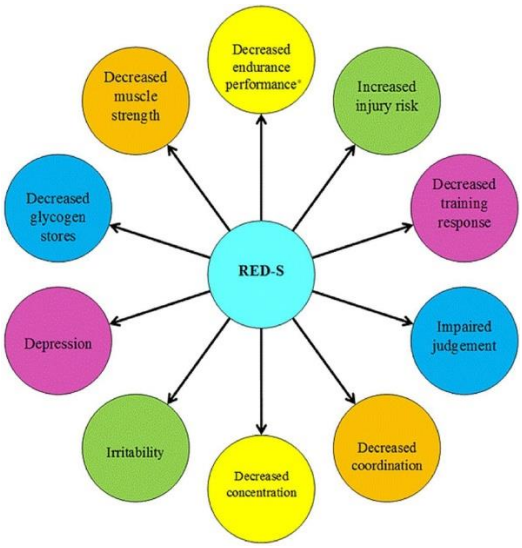

Figure 1: Performance effects of RED-S (Mountjoy et al., 2014)

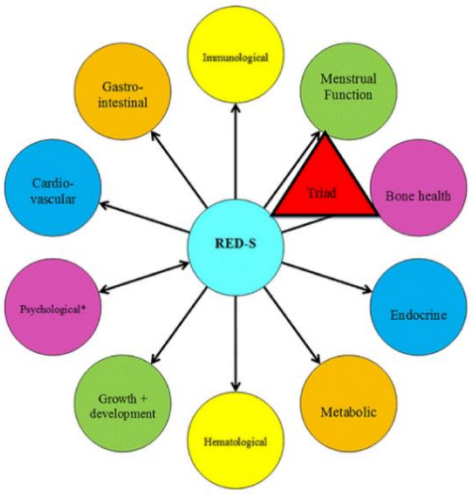

Figure 2: Health Consequences of RED-S (Mountjoy et al., 2014)

2.2.1 Low Energy Availability

Energy availability is defined as the amount of dietary energy available to sustain physiological function after subtracting the energetic cost of exercise (Areta et al., 2021). Insufficient energy availability due to increased exercise, reduced energy intake, or a combination of both, is a potent disruptor of the endocrine enviromental reproductive system and other interrelated hormonal pathways in the human body (Areta et al., 2021; Elliott-Sale et al., 2018). LEA, which underpins the concept of RED-S is a mismatch between an athletes energy intake and the energy expended in exercise. LEA is simple math, energy is first used for exercise and the remaining energy serves to regulate bodily functions. When energy availability falls into a negative balance, the body reacts by reducing the amount of energy needed for bodily functions such as cellular maintenance, thermoregulation and reproduction (Thein-Nissenbaum & Hammer, 2017). This shift in energy distribution is negative as it impairs overall health (Thein-Nissenbaum & Hammer, 2017). Operationally energy availability is defined by Mountjoy et al. (2018) as:

Energy Availability

= Energy intake (EI) (kcal)

-Exercise Energy Expenditure (EEE) (Kcal) / Fat Free mass (FFM (kg)

(EEE) is calculated as the additional energy expended above that of daily living during exercise bouts, and the overall results is expressed relative to fat-free mass (FFM). Controlled laboratory trials have shown that optimal energy availability for healthy physiological function is typically achieved at an energy availability of 45 kcal/kg FFM/day which translates into 188kJ/kg FFM/day (Mountjoy et al., 2018). Various bodily systems are substantially perturbed at an energy availability at < 30 kcal/kg /FFM/day (125kJ/kg FFM/day), this making it the historically a targeted threshold for LEA (Mountjoy et al., 2018). A LEA at < 30kcal/kg will roughly equal the resting metabolic rate (McMurray et al., 2014; Mountjoy et al., 2018). Although this cut-off does not predict amenorrhoea in all women (Lieberman et al., 2018) and there might be some limitations to the application of this clinically LEA. Self-reported nutritional data in athletes have failed to find clear thresholds or associations between energy availability and objective measures of energy conservation or health impairement such as disruption to metabolic hormons and menstrual disturbances (Logue et al., 2020).

2.2.2 Prevalence of LEA, RED-S and Triad symptoms in Sports

The prevalence of ED/DE and EA in sports will be covered in the chapter *"***2.3.4 Prevalence of Exercise Addiction in Sports**" and "**2.4.4 Prevalence of Eating Disorders***"*. The narrative review by Logue et al. (2020) ranges the prevalence rates of LEA of various sports from 22% to 58%. It is prevalent in both male and females by studies that have been investigated with male road cyclists and elite distance athletes (Logue et al., 2020) and recent research confirms that female endurance athletes are at high risk of LEA with a prevalence of 65% in a sample, which is also associated with higher risk of EA and symptoms of EDs (Fahrenholtz et al., 2022). In a sample female collegiate athletes (n=25) there where reported 52% of their participants had < 30 kcal/kg of FFM/day and 40% of these reported MD (Day et al., 2016). A recent observational study by Rogers et al. (2021) showed that in a sample of 112 elite australian athletes across 8 different sports, there were a prevalence rate of 41% where the athletes had atleast one of the RED-S symptoms present and symptoms that can be associated with RED-S were prevalent in up to 80% of the cohort. The most prevalent symptoms were gastrointestinal (GI) (Rogers et al., 2021) function which ranged from 31% to 58%. Other studies call into question wether the Triad model for both males and females is applicable to high-level distance runners of Kenyan ethnicity. Altough the sample had low EI, the athletes did not show a tendency towards a higher prevalence of low bone mass density or Triad RED-S hormonal abnormalities (Õnnik et al., 2022). MD was observed in 60% of athletes in a self-reported study of english elite middle- and long-distance runners, these are similar results observed in a danish and swedish sample with clinically verified functional hypothalamic amenorrhea (Logue et al., 2020). LEA contributes to impaired bone health in athletes, particulary women. LEA shows decrease in bone mass density (Mountjoy et al., 2018), altered bone microarchitecture and bone turnover markers. Specifc female and male populations are at risk for lower bone mass density, these are jockeys, runners, svimmers and cyclist amongs others (Mountjoy et al., 2018). This is also observered in Rogers et al. (2021) where the only population of athletes in the sample who had compromised bone health were the triathletes (23%).

In sports where leanness is of a factor, there is a higher prevalance of any of the components of the Triad than in non-leanness sports. A review by Gibbs et al. (2013) which included randomized controlled trials and observational studies that evaluated the prevalance of clinical and subclinical conditions such as disordered eating (DE), menstrual disturbance, low bone mineral density and LEA showed that that a small percentage of athletes (out of a total n=

10,498) exhibited all three conditions (0-15.9%). The prevalance of two of the Triad components ranged from 2.7% to 27.0% and 16.0% to 60.0%. In athletes who participated in leanness sports the prevalence of all three Triad components ranged from 1.5% to 6.7%, compared to the athletes in non-leannes sports the prevalence ranged from 0% to 2.0%. MD is significantly higher in prevalence in aesthetic and lean build athletes (26.7% and 28.2%) when compared to general high school athletes and if left untreated, females can continue to lose bone mass at a rate of 2-3% per year (Thein-Nissenbaum & Hammer, 2017).

2.2.3 Disordered Eating Behaviors and RED-S

Clinically diagnosable EDs or DE can cause LEA and athletes are more likely to present with disordered eating rather than a clinical eating disorder (Mountjoy et al., 2018; Wells et al., 2020). DE can cause LEA, which is the symptom that underpins RED-S (Mountjoy et al., 2018) as DE might manifest itself in the form of atypical anorexia nervosa (AN) or low-frequency bulimia nervosa (BN) (Erzegovesi & Bellodi, 2016). In a sample from the United Kingdom which featured competitive, recreational and professional female athletes representing soccer, rugby, hockey, netball, cricket, gaelic fotball, running, powerlifting, cycling, Olympic weightlifting, boxing, acrobatics, kickboxing, MMA, competitive yoga, swimming, tennis, golf, athletics and climbing a total of 44% showed risk of subclinical DE while 18% showed a risk of clinical EDs (Sharps et al., 2021). This same sample had 53% with a LEAF-Q score above >8, which shows at risk for LEA. In a sample of collegiate NCAA division 1 athletes and artists featuring equestrians, volleyball, softball, beach volleyball, ballet and soccer the EDs risk were observed at 76% (n = 96) with LEA (Torres-McGehee et al., 2020). For slender female athletes, having DE can put them at risk for FHA, which according to the American College of Obstetricians and Gynecologist, 16% to 47% of slender female athletes have DE (Huhmann, 2020). This puts them at risk for low bone health. Low bone health is a major-long term risk associated with FHA (Huhmann, 2020; Sundgot-Borgen & Torstveit, 2007).

2.2.4 Educational Programs and RED-S

Educational initiatives for athletes, coaches, members of the entourage and sport organisations is encouraged, and are the best method of primary prevention of DE and EDs (Mountjoy et al., 2018; Wells et al., 2020). It can be used to support athletes mental health by offering evidence based coaching education (Reardon et al., 2019). Psychoeducation and counseling

are considered treatment choices for athletes (Reardon et al., 2019). Educational programs have previously been implemented to increase triad knowledge by using 10-minute educational videos or longer interventions varying from 1-year all the way through high school (**Table 1**).

An intervention involving female high school athlete had the purpose of assessing changes in the triad knowledge after participating in a brief 10-minute triad educational intervention (Krick et al., 2019). The video included footage of a registered dietitian who defined triad etiology and progression, former collegiate athletes sharing the personal stories of overcoming negative effects on the triad and returning to health and sports and commentaries from a collegiate coach regarding potential negative consequences of athletes perceived pressure to achieve certain body weight or appearance. The participants who completed the intervention achieved greater knowledge than their control group counterpart. Other interventions has been completed, in the study by Keay et al. (2019) 45 male cyclist completed a six-months educational programme which were designed to improve eating behaviour and skeletal loading exercise. The athletes were at risk of poor bone health and impaired performance due RED-S. Nutritional and exercise recommendation were explained and provided, including online resources with video demonstrations. The cyclist had positive correlation between energy availability clinically significant changes in lumbar spine bone mineral density. The changes in energy availability resulted in ± 95 points over a race season (Keay et al., 2019) and certain cyclist were at fear of implementing behavioural changes to adress RED-S for fear of negatively impacting performance. Studies like these might suggest that educational videos may be an effective method of improving athlete knowledge of the Triad or behavioural change in athletes with LEA (Logue et al., 2020).

Table 1.

Overview of studies using educational programs to increase knowledge and/or about the Triad and reduce symptoms and risks.

Study (year)	Selection	Method	Results	Conclusion
Becker et al. (2012)	Female college students (N = 168). Participating in 9 different varsity teams.	Athletes were randomly assigned to the Athlete-modified dissonance prevention or healthy weight intervention. ED risk factors were assessed pre/post-treatment, and 6 week and 1-year follow-up.	Analyzed sample N = 157. Indicated that both interventions reduced thin-ideal internalization, dietary restraint, bulimic pathology, shape and weight concern and negative affect at 6 weeks, and bulimic pathology, shape concern, and negative affect at 1 year. Observed an unexpected and spontaneous increase in students medical consultation for the Triad.	Preventing dissonance reduced all EDs risk factors at six weeks. Healthy weight program reduced all ED risk factors at six weeks. Dissonance reduced bulimic pathology, shape concern and negative affect at 1-year. Healthy weight yielded similar results to dissonance at one year. Healthy weight was qualitatively better received compared to dissonance.
Brown et al. (2014)	Female athletes (N = 240) ages 14-18 and their coaches (N = 10)	Cross-sectional design where participants completed surveys that assessed Triad knowledge and athlete Triad risk factors.	Half (N = 120) reported mentrual irregularity, and 42% (N = 101) had two or more triad risk factors. Average athlete Triad knowledge score was 2.97 ± 1.61 out of 8. Coach Triad knowledge was limited; however most (9/10) were comfortable discussing mestruation with their athletes. Barriers to triad screening/education were coaches insufficient time, knowledge and educational resources.	Triad risk factors were prevalent among athletes and coach and athlete knowledge was low. Providing coaches with Triad screening/education training may increase Triad knowledge and decrease triad risk among high school athletes.
Brown et al. (2020)	Collegiate dancers (N = 25)	Participants completed two questionnaires: One assessed demographics, triad risk, and DE. The other measured triad knowledge before and after viewing a 10-minute triad video.	27% were at risk for the triad, and 8% at risk for triad and DE. Significant improvements in triad knowledge were observed following the educational videos.	Brief video education may be an effective tool that can be easily integrated into existing curricula. Furthermore it should be part of a dancers collegiate curriculum in order to promote overall health.
Krick et al. (2019)	Female high school athletes (N = 93) representing basketball, cheerleading, volleyball, soccer, softball, golf, tennis and trank and field.	Randomly assigned to the intervention or control group. Participants then completed a brief questionnaire before and after the educational intervention or the control activity.	Participants answered <50% of Triad knowledge questions correctly. After the intervention, triad knowledge score changed in both groups. Post-scores were significantly higher in the intervention group compared to the control group. The control group achieved a higher mean score on the triad knowledge.	Findings suggest viewing triad educational videos promote increases in triad knowledge among female high school athletes within 10 minutes without the need for multiple hour-long sessions.

Martinsen et al. (2014)	16 Norwegian Elite Sport High Schools were included (intervention group [N = 9] and control group [N = 7]). Total 465 first-year students.	The students were followed during high school (2008-2011). The athletes completed the Eating Disorder Inventory 2 and questions related to EDs before (pretest), immediatly after (posttest 1) and 9 months after the intervention (posttest 2).	Among females, there were no new cases of EDs in the intervention schools, while 13% at the control schools had developed and fulfilled the DSM-IV criteria for ED not otherwise specified or bulimia nervosa.	A 1-year intervention program can prevent new cases of EDs and symptoms associated with ED in adolescent female elite athletes.
Martinsen et al. (2015)	76 coaches from all Norwegian Elite Sport High Schools were included. Intervention group (N = 9) and control group (N = 7).	Coaches employed at and coaching first year student athletes at the different schools were followed for three years (2008-2011). At pretest and posttest (9 months after intervention) they completed a questionnaire regarding nutrition, weight regulation and EDs.	The coaches who completed the intervention had higher knowledge index score than control coaches for weight regulation, EDs and total knowledge at posttest.	An intervention program developed to provide coaches with knowledge and strategies regarding identification, management, and prevention of EDs produced a significant long-term effect (at least 9 months. The intervention also show positive effects on the coaches subjective evaluation of their EDs knowledge.
Valliant et al. (2012)	Female participants from a NCAA Division 1 volleyball team (N = 11).	Participants were evaluated for adequate energy and macronutrient intake during two-offseasons. Total energy and macronutrient intake were assessed by food records and results were compared against estimated needs using the Nelson equation. Dietary intervention was employed regarding the individual dietary needs of each athlete as well as a pre- and post-sports nutrition knowledge survey.	Post dietary intervention, total energy and macronutrient intake improved as well as a significant improvement in sports nutrition knowledge.	Nutrition education is useful in improving dietary intake and nutrition knowledge of female athletes.
Day et al. (2015)	Female collegiate athletes (N = 25).	Six interactive sessions of nutrition education focusing on aspects of the Triad. The educational sesions were delivered in 30-minute increments in a classroom setting once a week after participants completed track and field practice.	There was an increase in summed nutrition knowledge, post-nutrition education.	Nutrition education provided in a classroom setting increased nutrition knowledge scores among participants, but did not change dietary behavior. A change in behavior is necessary to decrease the risk of short and long torm consequences associated with the Triad.

2.2.5 Perspectives

It has become more apparent that some male athletes might experience Triad-like syndroms which are similar to the Female Athlete Triad. It has been termed The Male Athlete Triad. It is the consensus statement from Fredericson et al. (2021) that proposes the model for the Male Athlete Triad to be *functional hypogonadotropic hypogonadism, severe energy defieciency with or without DE/ED* and *osteoporosis with or without bone stress injury* all in its most severe state of the spectrum. In comparison to the female athletes, the key etiological factor of the Male Triad is energy deficiency/LEA which may result in impaired reproductive and bone health. Females athletes may develop functional hypothalamic amenorrhea as a consequence of LEA, a dose-response relationship between LEA and markers of hypothalamic-pituirary-gonadal (HPG) axis function has been outlined. These include reductions in luteinizing hormone pulse frequency and serum concentration of estradiol. For men, high-volume training or rapid increases in training can result in suppression of HPG function and lower testosterone levels (Tenforde et al., 2016). This can in turn result in hypogonadotropic hypogonadism which are low levels of testosterone and/or defects in spermatogenesis (De Souza et al., 2019). Consequences of this can be low libido, erectile dysfunction, infertility, decreased shaving of facial hair, gynocomastia, low trauma fractures or reduced bone mass density, reduced muscle mass and strength, decreased energy and motivation, depressed mood, poor concentration, sleep disturbance or diminished physical performance (Fredericson et al., 2021).

2.3 Exercise Addiction

2.3.1 Exercise Addiction: Overview

> «*If I don't exercise I tend to get very down, a low self esteem, irritable...I find fault with things, picky about things just generally feel out of condition, even if I miss it for a short time I feel out of condition, unhealthy I suppose*» - A woman being interviewed in a study by Cox and Orford (2004) about how she feels if she can not exercise.

Physical activity is a planned, structured and repeatable process which can in turn improve physical and mental health and counteract many diseases (Berczik et al., 2012; Macfarlane et al., 2016). The American College of Sports Medicine recommends atleast 150 minutes of moderate physical activity and strength training two times per week for all ages between 18-65 (American College of Sports Medicine, 2021). Physical activity has in modern times been associated with a phenomenon which has multiple terms such as *compulsive exercise, exercise addiction* or *exercise dependence* (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015). The term compulsive means repetitive behaviors and mental acts that an individual will feel driven to do in response to an obsession (American Psychiatric Association, 2013). According to the National Institute on Drug Abuse there is a difference in symptoms between an addiction and dependence (altough often they are wrongfully used to describe one another). An addiction is characterized by an inability to stop using a drug, whereas a dependency the body will show tolerance and withdrawal, meaning the body adapts to the drug, requiring more of it to achieve a certain effect (tolerance) (National Institue on Drug Abuse, 2020).

First dubbed "*running addiction*" by Glasser (1976) who named it a positive addiction because of its positive psychological effects. Although in the later years, growing research has supported that exercise and sports can be taken to the extremes which can cause injury, impairement of health and affected interpersonal relationships (Lichtenstein et al., 2017a). EA has no clear definition and is not classified as a mental disorder in Europe through the *International Classification of Diseases* (ICD-10), and it is also not classified as a mental disorder in USA through the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5). The only behavioral addiction presented currently in the DSM-5 is gambling addiction (American Psychiatric Association, 2013; Freimuth et al., 2011). It is often associated with alcohol addiction and the terminology *addiction* is often used to explain the phenomenon as it contains both the terms for addiction and compulsiveness (tolerance, withdrawal, lack of control, intention effect, time, reduction in other activities and continuance) (Berczik et al.,

2012; Egan et al., 2017; Hausenblas & Symons Downs, 2002; Lichtenstein et al., 2017b). Individuals with EA may develop addictive behaviors where exercise becomes the most important thing in their lives (Lichtenstein et al., 2017b) and Hausenblas and Symons Downs (2002) describes EA as «*Operationalized as a multidimensional maladaptive pattern of exercise, leading to clinically significant impairment or distress»*, and Szabo, Griffiths, Marcos, Mervó and Demetrovics (2015) describes it as a morbid pattern of behavior in which the individual loses control over his or her exercise habits and act compulsively, exhibits dependence, and experiences negative consequences to health as well as in his or her social life. There are some suggestions to how EA occurs, Freimuth et al. (2011) suggests that the key factor in identifying those at greatest risk is the individuals motivation. While others supports the notion that the addicitve behaviors linked with exercise is likely the results of one's character and that the hard-driven, perfectionistic type of person is more prone to the condition (Landolfi, 2013). Berczik et al. (2012) believes it is a dysfunction of personality and Asp (1999) suggest that individuals with obsessive-compulsive disorder might be of greater risk for developing addictive exercise habits.

2.3.2 Theoretical Models For Exercise Addiction

Several theories and models have been proposed as a means to try and offer an explanation to how EA occurs. One of these are the four-phase model for exercise addiction proposed by Freimuth et al. (2011). This clinical heuristic can be used to explore the distinction between recreational exercise and an addiction to exercise. For a clinician this is a useful tool in order to decide when a normal behavior has become addictive. *Phase One:* Sources of motivation in this phase are to achieve health and fitness and the recreational exercise primarily occurs because it is a pleasurable and rewarding activity. *Phase Two:* Individuals may be exposed to the mood-altering effects of recreational exercise which may be attributed to altered chemical functioning of the brain. Herein lies three hypotheses: The *Thermogenic Hypothesis*: Exercise increases body temperatur, thereby reducing somatic anxiety. This decrease in anxiety is related to an increased temperature in certain brain regions*; The Catecholamine Hypothesis*: Exercise releases catecholamines, which are strongly implicated in control of mood, attention, and movement as well as endocrine and cardiovascular responses linked to stress; *The Endorphin Hypothesis*: Exercise releases endorphins, which are opiates that occur naturally in the body. This pleasureable experience of exercise may have unplanned consequences. With regular intense aerobic exercise, the increased endorphin production results in the brain down-regulating endorphin production. If this happens, the person will need to continue the exercise

in order to maintain the natural balance in the brain. What distinguishes recreational exercise from exercise at-risk is the motivation. It is more likely to become an addiction when the acitivity is not enjoyable and is a relief from stress. *Phase-Three:* Those who become problematic begin to organize their day around their exercise regimen, which is becoming more and more rigid. *Phase Four:* The frequency and intensity of exercise continues until this behavior becomes lifes main organizing principle. As the life of the addicted person revolves around exercise, the pleasure of the behavior recedes as the primary motivation becomes avoiding withdrawal symptoms. For more in depth reading on each of the phases, seek out Freimuth et al. (2011).

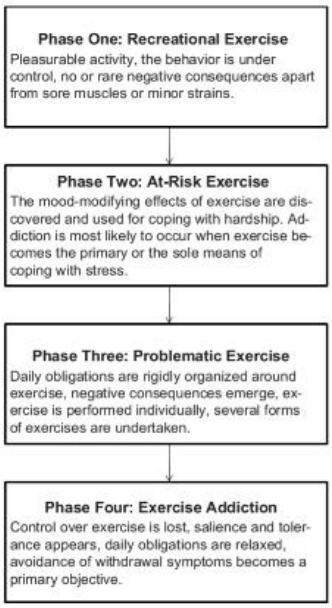

Figure 3: The "Four Phase" Model for exercise addiction (Freimuth et al., 2011).

Other models are are presented by Egorov and Szabo (2013). *The Sympatethic Arousal Hypothesis*: Exercise adaption leads the body to lower its sympathetic activity which means lower levels of arousal. This prompt the person to do something about it to lower his/her arousal. One means to that is exercise, however the effects of exercise are only temporary, and therefore more and more bout of exercise are needed. *The Cognitive Appraisal Hypothesis*: Explains how exercisers may try to escape from an ongoing or a sudden stress by resorting to exercise as a means of coping with stress. McNamara and McCabe (2012) presented a *Biopsychosocial Model* for exercise addiction. This model proposes that biological factors such as Body Mass Index (BMI) have a peripheral influence of the development and maintenance of the condition. However, the biological factors are suggested

to have a close relationship with a range of social forces and psychological processes that directly contribute to EA.

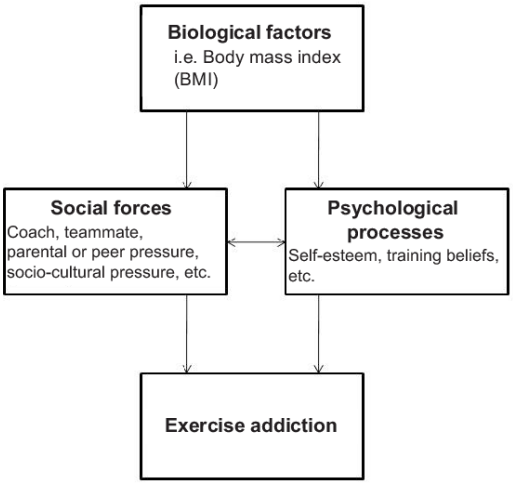

Figure 4: The Biopsychosocial Model for exercise addiction in elite athletes (McNamara & McCabe, 2012)

Hamer and Karageorghis (2007) proposed the *Cytokine Hypothesis and the Interleukin-6 Model*. IL-6 in humans have been shown to result in changes in mood and behaviour which results in increased fatigue, poorer concenctration and altered sleep architechture. In this conceptual model, an initial trigger may cause an over production of IL-6 and promote cytokine-induced sickness behaviour with the associated increase in negative affect. This could then yield a even more negative mental state.

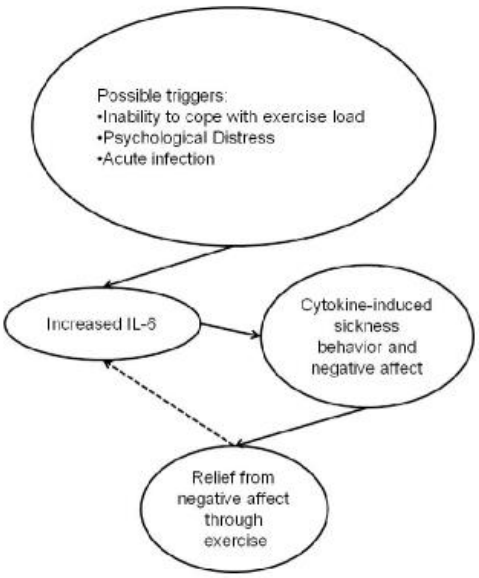

Figure 5: The IL-6 Model for exercise addiction (Hamer & Karageorghis, 2007).

EA is as mentioned previously in the introduction often associated with people who has an EDs or DE symptoms (Beumont et al., 1994; Guidi et al., 2009; Hauck et al., 2020; Mond &

Calogero, 2009). EA also associated with people who as perfectionistic and neurotic characteristics (Hagan & Hausenblas, 2003; Hausenblas & Giacobbi, 2004). Athletes across different sporting events, especially individuals who compete in endurance sports can be prone to developing EA (Di Lodovico et al., 2019). There is not much litterature on how to excactly treat individuals who has EA, most people with behavioral addictions will need to undergo some form of cognitive behavioral therapy (Freimuth et al., 2011). Adams et al. (2003) gives clear steps in how a therapeutic intervention for the treatment of an individual with EA would undergo.

- Accept the role and responsebility of primary support for the person and participate in the management process.
- Recognize that the addiction is likely to cause a breakdown in communication with significant others.
- Recognize that the likely response is intense fear of losing control, helplessness, and that this may show itself through disorganized behavior through compulsion.
- Psychotherapeutic intervention utilized indiviualized approaches depending on the psychopathology noted in the patient. The common core of therapeutic intervention strategies include the following:
    1. Identifying and interrupting the compulsive behavior through supportive individual psychotherapy
    2. Engage the patients in understanding the health benefits and importance of moderation.
    3. Empover the patients in understanding the health benefits and importance of moderation.
    4. Understanding the organization of the persons defence structure and how the patient is coping with the addictive nature.
    5. Increasing the tolerance of the patients in adapting or accommodating to the compulsion through modification of their psuchological defenses and acceptance and understanding of their response to the gaining of control and appropriate self-management skills.
    6. Unlink the compulsion and process specific triggers related to the exercise dependence.
    7. Rebuilding the coping behaviors and enhancing the support systemt for the patient with respect of exercise.

The goal should not be to have complete abstinence from exercise and physical activity as this is seen as a healthy habit in moderation (Freimuth et al., 2011).

2.3.3 Measuring Exercise Addiction.

A question that has been raised by M. D. Griffiths et al. (2005) is; how does a health practioner administer such instruments to detect this addictive, dependent or compulsive way of exercising in an effective manner? The Exercise Addiction Inventory (EAI) which was created by M. D. Griffiths et al. (2005) and modified after Brown et al. (1997) is a six point questionnaire with a likert scale ranging from 1 (agree) to 5 (strongly disagree) which screens for addictive components such as *Salience* (exercise is the most important thing in my life); *Conflict* (Conflicts have arisen between me and my family and/or my partnert about the amount of exercise I do); *Mood modification* (I use exercise as a way of changing my mood); *Tolerance* (Over time I have increased the amount of exercise I do in a day); *Withdrawal* (If I I have to miss an exercise session I feel moody and irritable); and *Relapse* (If I cut down the amount of exercise I do, and then start again, I always end up exercising as often as I did before) (Griffiths et al., 2015). The EAI is a validated and reliabel psychometric test which has been used on regular exercisers, the general population and university students (Freimuth et al., 2011).

The Exercise Dependence Scale (EDS) is another psychometric instrument used for measuring EA (Lichtenstein et al., 2017a). It is a 21-point likert scale based on seven diagnostic criteria for alcohol dependence (Tolerance, Withdrawal, Intention, Lack of control, Time, Reduction in other activities and Continuance) adopted from the Diagnostic and Statistic Manual of Mental Disorders - IV (American Psychiatric Association, 1994; Downs et al., 2004). The EDS has been widely used in different exercise settings: Spanish sports centers with people aged 16-60, swedish college students, Portugese local gyms and Greek private fitness centers (Lichtenstein et al., 2017a)

The Compulsive Exercise Test (CET) is a psychometric test that screens for compulsive exercise in a multidimensional way. There are five distinct subscales which are described in Meyer et al. (2016): *Avoidance and rule-driven behavior* (continuing to exercise despite injury or illness, making up for missed sessions, experiencing withdrawal symptoms and feeling extremely guilty when unable to exercise); *Weight control exercise* (exercising to modify or control weight and shape, engaging in compensatory exercise to account for calorie intake); *Mood improvement* (experiencing the positive, mood enhancing effects of exercise);

Lack of exercise enjoyment (experiencing exercise as a chore rather than a pleasure), and *Exercise rigidity* (maintaining a strict and repititive exercise schedule).

2.3.4 Prevalence of Exercise Addiction in Sports

EA amongst athletes are not uncommon, and in many instances there are reported to be a higher prevalance amongst elite athletes than recreational exercisers (Reardon et al., 2019). The prevalance rates have varied considerably (Reardon et al., 2019) and is considered to be between 3.0% to 6.0% amongst athletes and regular exercisers (Dumitru et al., 2018). For comparison it is estimated that the prevalence of EA in the general adult population to be between 0.3-0.5% (Mónok et al., 2012). In sports there are varied reports about the prevalence of EA, in studies where there are different sports involved the prevalence rates are estimated to be between 7.6-34.8% (Costa et al., 2015; Lichtenstein, Melin, et al., 2021; McNamara & McCabe, 2012). In samples of triathletes and ultramarathon runners the rates were 19.9% and 3.2% respectively (Allegre et al., 2007; Youngman & Simpson, 2014b). These prevalence rates are reflected in reviews by Di Lodovico et al. (2019) and Nogueira et al. (2018). The former meta-analysis identified a prevalence rate at 14.2% for endurance athletes and the latter quotes values ranging from 3% to 42%.

The systematic review by Di Lodovico et al. (2019) highlights the key point that endurance sports are associated with the highest risk of EA (14.2%). A limitation with this review is that there is a lack of distinction between the genders. It can be assumed that this risk of EA if also prevalent in females as in the study conducted by Mayolas-Pi et al. (2016) identified 15.7% (n = 17) out of a sample of 108 female competitive amateur endurance cyclist to be at risk of EA and 84.2 % (n = 91) at low risk of EA. There were no significant differences between the groups in mean age (34 ± 10.0 and 37.4 ± 7.4), training frequency (3.7 ± 1.6 and 3.6 ± 1.5) and volume measured in hours per week (10.7 ± 4.2 and 10.3 ± 4.4). A bit higher prevalence of EA was seen in a female sample of triathletes (n = 684) 21.7% (n = 138), were at high risk of EA and 77.6% (n = 494) were at medium risk of EA (Youngman & Simpson, 2014b) in comparison; 17.9% (n = 99) of male triathletes had the same high risk of EA and 81.2% (n = 448) were at medium risk. In other samples where female endurance athletes are present in the sample Pierce et al. (1997) reported a significantly higher exercise dependence score than their male counterparts with no difference in training volume in marathon running. Dumitru et al. (2018) discusses how the data between male and females endurance athletes are similar or that in certain cases males report higher prevalence of EA. However, the author makes it worth noting that most studies are focused on university students and recreational exercise

samples and that the differences between men and women could be lower in elite athletes or athletes that compete in endurance races than in the rest of the studies that includes recreational exercisers, and as pointed out in Lichtenstein et al. (2017a) the reason for the large inconsistency might be because of sample sizes, measurements and different sports.

2.3.5 Perspectives

"*The Exercise Paradox"* is a term used by Egorov and Szabo (2013) in order to try and clarify the conceptualization of exercise addiction. In order to avoid confusion, this is not the Paradox that will be mentioned here, rather it is the Paradox suggested by Bratland-Sanda et al. (2019) concering how individuals with bulimia nervose (BN) or binge eating disorder (BED) may display high scores on instruments measuring Compulsive Exercise despite objectively having low volumes of physical activity, which are well below the official recommendations. The authors explains how obsessive beliefs about a need to exercise may reflect an intention to be healthy, but can not translate these feelings into actions. This can cause significant psychological burdes as the individuals to not meet the societal expectations of healthy exercise in lin with official physical activity recommendations. The authors propose therefor a new subtype of excessive exercise dubbed "*Exercise Obsessions*" as obsessions are unwanted and intrusive thoughts, doubt, image or urge that repeatedly enters the mind. These obsessions are related to compulsive behavior (Veale & Roberts, 2014). The concerns Bratland-Sanda et al. (2019) put forth are the individuals without excessive exercise may be at risk for exercise obsessions and that they may go unnoticed in clinical evaluation and treatment.

2.4 Disordered Eating and Eating Disorders

2.4.1 Eating Disorders: Overview

EDs are serious psychiatric disorders characterised by abnormal eating or weight-control behaviours (Treasure et al., 2020). EDs can occur independently of gender, age, ethnicity, cultural background and weight (Samuels et al., 2019). EDs contain a cluster of mental disorders which are characterized with an abnormal eating pattern, purification and overestimation of shape and weight. There are mainly three diagnosis of EDs: Anorexia nervosa (AN) is seen as a psychiatric illness which is marked by an inability to maintain a normal healthy bodyweight which can drop to below 85% of normal bodyweight (Berkman et al., 2007). Diagnostic criteria for AN according to the DSM-5 is a BMI of ≤18 and in extreme settings less than 15. Individuals with AN have persisent behavior that interferes with weight gain and has an intense fear of gaining weight or becoming fat. Core psychopathological features is the persisent lack or recognition of the seriousness of the current body weight (American Psychiatric Association, 2013; Erzegovesi & Bellodi, 2016). The second ED is Bulimia Nervosa (BN). Early on it was not categorized as a ED, but rather a «*Chronic phase of anorexia nervosa*» by the british psychiatrist Gerald Russel in 1979 (Castillo & Weiselberg, 2017). It is characterized by reccurent episodes of binge eating with some form of inapproriate compensatory behavior (Berkman et al., 2007). Diagnostic criterias listed in the DSM-5 explains that individuals with BN will experience a feeling of lack of control over eating during episodes of binge-eating and will perform self-induced vomiting, misuse of laxatives, diuretics or other medications, and fasting and excessive exercise. Core psychopathological features is that the individuals self-evaluation is unduly influenced by body shape and weight (American Psychiatric Association, 2013; Erzegovesi & Bellodi, 2016). The third ED is Binge-eating disorder (BED) and was listed as a independent ED in the DSM-5. It shows many of the same features as BN, but without the use of regular inapproriate compensatory behavior aimed at preventing weight gain (vomiting etc. See above). BED also shows characteristics of behavioral abnormalities such as eating rapidly or until feeling uncomfortably full which can result in marked distress (Hilbert, 2019). In the general population it is estimated that a rate of 0.5% to 10% for disordered eating exists and AN is the most fatal with a prevalence rate of 1% to 4% and a mortality rate of 5% to 6% (Huhmann, 2020).

Other Specified Feeding or Eating Disorders & Unspecified Feeding or Eating Disorder

Other Specified Feeding or Eating Disorder (OSFED) is a category of eating disorders that causes impairement or significantly clinically distress in social, occupational or other important areas but does not meet the full criteria for any of the categorical eating disorders in the diagnostic class (American Psychiatric Association, 2013). This was formely recognised as Eating Disorders Otherwise Not Specified (EDNOS) in the DSM-4 (Erzegovesi & Bellodi, 2016). Examples given by these different distresses by the American Psychiatric Association (2013) are: Atypical AN, low frequency and/or limited duration of *Bulimia Nervosa* and *Binge-Eating Disorder*, *Purging Disorder* and *Night Eating Syndrome*. There are some differences in the diagnostical categories between EDNOS and OSFED between the DSM-4 and DSM-5 and for more details it is recommended to seek out Table 1. in the article by Erzegovesi and Bellodi (2016) which is based on information from the American Psychiatric Association (2013). The Unspecified Feeding or Eating Disorder (UFED) is a category where symptoms of characteristics of a feeding and ED causes the same distress as OSFED but do not meet any of the diagnostical criterias for any ED or feeding disorder. This category is applied when a clinician chooses not to specify a ED for reasons that there are insufficient information to make a specific diagnosis (American Psychiatric Association, 2013).

2.4.2 Theoretical Models for Eating Disorders

Cognitive Behavioral Therapy for Eating Disorders

Cognitive behavioral therapy is the leading evidence-based treatment for BN. The new enhanced version has the added advantage of being more suitable for all eating disorders. Murphy et al. (2010) provides a review of the different stages of the treament written in a summary here. *Stage One:* The aims of this first stage is to engage the patient in treatment and change, to provide education about treatment and the disorder and to implement two important procedures which are collaborative weekly weighing and regular eating. This first stage is the foundation for which the other stages are built. *Stage Two*: Is a brief, but essential transitional stage that compromises two appointments a week apart. The goal is to identify problems still to be adressed and any emerging barriers to change and to revise the formulation if necessary, and to design the third stage. *Stage Three:* With generally eight weekly appointments, this is the main body of treatment. Its main goal is to adress the key

processes that are maintaining the patients eating disorder. The important processes are adressing the overevaluation of shape and weight, enhancing the importance of other domains for self-evaluation, adressing body checking and avoidance, adressing «feeling fat», exploring the origins overevaluation, adressing dietary rules, event-related changes in eating, clinical perfectionism, low-self esteem and interpersonal problems. *Stage Four:* This is the final stage in the treatment and is concerned with ending the treatment well, focusing on mainting the progress that have been made the past stages and reducing the risk of relapse.

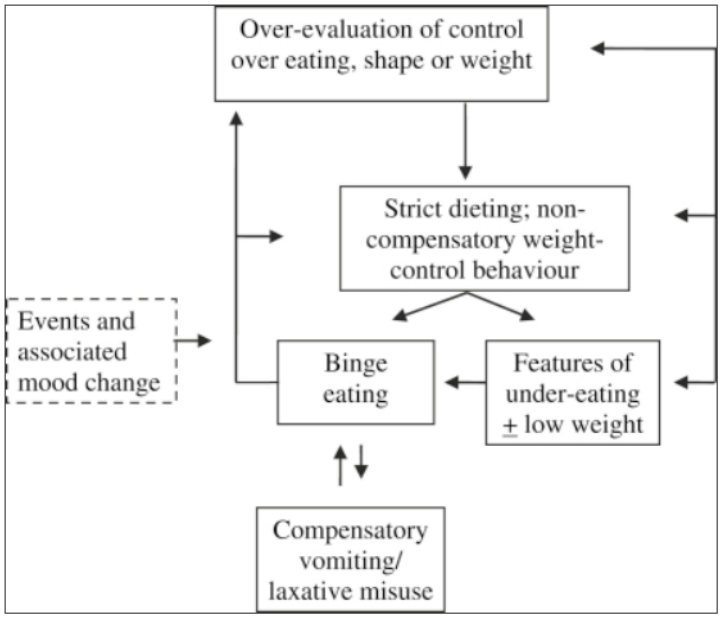

Figure 6: The Model for Cognitive Behavioral Therapy (Murphy et al., 2010)

Markey (2004) explains through the *Tripartite Model of Eating Disorders* how there are three differenct pathways that link culture to disordered eating behaviors. Intergenerational transmission of dietary pattern, including food preferences and restrictive practises together with the values regarding physical appereances, which are in part culturally determined, both influence ED behaviors. The symptoms of eating disorders might be recognized among divers populations, the meaning of these symptoms and their etiology are in part culturally influenced. The author puts it into different words that explains it well *«Health and illness cannot be objectively defined, they are socially and culturally constructed»* (Gordon R. A,. 2000, as cited in Markey, 2004).

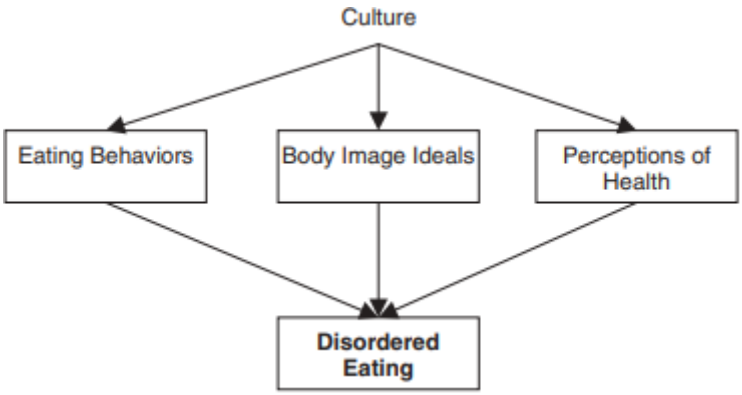

Figure 7: The model for the Tripartite Model of Eating Disorders (Markey, 2004)

Schematic Propositional Analogical Associative Representation System Model applied to Eating Disorders, or more simply put, SPAARS-ED. It is a Multi-level model of emotion presented by Fox and Power (2009). The authors argue that particular early life experiences may leave individuals with a sense and feeling of unfairness about the world and will therefore be more prone to elevated anger within interpersonal situations. The individuals however, will inhibit this anger due to the experience that it is dangerous which will leave them more vulnerable to the development of DE symptoms. Other emotions part for anger that influences eating disorderd symptoms are disgust, especially self-disgust in relation to food and bodyshape, this self-disgust have been suggested to be part of the more complex emotion of shame, fear and anxiety, both the latter are emotions of avoidance and the fear of fatness is a crucial symptom for eating disorders (Fox & Power, 2009; Fox & Froom, 2009).

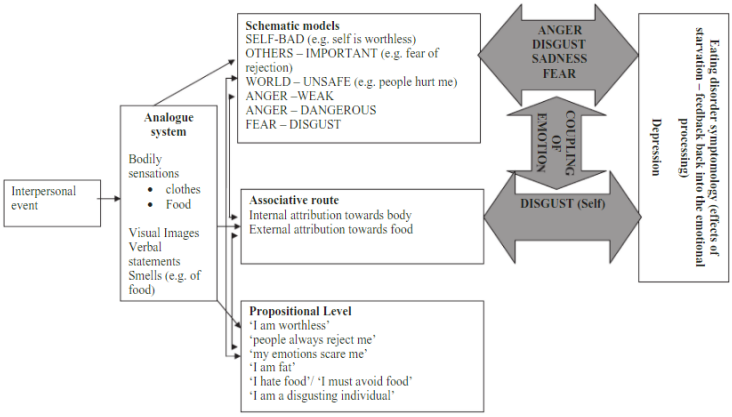

Figure 8: The modell for the Schematic Propositional Analogical Associative Representation System Model applied to Eating Disorders (Fox & Power, 2009)

2.4.3 Measuring Eating Disorders and Disordered Eating Behavior

It is generally accepted that structured clinical interviews are "gold standards" for making a diagnosis and assessing the level of severity of an ED (Rø et al., 2015). Although, researchers

and clinician are often in need of more cost-effective assessment methods (Rø et al., 2015). In this chapter some of the more used questionnaire tools are being presented in short.

The SCOFF (Sick, Control, One, Fat and Food) is a 5-item questionnaire developed in 1999 and is the most widely used screening measure for EDs (Kutz et al., 2020; Morgan et al., 1999). The questions; 1) Do you make yourself sick because you feel uncomfortably full? 2) Do you worry you have lost control over much you eat? 3) Have you recently lost one stone in a 3-month period? 4) Do you believe yourself to be fat when others say you are too thin? 5) would you say that food dominates your life? Are ordered in "Yes" or "No" answers. One "Yes" gives one point. A score of >2 indicates a likely case of AN or BN (Morgan et al., 1999). SCOFF is a simple and useful screening tool for young women at risk for AN and BN. However there is not enough evidence to support utilizing the SCOFF for screening for the range of DSM-5 EDs (Kutz et al., 2020).

The Eating Disorder Inventory-3 (EDI-3) (Garner, 2004) is a questionnaire with 91-items and subscales consisting of disorder relevant psychological traits *low self-esteem, personal alienation, interpersonal insecurity, interpersonal alienation, interoceptive deficits, emotional dysregulation, perfectionism, asceticism, maturity* (Clausen et al., 2011). The EDI originally had 64-items and was first developed by (Garner et al., 1983) and revised as EDI-2, enlarging the questionnaire to 91-items (Garner, 1991). The earlier versions of the EDI has been widely used in both research and clinical settings to assess the symptoms and psychological features of EDs, and overall the new version EDI-3 stands out as a psychodiagnostic assessment tool that may be used to capture eating problems (Clausen et al., 2011).

The Eating Disorder Examination Questionnaire Version 6 (EDE-Q) (Fairburn et al., 2008). has four clinically derived subscales each consisting of five to eight items which measures core eating disorder behaviors in the previous 28 days, which include objective binge episodes, and the core pathology of eating disorders which are the undue importance of weight and shape in determining self-worth. It is based on the Eating Disorder Examination Interview by (Fairburn et al., 2008). EDE-Q is comprised of a global score and four subscales: *Dietary restraint, eating concern, weight concern* and *shape concern.* The three first subscales is comprised of five questions each, while the latter subscale is comprised of eight questions. The responses are rated on a 7-point Likert scale, except the items relating to the frequency of behavior. The score is calculated by an average of each of the subscales and the global score is the mean score of the four subscales. The EDE-Q has recently been validated in an athletic population (Lichtenstein, Haastrup, et al., 2021).

The brief eating disorder in athletes questionnaire (BEDA-Q) (M. Martinsen et al., 2014) distinguishes adolescent female elite athletes with and without eating disorders by using a weighted equation score based on nine questions. An athlete who scores >27 on the BEDA-Q is classified to be at risk of EDs. It contains questions regarding body image and perfectionism and participants who screens positive only on BEDA-Q may be early in their disorder and have less severe energy availability deficits (Ackerman et al., 2019). It is only validated in female adolescent athletes, the items are not female-specific and potential use exist in male athletes (Sim & Burns, 2021).

2.4.4 Prevalence of Disordered Eating and Eating Disorders

Incidences of eating disorders in the general populations are quite rare, and Smink et al. (2012) gives a summary of the incidence amongst AN in the UK and Dutch samples, these being respectively between 4.7 and 7.7 incidents per 100,000 between 1999-2000. The majority of these being women between the age of 15-19 that made up for 40% of the sample, resulting in an incidence of 109.2 per 100,000 cases. A national survey conducted by Swanson et al. (2011) in the US found amongst a sample of 10,123 adolescents aged 13 to 18 a lifetime prevalence estimates for AN, BN and BED to be respectively 0.3%, 0.9% and 1.6%. A larger sample of adults in the US with 36,306 participants were investigated by Udo and Grilo (2018) gave the lifetimes prevalence of these EDs 0.8%, 0.28% and 0.85% respectively.

EDs and DE in female and male elite athletes are common and elite athletes are at significantly greater risk than non-athletes (Sundgot-Borgen & Torstveit, 2004) This might be for reasons of sociocultural pressure to conform to an ideal body shape (Byrne & McLean, 2001). Prevalence rates in athletes in general range from 0% to 19% in men and from 6% to 45% in women (Mountjoy et al., 2018). For men, contact and combat sports with weight categories DE can be more prevalent. For females it can be more weight-bearing sports such as track and field and fine aiming/motor skills classes. Female athletes in team ball sports, raquet and aesthetics sports can fare better (Schaal et al., 2011). Altough other research might indicate that aesthetic sports such as gymnastic might show high prevalence of ED symptoms in both men and female such as the study by Tan et al. (2016) where 67% of females above 16 years and 61% younger than 16 showed mean scores above the population norms. In the same sample 31% of males showed scores above the population norms for eating disorder symptoms. The hours of physical activity have no clear correlation with the risk of developing EDs (Augestad & Flanders, 2002)

For athletes with EDs or DE immediate risks might be the results of other medical issues such as electrolyte abnormalities, refeeding syndrome, cardiac arrhytmias and skeletal fractures (Currie et al., 2019), GI problems, mental health issues (depression, anxiety, personality disorders, substance abuse, self-harm and suicidal ideation) (Wells et al., 2020). EDs and DE might cause a potential development of RED-S which can cause direct impairement to physiological and psychological function aswell together in conjunction with LEA can result in impairements of bone health, menstrual function, endocrine, metabolic and haematologi cal status, growth and development (Mountjoy et al., 2018; Wells et al., 2020).

For athletes in high performance sports EDs and DE are at risk with other factors such as perfectionism and especially in its maladaptive form can be correlated to DE in male and female exercisers and women with bulimia nervosa and binge eating disorders (Costa et al., 2016; Pratt et al., 2001). Other psychological risk factors may include body dissatisfaction and body image distortion, Obsessive-compulsive tendencies, depression, anxiety and low self-esteem (Wells et al., 2020).

Female athletes competing in endurance driven sports can show EDs prevalence rates of 24% (out of n = 102) with the use of questionnaires and clinical interviews to assess ED symptoms (Sundgot-Borgen & Torstveit, 2004), this is comparable to recent research which showed a prevalence of 21% in a similar sample (Fahrenholtz et al., 2022). In the former sample the prevalence of AN were at 4% and BN at 10%, this is a higher prevalence rate than female elite athletes who participate in distance running who of which shows a prevalence rate of EDs from 1% for BN and 4% for AN (Gouttebarge et al., 2019). In junior females competing in biathlon and cross-country the prevalence of DE at 18.7% were found of which those with DE were also struggling with body image disturbance (Pettersen et al., 2016). In this study the prevalence rate among those athletes who underwent upper secondary school with specialisation in elite sports were among those with the highest prevalence at 28.3% (n = 13). Biatlhon athletes were the ones with the highest prevalence at 22% and those competing in both biathlon and cross-country had 24% (n = 6). The risk factors for EDs and DE in sports are many and complex (Mussell et al., 2000) and since performance is at the core of elite endurance sports, a development of extreme pursuance of ideal body composition and focus of nutrition might surface (Sundgot-Borgen et al., 2010). Effective prevention and intervention strategies are needed to determine and treat EDs. This has become especially important as the data might indicate an increase in the prevalence of EDs since the beginning of the 1990s (Sundgot-Borgen et al., 2010)

2.4.5 Educational Programs and Eating Disorders and Disordered Eating

Educational programmes are the best method of primary prevention of DE and EDs (de Oliveira Coelho et al., 2014). Their main aims of education should be to reduce stigma, promote healthy relationships with food and body, and encourgage open and honest discussion, educate about potential health and performance consequences, and educate about optimal nutritional strategies (Wells et al., 2020).

Sport specific interventions has previously been conducted and developed for elite athletes where the focus on health-promoting factors has been highlighted as essential when preventing EDs. As the study by (Martinsen et al., 2014) where 465 student elite athletes across 50 different sports/disciplines. A one-year intervention program was devised to enhance self-esteem by strengthening self-efficacy, self-confidence, growth and development, restitution, sports nutrition through lectures, teamwork exercises, and practical and theoretical assignments. Questionnaires and clinical interviews would be used as screening and posttest after one year of the intervention, and a followup after 2 years. The authors claim the results indicate that the adolescent elite athletes attending the intervention found the themes to be relevant and that as many as 12 of 13 athletes from the intervention group with an EDs recovered, in comparison to the control group where only 4 out of 13 recovered. Other interventional programs has been implemented in college students, which has reduced EDs symptoms with the use of computer programs designed at psychoeducational which covers nutrition, EDs, exercise and healthy weight regulation (Winzelberg et al., 1998) and psychotherapeutic interventions which follows women with eating disorders over a 12-month period showed an increase in psychological well-being and functional health (Stein et al., 2013).

The review by de Oliveira Coelho et al. (2014) examines studies between 1998 and 2012 where the studies aims where at EDs prevention in female athletes (See **Table 2** for more relevant studies) Here the author claims that the amount of studies with these aims are lacking, and the six that were identified have their main aims in promoting self-acceptance, healthy eating and reasonable training. A possibility for preventing EDs is the education of coaches and the social support from family, friends and and peers. The studies adressed the following issues: the destigmatization of EDs through open, truthful and factual discussions; the ways to break down presumed barriers to accessing care; the harmful effects of pathogenic

weight control methods; and healthy nutritional practices to ensure adequate energy availability (de Oliveira Coelho et al., 2014).

2.5 Exercise Addiction, Eating Disorders and Disordered Eating Behaviors

EA is described as a morbid pattern of of behavior in which the individual loses control over his or her exercise habits and act compulsively, exhibits dependence, and experiences negative consequences to health as well as in his or her social life (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015). It has been discussed whether EA only appears as a secondary condiction to EDs, but evidence for the syndrom as a primary condition has been demonstrated and should be understood as a serious psychological morbidity, because psychosocial functioning is impaired (Lichtenstein et al., 2017a).

2.5.1 Primary and Secondary Exercise Addiction

The first to categorize EA into Primary (PEA) and Secondary (SEA) categories were De Coverley Veale (1987). PEA being a primary state where EA can occur independently of an ED and that different diets and weight loss strategies are primarily a means to increase the performance of the individual. SEA can be developed as a result of a ED. A person with AN will use exercise as a tool in order to regulate weight, which in turn can cause the development of SEA (Lichtenstein et al., 2017b). Cunningham et al. (2016) uses the term *pathological exercise* and describes how a PEA mainly occurs in men and in a form of addiction and the SEA occurs more frequently in women and in a state of compulsion, this conclusion is based on their study where 1497 adults completed a set of validated surveys. PEA and SEA share many of the same symptoms and consequences since excessive exercise frequently co-occurs with EDs or DE behavior, and participants with SEA were most likely to express exercise pathology when compared to those with other EDs or with no eating disorder (Cunningham et al., 2016). This is consistent with the DSM-5 characterization of exercise as an inapproriate compensatory behaviors (American Psychiatric Association, 2013).

Table 2.

Shows studies where researchers has investigated the correlation between EA and EDs and DE in female athletes.

Study (year)	Selection	Method	Results	Conclusion
Plateau et al. (2014)	N = 689 (35% females). Athletes from a variety of sports specialties and competitive levels up to elite.	Cross-sectional, correlational study. Measures used: CET and EDE-Q.	Eating psychopathology correlated with compulsive exercise and factors of weight control exercise.	The CET can be used as a screening measure due to its ease of administration and faciliate practitioners in detecting athletes who are motivated to exercise for weight control and mood regulation.
Plateau et al. (2017)	N = 349 female athletes from a variety of sports.	Case-control, cross-sectional study. Measures used: CET-Athlete version and EDE-Q.	30% of athletes (40% of lean sports and 26% of non-lean sports were classified as positive and showed higher compulsive exercise and eating pathology. Participants screening positive on the CET-A were 3.2 times more likely to have EDs compared to those screening negative.	Athletes with previous or current EDs had higher compulsive exercise and eating pathology compared to those not reporting EDs
Levit et al. (2018)	N = 35 Female athletes. Type of sports were groups vs. Individual and sportsman was professional vs. Amateur.	Cross-sectional, correlational study. Measures used: EAI, EAT-26 and BSQ.	15% of athletes (12%males and 20% women) demonstrated EA. No differences were estabilshed for gender, type of sport, performance level and amount of training. 29% of females demonstrated eating pathology, Eating disorder pathology and body concerns were higher for individual sports.	This study extends the preliminary findings of an association between EA and depression. And abnormal eating attitudes may explain most of the variance of EA.
Gorrell and Anderson (2018)	N = 146 amateur and professional females competing in half-marathon and marathon.	Cross-sectional, correlational study. Measures used: CET, EIS and EDE-Q.	Compulsive exercise correlated with eating disorder pathology. Increased EIS and CET scores contribute to decreased eating pathology.	The current study provides preliminary evidence that for those who are less elite runners, the relation between exercise identity and eating pathology may be impacted across a continuum of compulsivity.
Chapa et al. (2018)	N = 332 females athletes from a variety	Cross-sectional, correlational study.	ART scores significantly predicted health health care utilization and differed	ART scores were higher in athletes with EDs than athletes without. The

	if collegiate sports specialties (N = 267 athletes participating in an ED prevention program, N = 65 athletes in EDs treatment)	Measures used: ART and EDE-Q.	between athletes with an EDs versus athletes without and EDs.	ARTs a useful tool to understand when an athletes training behaviors and beliefs may put them at risk for needing medical attention or developing EDs
Gorrell et al. (2020)	N = 277 (141 female runners in half-marathon and marathon)	Cross-sectional, correlational study. Measures used: CET and EDE-Q.	6% demonstrated eating pathology. 59% of females reported compulsive exercise. Females reported higher eating pathology and compulsive exercising than their male counterpart in the same study.	Females reported greater compulsive exercise and eating pathology and males reported higher levels of weight suppresion. Regardless of weight history, female runners exhibiting compulsive exercise behaviors demonstrated increased report of EDs pathology.

3.0 Method

This masters thesis is a part of a bigger multicenter study based at the Institute of Sports and Physical Education at the University of Agder (www.uia.no/fuel). The aim of the FUEL projects is to develop, implement and evaluate a 16-week practice orientated sports nutrition education and counselling program to improve symptoms of low energy availability in female endurance athletes. This thesis will use data measuring risk of EA and symptoms of DE from pre- and posttest in the intervention.

3.1 Study design

This project is of an intervention design which was initiated with a screening phase (part 1) where volunteers were asked to complete the Eating Disorder Examination Questionnaire (EDE-Q) (Fairburn et al., 2008), the Exercise Addiction Inventory (EAI) (Terry et al., 2004) and the Low Energy Availability in Females Questionnaire (LEAF-Q) (Melin et al., 2014) (**Figure 9**). Athletes who had a global EDE-Q score of ≥ 2.5, a LEAF-Q score ≥ 8 had chronic diseases (diabetes, chrohn`s disease or thyroid dysfunction), and/or used hormonal contraceptives were excluded from further participation.

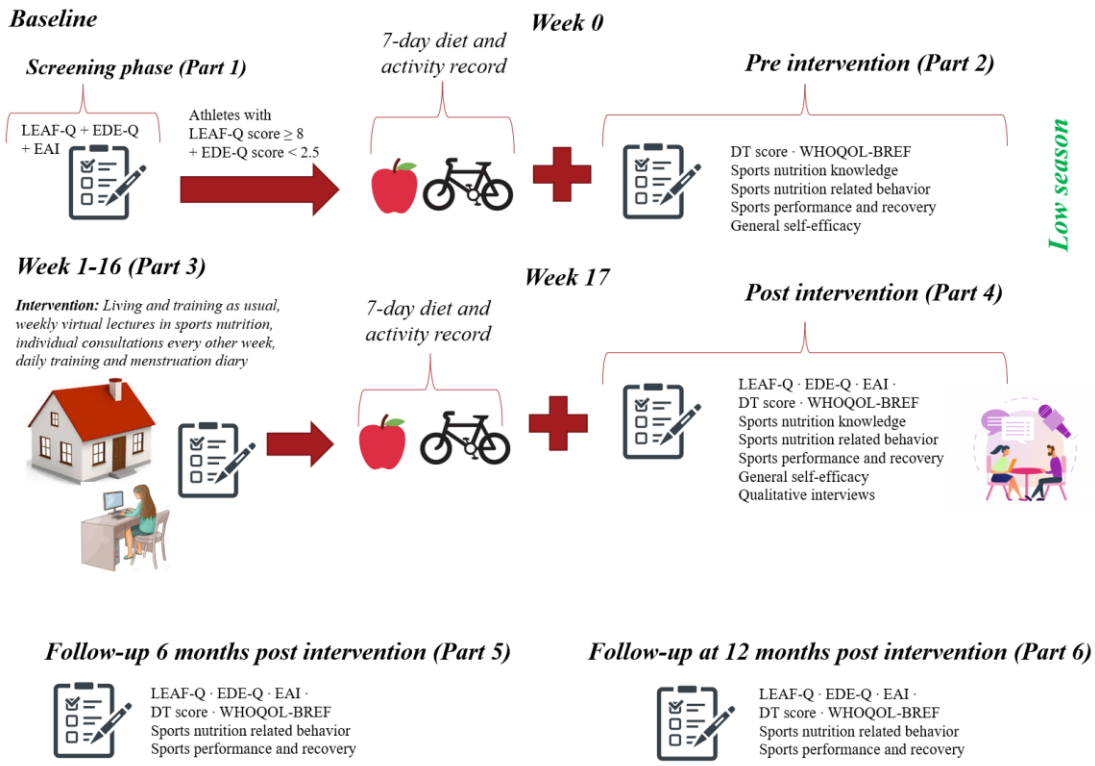

Figure 9: Phases from the FUEL project. Reprinted with permission. Part 5 and part 6 will not be a part of the current study.

3.2 Participants

Female endurance athletes between 18-35 years of age were recruited before and during the COVID-19 pandemic via Norwegian, Swedish, Irish, and German competitive endurance clubs, the Norwegian Olympic Sport Centre, Sport Ireland Institute, Swedish Olympic Committee, German Ski Federation, German Olympic Sport Confederation and social media with a link to the project website (uia.no/fuel)) and the Part 1 survey. The participants had to be non-smoking, non-pregnant, non-contraceptive using and competitive, training ≥ 5 hours per week without any chronical diseases to be included in the intervention. The athletes were included in their off-seasons, i.e., biathletes and cross-country skiers were included in May, while runners, cyclicst, triathletes and orienteers were included in December/January.

3.2.1 Selection Process

In total 208 athletes completed the part 1 of the study and were assessed for eligibility (Figure 10), where n=141 were excluded (n=2 were male athletes, n=2 were under the age of 18, while n=1 was over the age of 35. One athlete was not from an endurance sport [badminton], n=3 reported having a chronic disease [n=1: Crohn's disease, n=1: Hashimoto Thyroiditis, n=1: hypothyroidism]. Fifty-five were excluded due to hormonal contraceptives, n=23 due to EDE-Q global score ≥ 2.5, n=51 due to LEAF-Q score < 8, while n=3 had not provided any contact information, indicating that they wished to participate in Part 1 of the study only). All the excluded participants with available contact information (n=138) were individually contacted with the opportunity to receive the reason for exclusion via a phone call from the researchers or in an encrypted file. Several participants had more than one reason for exclusion, e.g., hormonal contraceptives and high EDE-Q global score, but all athletes with EDE-Q ≥ 2.5 (n=43) were informed about this with a proposal to consult general practitioner and links to relevant webpages, including voluntary associations that offer help to people who suffer from DE behavior.

The LEAF-Q responds were further reviewed for the remaining n=67, and athletes were contacted for any clarifying questions. Consequently n=7 where excluded due to a false positive identification on the LEAF-Q. Further, n=4 were unavailable and n=3 got sick ahead of baseline testing. In total, n=18 were allocated to a 16-week control period followed by SNL or SNL + IC of which n=15 (83%) completed CON (n=1 wished to start using hormonal contraceptives, while we were unable to contact n=2). n=3 were not willing to participate after CON (n=1 wished to start using hormonal contraceptives, while we were unable to contact n=2) and n=2 had LEAF-Q < 8 after CON, and therefor did not meet inclusion

criteria. The latter two were offered the intervention, but excluded from the analysis. In total, n=4 were offered SNL without CON, but n=1 did not complete post testing, meaning that n=11 were eligible for the analysis of SNL. Overall, n= 34 were offered SNL + IC, of which n=2 had completed CON prior to the intervention. n=1 athlete dropped out during SNL + IC (project week 13) with the explanation that she felt like a maschine when doing registrations related to the project. Consequently n=33 (97%) completed SNL + IC.

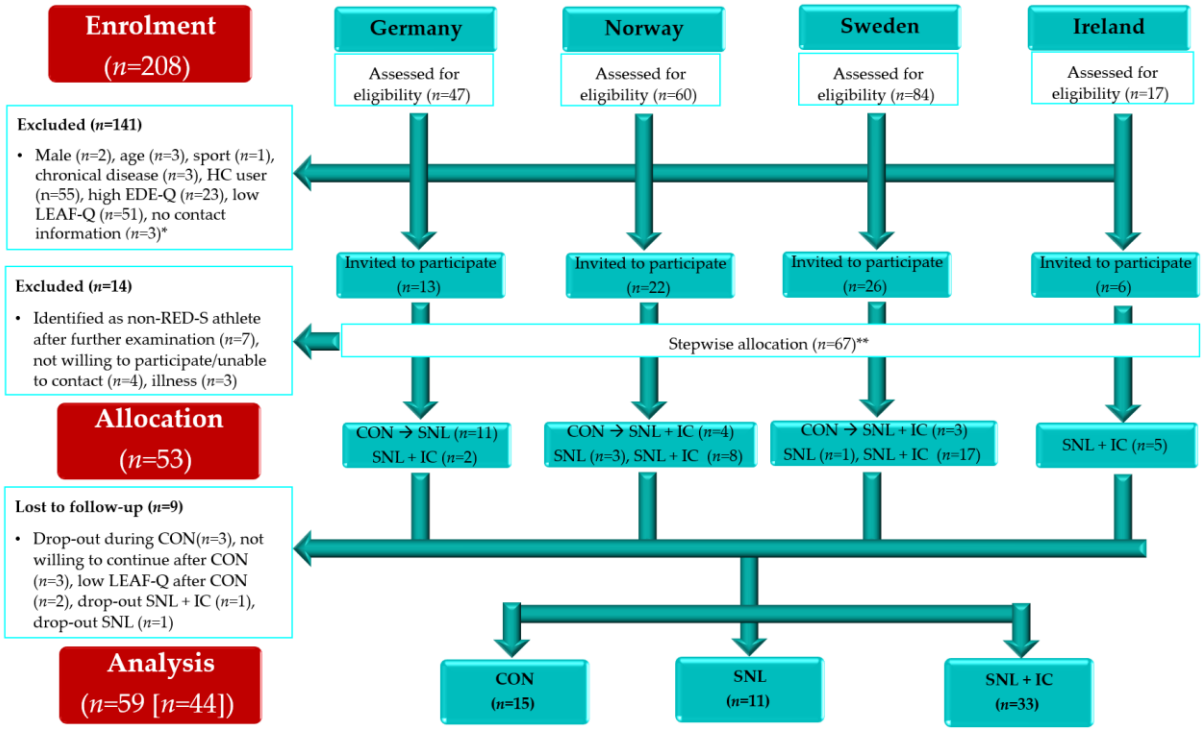

Figure 10: Flow chart. *Several participants had more than one reason for exclusion, e.g., hormonal contraceptives + high EDE-Q global score. The primary cause for exclusion is based on the given order. **Allocation to one of the three groups was depending on the resource capacity at the individual recruitment site. Seats for individual consultations were allocated on a first-come, first-served basis. Abbreviations: CON: control period, EDE-Q: Eating Disorder Examination Questionnaire, HC: Hormonal contraceptives, IC: individual counselling, LEAF-Q: Low Energy in Females Questionnaire, RED-S: Relative Energy Deficiency in Sport, SNL: sports nutrition lectures. Reprinted with permission.

3.3 Intervention

The theory ground of the FUEL project was primarily based on self-determination theory (Deci & Ryan, 2012; Ryan & Deci, 2000), models/theories such as the theory about self-efficacy (Bandura, 1977), social-cognitive theory about self-regulation (Bandura & processes, 1991), theory about attitude and social behavior (Ajzen et al., 1985; Fishbein & Ajzen, 2011), theory about planned behavior (Azjen, 1980), model for information-motivation-strategy (DiMatteo et al., 2012) and the transtheoretical approach to change (Prochaska et al., 1992)

The 16-week intervention was initiated with the participants being evaluated and completing the questionnaires EAI and EDE-Q at baseline (part 1) and week 17 (part 3) (Figure 9). During the intervention the participants registered training, sleep, menstruation, appetite and readiness to train in BESTR training diary every week (www.bestr.no). The participants got access to an online learning platform where highly experienced sports dietitians lead the lectures with themes in sports nutrition relevant for female endurance athletes with risk of RED-S. Certain themes was about prevalence, health- and performance consequences of RED-S, macro- and micronutrients, periodisation, rehabilitation, performance nutrition and nutrition before, during and after competition. These lectures were held every week from week 1 until 16 (Table 3) and the participants received the lectures in their respective languages. The participants were offered individual nutritional counseling every other week (eight in total) by highly experienced sports nutritionist in each country, which the regional partner responsible for the cohort coordinated the allocation of.

The individual nutritional counseling were held at a time which suited the participants best, and the counselor sent an invitation to a zoom-meeting with the athlete. The nutritionist used a «motivational interview» method approach (Miller & Rollnick, 2012). The counseling was athlete centered and empathic and included elements from i) value based guidance («What is important to you»?), ii) cognitive approach (thoughts, feelings, body, behavior), and iii) solution focused guidance (emphasizes what works rather than the problem) (Eide et al., 2017). The guidance emphasized creating autonomy, competence and belonging based on the self-determination theory, and the development of motivation rather than a conversational apporoach (Deci & Ryan, 2012; Ryan & Deci, 2000).

Table 3.

Topics and events that occurs during the different weeks of the four month intervention.

Week	Topics and events
0	Questionnaires + Welcome conversation 7 day diet registration.
1	Lecture: Introduction to the project, sportsnutrition and information regarding counseling. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
2	Lecture: RED-S part I: Causes and prevalence of RED-S and LEA among female athletes. Registration in BESTR.
3	Lecture: RED-S part II: Health consequences of RED-S. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
4	Lecture: RED-S Part III: Performance consequences of RED-S. Registration in BESTR.
5	Lecture: Myths in sportsnutrition. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
6	Lecture: Carbohydrates in endurance sports. Registration in BESTR.
7	Lecture: Protein and endurance sports. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
8	Lecture: Fats and endurance sports Registration in BESTR.
9	Lecture: Eating pattern and food choice. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
10	Lecture: Performance nutrition - Nutrition before, during and after training and competition. Registration in BESTR.
11	Lecture: Periodisation of energi and nutrition intake. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
12	Lecture: Important micronutrients for endurance athletes. Registration in BESTR.
13	Lecture: Supplements. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
14	Lecture: Weight, body composition, health and performance. Registration in BESTR.
15	Lecture: Injuries and nutritional rehabilitation. Individual counseling with a sports nutritionist over Zoom. Registration in BESTR.
16	Lecture: Menstruation and performance Registration in BESTR.
17	Questionnaires + Final conversation

3.4 Measures

3.4.1 Exercise Addiction Inventory

The EAI (Terry et al., 2004) was used at pre- and post intervention (See **Appendix V** for the norwegian version). This instrument`s purpose is to measure the risk for exercise addiction. It has shown good psychometric properties cross-culturally and among competing athletes and is validated in Danish (de la Vega et al., 2016; Griffiths et al., 2015; Lichtenstein et al., 2014; Lichtenstein et al., 2017a). It is a 6-item questionnaire which is rated on a 5-point Likert scale ranging from *«1 = strongly disagree»* to *«5 = strongly agree»* with a cut-off point at ≥ 24 for the *«risk of exercise addiction»*. The EAI is based on a modified version of components of behavioral addiction that are designed to be indicative of addictive behaviour components (Griffiths, 1996) that measures *«salience», «mood modification», «tolerance», «withdrawal symptoms», «conflict»* and *«relapse»*. The six statemens of the EAI are*: «Exercise is the most important thing in my life», «Conflicts have arisen between me and my family and/or my partner about the amount of exercise I do», «I use exercise as a way of changing my mood», «Over time I have increased the amount of exercise I do in a day», «If I have to miss an exercise session I feel moody and irritable»,* and *«If I cut down the amount of exercise I do, and then start again, I always end up exercising as often as I did before».*

3.4.2 Eating Disorder Examination Questionnaire

The EDE-Q (See **Appendix IV** for norwegian version) was used to measure eating disorder psychopathology at baseline and post intervention.The participants from Ireland received the english version of the EDE-Q which is validated in english (Carey et al., 2019). The participants from Sweden received the swedish version, the participants from Norway received the norwegian version which is validated in norwegian (Rø et al., 2010) and the participants from Germany received a german version. EDE-Q has four clinically derived subscales each consisting of five to eight items which measures core ED behaviors in the previous 28 days, which include objective binge episodes, and the core pathology of ED which are the undue importance of weight and shape in determining self-worth. It is based on the Eating Disorder Examination Interview by (Fairburn et al., 2008). EDE-Q is comprised of a global score and four subscales: *Dietary restraint, eating concern, weight concern* and *shape concern.* The three first subscales is comprised of five questions each, while the latter subscale is comprised of eight questions. The responses are rated on a 7-point Likert scale, except the items relating to the frequency of behavior. The score is calculated by an average of each of the subscales and the global score is the mean score of the four subscales. In this

study, a global score of ≥ 2.5 was used to classify athletes with risk of eating disorders (Rø et al., 2010; Rø et al., 2015) as previous research with athletes (Kuikman et al., 2021). The EDE-Q has recently been validated in an athletic population (Lichtenstein, Haastrup, et al., 2021). This study found the Cronbach`s Alpha coefficients ranging from 0.81 to 0.91 in the EDE-Q subscales.

3.4.3 Low Energy Availability in Females Questionnaire

The low energy availability in females questionnaire (LEAF-Q) was used to measure the difference in risk of RED-S at baseline and post-intervention in the FUEL project. This masters thesis only used data from pretest to measure mean and standard deviation of the participants that scored above eight on the questionnaire. LEAF-Q is a 25-item questionnaire that identifies athletes at-risk for LEA. This questionnaire determines LEA risk from symptoms assessed in three subscales consisting of three to 18-items that measure *Injuries, Gastro intestinal function* and *menstrual function and use of contraceptives*. A question can have choices ranging from *«No, not at all»* to «*Yes, five times or more»*, or *«Yes»* or *«No»*. The score is calculated by adding the total scores from each question. A LEAF-Q score ≥ 8 out of 49 indicates that an individual is at-risk for LEA and female athlete triad. LEAF-Q is a questionnaire validated in female endurance athletes 18-38 years of age, training ≥ 5 hours/week (Melin et al., 2014).

3.4.4 Statistical Analysis

The data analyses were conducted in Statistical Package for the Social Sciences (SPSS) version 28. The significance level is set to two tailed ≤ 0.05. Data were checked for normal distribution by examining skewness and kurtosis, mean-median differences and visual assessment of histograms and Q-Q plot. Most data showed normally distributed data except for variables *Eating Concern* (EC), *Weight Concern* (WC) and *Global* subscales in the EDE-Q. Descriptive normally distributed data are represented as mean (SD). Correlation coefficient were assessed using both parametric and non-parametric bivariate analyzes to check for any differences on EC, WC and Global. Parametric correlation coefficient were then presented and both tests showed no difference in the conclusion of the tests. Skewness/kurtosis did not deviate from a +/- 2 cut-off (DeVellis, 1991) and the parametric results were used to represent the analyzes. Cronbach alpha were used to check for internal consistency for both the EDE-Q and EAI. A reported internal consistensy between 0.6 – 0.7 are acceptable level of reliability and 0.8 or greater is very good (Tavakol & Dennick, 2011; Ursachi et al., 2015). Internal consistensy for the EAI has been reported to be at 0.84 and in a danish sample 0.6 (Griffiths et

al., 2005; Lichtenstein et al., 2014). EDE-Q has previously been reported to be between 0.75 – 0.93 across all subscales for women (Rø et al., 2015). Paired t-test were used to explore differences between EAI and EDE-Q total and global score pre and post. To check for correlations between EAI and EDE-Q global pre and post tests non-parametric correlation coefficient test were used (Spearman).

3.5 Ethics

The FUEL-project is approved by the Regional Ethical Committee (**Appendix I, II & III**) and Norwegian Centre for Research Data (Ref: 968634) and is hypothesized to generate several health benefits and no side effect, and the intervention aims to be adapted to each participants everyday life. It was voluntary to participate in the project. The participants who wanted to join the project would complete a questionnaire which would indicate an automatic consent. This consent could at any time during the projects duration be withdrawn without question and the participants could have their information and collected data deleted, unless minor information already are part of analysis or scientific publications.

The project use Service for Sensitive Data (TSD) to handle data collection and data storage in a secure enviroment. A code binds the participants information through a list of names which only the leaders of the project which has any possibility to connect the participants name together with gathered data from questionnaire, nutrition and training diaries. TSD makes sure that all data processing occurs in a closed enviroment which fullfills all laws regarding security and privacy. Information about the participants will be anonymized or deleted five years after the end of the project which is set to be 31.12.2028. If any of the participants did not fullfill the criterias for part 2 of the study (intervention) (Se **Figure 9**) then information from introductory questionnaire would be treated the same as the remaining information in the project.

Possible benefits by participating in this project is the participants better knowledge of sports nutrition, own health and sports performance. The participants gained usefull knowledge and tools in order to optimize and adapt their nutrition for their training regime. This is expected to benefit their health and performance in both the short and longterm. Participating in this project involved no cost of money. The project is not expected to involve any sideeffects or disadvantages except the time the participants have to set aside in order to participate.

4.0 Results

4.1 Description of Participants

Total of 33 female participants competing in endurance sports form the basis for the results presented in this study. Majority of the participants were runners (n = 11, 33.3 %) and a the minority were biathlon athletes (n = 4, = 12.1 %) The participants from sweden made up 54.5% (n = 18) and participants from Germnay 6.1% (n=2). Descriptive data is listed in **Table 4** for all participants distributed across sports and country. The mean total LEAF-Q score was 12.2 (SD = 2.7) and is presented in **Table 5.**

Table 4.

Descriptive statistics for all participants (n=33) distributed by sports and country.

	N	Percent	Age (years)	Bodyweight (kg)	Height (cm)	BMI (kg/m^2)	Training amount (hours/month)
All	33	100	25.1 (0.8)	59 (6.8)	169.2 (6.1)	20.8 (2)	47.8 (17.7)
Sports:							
Running	11	33.3	26.6 (5.5)	55.3 (5.5)	167.4 (6)	19.71 (1.6)	39.2 (18.4)
Orienteering	7	21.2	23.6 (3.2)	60.4 (4.5)	171.1 (9.2)	19.79 (1.4)	45.3 (8.59)
Cycling	6	18.2	26.5 (2.8)	60.47 (4.6)	168.3 (2.9)	21.3 (1.88)	66.4 (12.8)
Triathlon	5	15.2	27.2 (5)	64.26 (8.8)	170.6 (9)	22.06 (2.5)	41.6 (13.5)
Biathlon	4	12.1	22 (2.4)	63.8 (6.1)	169 (1.8)	22.35 (1.9)	61.1 (14.4)
Country:							
Sweden	18	54.5	26.9 (4.4)	60.4 (8.1)	168.8 (7.3)	21.1 (2.3)	46.4 (19)
Norway	8	24.2	28.88 (4.6)	58.5 (4)	171 (3.7)	19.87 (1.3)	52.3 (17.3)
Ireland	5	15.2	23.2 (5)	56.9 (4.2)	165.8 (4)	20.7 (1.5)	45.2 (40)
Germany	2	6.1	20 (0)	65.2 (9.5)	170.5 (1)	22.4 (3.1)	48.75 (1.8)

Note. Descriptives are shown by mean and standard deviation.

Table 5.

Low Energy Availability in Females Questionnaire for all participants (n=33)

	Mean	SD
Total score	12.2	2.7
Injuires	3.0	2.3
Gastrointestinal symptoms	2.1	2.0
Menstrual dysfunction	6.9	2.6

Note. LEAF-Q scores across subscales for all sports and countries. Important to note that all participants in this study had a LEAF-Q total score >8.

Table 6 presents mean cronbach alpha and correlation coefficient scores across all subscales for all sports. All subscales were significant at $^{**}p < .01$ for all sports except for *Relapse* which were not significant and had the lowest cronbach alpha score (0.47), and the highest cronbach alpha score was the subscale *Conflict* (0.88). The Subscale *Withdrawal* for the sports Biathlon and Triathlon and subscale *Salience* for Cycling were constant because the participants answered the same from pre- to posttest. The subscale *Salience* for Triathlon, subscale *Conflict* for Biathlon and subscale *Withdrawal* for Cycling had a correlation coefficient at 1.0.

Table 6.

Cronbach alpha and correlation coefficient between subscales for the EAI and EDE-Q pre- and posttest and presented for the total group and for the different sports.

	α	All	Biathlon	Cycling	Orient.	Running	Triathlon
Salience	0.81	.69**	-.58	-[a]	.68	.74**	1.0*
MM	0.79	.65**	.82	.65	.63	.52	.65
Tolerance	0.74	.59**	-.58	-.03	.78*	.64*	.35
Withdrawal	0.60	.56**	-[a]	1.0*	.24	.63*	-[a]
Conflict	0.88	.78**	1.0**	.75	.89**	.67*	.70
Relapse	0.47	.31	-.33	-.58	.04	.70*	.30
Total	0.78	.65**	-.58	.53	.77*	.43	.46
R	0.49	.53**	.99*	.77	.36	.26	.52
EC	0.74	.61**	.76	.95*	.42	.67*	.74
SC	0.59	.52**	.93	.48	.45	.56	.95*
WC	0.72	.56**	.87	-.84	.34	.60*	.93*
G	0.69	.60**	.97*	.70	.45	.58	.79

Note. Σ = Cronbach Alpha, MM = Mood Modifications, R = Restraint, EC = Eating Concern, SC = Shape Concern, WC = Weight Concern, G = Global. Non-parametric and parametric tests were done on EC, WC and G and no difference in the conclusions for the different subscales were found. The **α** score is the mean for pre- and posttest.

*[a] = SPSS can not compute scores because the variable is constant.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

4.2 Differences in risk of exercise addiction from pre- to posttest

There was a significant difference in the total EAI scores for pretest (M=20.9, SD=2.97) and posttest (M=20.6, SD=2.63), $t(31) = 0.301$, $p < = 0.001$. There was a significant positive correlation between the pre- and posttest $r(32) = 0.647$ $p < 0.001$. Overall 15.1% (n = 5) of the participants were at risk of EA at prettest. Out of these, one participant did not respond the posttest questionnaire, one remained at risk of EA and three participants were no longer at risk. A total of five participants were at risk of EA at posttest. There were four participants

who scored <24 at pretest and then >24 at posttest. These participants increased their EAI total scores by one, two, four and five points. **Figure 11** gives visual representation for the average EAI scores pre- and posttest intervention across all the subscales for all sports and countries. There was a significant difference between the pre- and posttest score for *Salience* (M = 3.8, SD = 0.7, M = 3.7, SD = 0.6), *Mood Modification* (M = 3.5, SD = 1.3, M = 3.6, SD = 1.19), *Tolerance* (M = 4.2, SD = 1.0, M = 4.3, SD = 1.0), *Withdrawal Symptoms* (M = 3.7, SD = 0.8, M = 3.8, SD = 0.9) and *Conflict* (M = 2.5, SD = 1.0, M = 2.5, SD = 0.7).

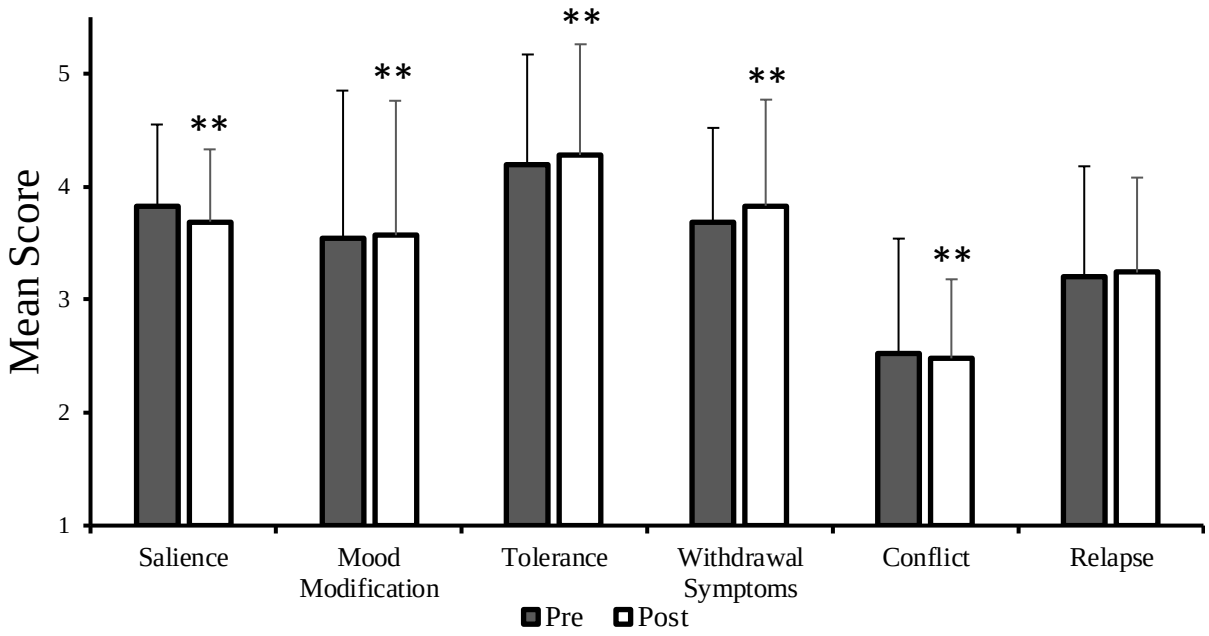

Figure 11. Exercise Addiction inventory. *Note*. The figure shows average scores for the EAI pre- and posttest subscales. Scale ranges from 1 (Strongly disagree) to 5 (strongly agree). All differences are significant at p<.01**. For representative reasons the EAI total scores are not shown in the figure for causing skewness.

4.3 Differences in eating disorder symptoms from pre- to posttest

EDE-Q Global score pretest (*M* = 1.1, SD = 0.7) was higher than the EDE-Q Global score at posttest (*M* = 0.8, SD = 0.8) and there was a statistically significant difference between pre- and posttest, t(31) = 2.60, $p < .014$. There was a positive correlation between the pre- and posttest global scores $r(32) = 0.598$ $p < 0.001$. **Figure 12** gives visual representation of the EDE-Q pre- and posttest. There was a significant difference in the subscale *Restraint* (M = 0.8, SD = 1.1, M = 0.3, SD = 0.6), *Eating Concern* (M = 0.7, SD = 0.7, M = 0.5, SD = 0.6), *Shape Concern* (M = 1.5, SD = 0.9, M = 1.0, SD = 1.0), *Weight Concern* (M = 1.3, SD = 0.9,

M = 1.0, SD = 1.0). Regression showed that TTA did not explain the variance on the Global score in both at pre- and posttest.

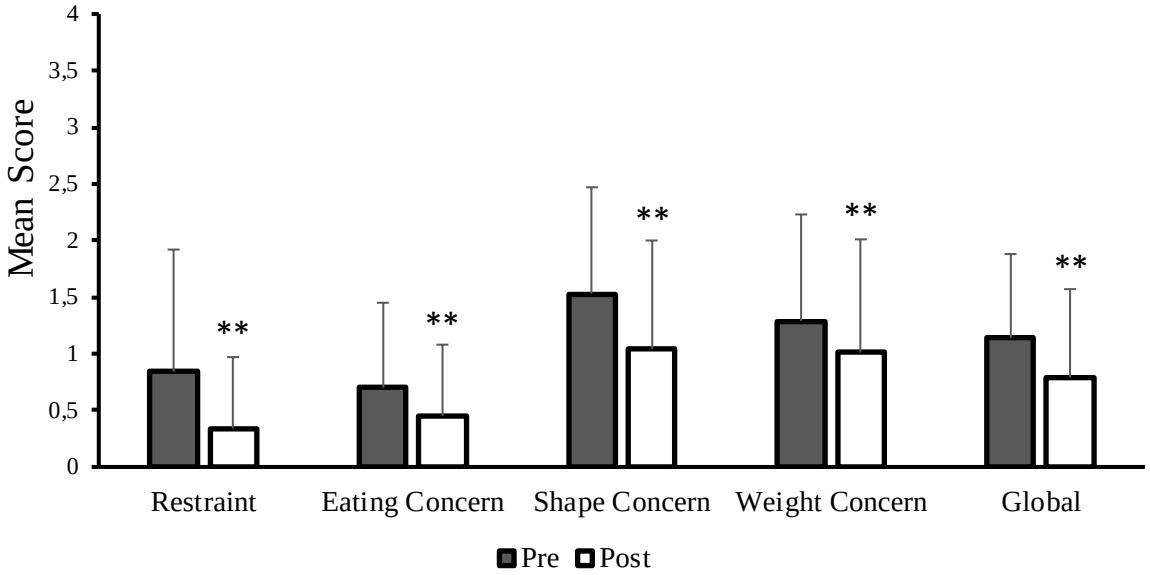

Figure 12: Eating Disorder Examination Questionnaire V6. *Note.* Figure gives visual representation of the mean score across all subscales, sports and country for the EDE-Q6. All differences are significant at $p<.01^{**}$. EC, WC and Global distribution was skewed and both parametric and non-parametric tests were conducted and showed that main results remained the same.

4.4 Relationship between risk of Exercise Addiction and Eating Disorder symptoms

There was a significant positive correlation between the EAI total score and EDE-Q Global at pre-test r(33) = .48, $p < 0.01$ CI [0.15, 0.71] but not at post-test r(32) = .3, $p = 0.1$ CI [-0.7, 0.59]. Regression showed that in the pretests the EAI total score was a significantly predictor that explained 35% of the variation in the subscale *Shape Concern* in the EDE-Q (R^2=.350, F(1)=31, $p = 0.046$). EAI total pretest score was a non-signifcant predictor for the EDE-Q subscale *Weight Concern* pretest (R^2=.18.3, F(1)=30, p = .309). The same variables in the posttests showed that EAI Total was a non-significant predictor for *Shape Concern* and *Weight Concern* and explained the variation by 10.8% and 14.5% respectively (R^2=.108, F(1)=31, $p = 0.555$) (R^2=.145, F(1)=30, $p = 0.43$). **Figure 13** shows a visual representation of the relationship EAI total score and EDE-Q Global score at pretest and posttest. Each point on the figure represents a participants score on both questionnaires.

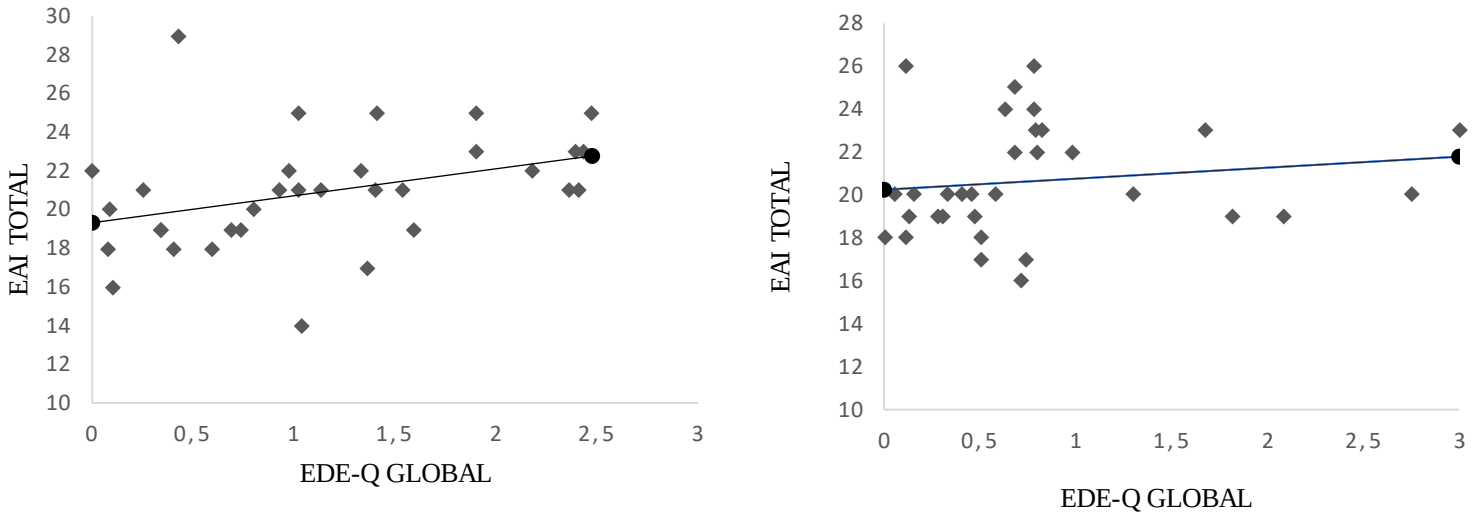

Figure 13: Shows the relationship between EAI total score and EDE-Q global score at pretest (left) and posttest (right). The relationship at pretest was significant at $p < 0.01$. At posttest the relationship was non-significant.

5.0 Discussion

The main findings of this study was that a 27.3% reduction of DE symptoms and a 1.4% reduction of EA risk were observed after a 16-week intervention among female endurance athletes at risk for RED-S. Furthermore, a significant positive correlation between ED and EA at pretest, but not at posttest was found in the same sample.

To the best of the authors knowledge, this study is one of the first that have examined EA in a population throughout an nutritional intervention with testing at pre- and posttest. This chapter will discuss these results with regards to methodology, instruments and the validity and reliability of these.

5.1 Discussion of Methods

5.1.1 Study Design

This project was completed by means of quantitative method by using an interventional design. It was part of a doctoral thesis with a duration of 16-weeks with planned follow-ups at 6- and 12 months. This masters thesis examined the variables from the instruments EAI and EDE-Q from the screening phase until posttest at week 17. Experimental interventional designs are generally used to identify wether an independent variable has an effect upon a chosen dependent variable (Gratton & Jones, 2014) and are gold standards that can yield persuasive evidence about an ideal counterfactual and casual relationship (Polit & Beck, 2020). The independent variable in question here was a nutritional educational programme, and the dependent variable were symptoms of EDs and risk of EA. This was an intervention with a duration over 12-months which may have caused challenges in recruiting participants considering its commitment to long-term follow-ups (Patel et al., 2003) and this may be especially true in participants who are active in competing as elite/sub elite athletes.

The 16-week intervention program included in the FUEL-project were initially designed to have laboratory trials and a control group. The worldwide COVID-19 pandemic hindered the trials and the recruitment of the control group for of fear of infections. Also, the decision was made to not randomize as many of the participants would have been in the same clubs and organizations. As experimental randomized controlled trials (RCTs) has great strength, the process of randomizing can be difficult as certain human traits such as diseases and health habits can not be randomly conferred (Polit & Beck, 2020), and the decision for not randomizing was made for fear of imitation of the intervention by the participants which would create great difficulty in determining the main causality for the intervention.

The absence of a control group makes it difficult in explaining the main effect of the sports nutritional lectures and individual counseling on the athletes during the intervention as this design permits the researchers to see if the changes were caused by the intervention, this is an important comparison (Polit & Beck, 2020), as question arises then on the effects of the lectures or counseling itself and what effects the differenct aspects of the intervention has on the risk of EA and symptoms of EDs. The absence of a control group makes it difficult to determine if the intervention has had a clear effects on risks of EA or symptoms of EDs, or if there is a maturation threat, or a natural "development" that has occured during the intervention which would have caused the same effects (Polit & Beck, 2020), perhaps the participants in the intervention had a "natural" effect going from low-season to high-season, which may have had an effect on the posttest result. Although one intervention group might have its limitations when determining the effects of a nutritional program over the course of 16-week, such as the COVID-19 pandemic being a massive historic event which may be considered a threat to the independent variable, it should be reflected that this were in times of a global pandemic which caused the recruitment process and data collection to be more difficult. It also has generated temporal data which can be compared at further instances where control groups are present and where there is an absence of a global pandemic, as the pandemic might have caused further impact on the results presented in this thesis.

5.1.2 Participants and Selection

The population of interest in this project are specified through eligiblity criterias. They were female endurance athletes between the ages of 18 and 35 (For more details see method section), and are sampled through a probability sampling in the recruitment phase. Participants were later stepwise allocated after an inclusion-exclusion process. Probability sampling is the only viable method of obtaining representative samples. If all people in a population have an equal chance of being selected, then the resulting sample is likely to do a good job of representing the population (Polit & Beck, 2020).

The power calculations in the recruitment phase initially suggested that a group of 28 participants were needed to be able to expect an improvement in the LEAF-Q score by 3 with Type I and II error at 5% and 20% respectivally. The group in the intervention phase included 33 participants. Considering the challenges presented earlier, this sample size might be sufficient for drawing a causal relationship between the variables. And it is important that the

sample size is sufficient as the risk of drawing wrong conclusion increases when samples are too small and researchers risk gathering data that will not support their hypotheses even when those hypotheses are correct (Polit & Beck, 2020).

The normative paradigme of quantitiative research is to be able to be representative of the population of interest and allowing its results to be generalized to the wider population (O'Donoghue, 2013). This sample of female endurance athletes can seem like a homogenous group. The majority of participants were from Sweden and the sport with the most participants were running, and the bodyweight across all sports ranged from 55 to 64 and monthly hours spent training between 39 to 66. Also questions can be raised on the differences the life of a 18- and 35- year old athlete lives, and the contrast in cultures across sports and countries, and that individuals between ages 18 and 26 years are more susceptible to EDs (Pope et al., 2015), and how much this can affect the homogenity of the group.

5.1.3 Collection of Data

Quantitative data collection tends to involve the collection of factual or directly measurable data. The data needs to both be valid, as in that it really measures what it intends to measure. And have reliability, which refers to the consistency of the results obtained (Gratton & Jones, 2014).

The data in this intervention were collected through self-reported questionnaires in the form of Likert scales (except the questions related to eating frequency in the EDE-Q) at pre – and posttest. Questionnaires are less costly, especially those used through the internet and are advantageous for geographically dispersed samples (Polit & Beck, 2020). As in this project, the participants were recruited through social media and endurance sports clubs throughout four different countries. This makes questionnaires efficient for collection of data and for the participants to able to participate. As the participants were asked about personal information regarding age, weight, height, different symptoms for EDs, active sport and country of residence and more, it becomes crucial for the protection and safety for the participants that the researchers responsible for conducting this intervention can provide security. So as not that the participants personal information both direct or indirect can be linked to the individual participation, therefore the use of Service for Sensitive Data (TSD) was used, it is a program that can collect, store and analyze sensitive research data in a secure enviroment. Questionnaires are frequently used and since behaviors can be observed, the most direct approach to know how people feel or what they believe is to ask them. This approach does

have its weaknesses. The most serious issue concerns the validity and accuracy of self-reports. Can we be sure that the respondents feel or act the way they do? The researchers must assume that most respondents have been honest, but people have a tendency of wanting to present themselves in the best light possible (Polit & Beck, 2020). Also, being presented with a long survey might cause respondents attention and motivation to drop, causing the quality of the data they provide to deteriorate, and engage in a "straight-line" responding (Encyclopedia of Survey Research Methods, 2008). There is evidence to suggest that athletes significantly under-report eating psychopathology on self-report questionnaires, for reasons of concerns over potential restrictions to training and competition, loss of scholarships, governing body funding or concerns over the perceived stigma of mental illness (Plateau et al., 2017), this is discussed further in **"5.2.2 Eating Disorder Symptoms".**

5.1.4 Measures

It is important to note that the use of psychometric tools such as questionnaires are easy to administrer in large populations and time-cost efficient (Polit & Beck, 2020). The scores on questionnaires should always be followed-up with clinical interviews and assessment by professionals in order to properly diagnose individuals for symptoms of EDs (Pope et al., 2015; Rø et al., 2015) and EA (Szabo, Griffiths, Marcos, Mervó, Demetrovics, et al., 2015).

Exercise Addiction Inventory

The participants were presented with a EAI version of their respective language. The EAI has shown good psychometric properties across different countries, with some samples showing excellent degree of fit and other adequate fit, and with competing athletes (de la Vega et al., 2016; Griffiths et al., 2015). This difference might be due to different sampling methods by different research teams in different countries. In this project the sampling was the same across the different countries. The EAI is not based on the American Psychiatric Association (2013) DSM-5, which the EDS is (Hausenblas & Downs, 2002). It is rather based on six common symptoms of of addiction (Szabo et al., 2019). They both present good comparable results, but as a consequence of diverse samples (students, runners, bodybuilders, gym users etc) may attribute to different interpretation of the items in the survey (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015).

A limitation for the use of the EAI on this sample might be that addictive urges can not be scheduled, unlike athlethic training. If elite athletes exercise beyond their already demanding training schedule, could mean the end of a career because of the almost physically impossible

training that would occur (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015). EA, is in definition a loss of control over a behavior, for an athlete this would mean that he/she would have to exercise before and after scheduled training. EA prevalence ranges from 7% to 42% across many sports disciplines (Blaydon & Lindner, 2002; McNamara & McCabe, 2012; Youngman & Simpson, 2014a).

Szabo, Griffiths, Marcos, Mervó and Demetrovics (2015) argues that the high scores on the EAI is due to the athletes interpretation of the instruments items. An example can be the first item «*Exercise is the most important thing in my life*», which can also be interpreted as the main goal is to succeed in a sporting career. Where a non-athlete might interpret this as «*i cannot manage my life without exercise*». Therefore a «*strongly agree*» (maximum score) might be an honest and sincere answer from the athletes. Item two of the EAI, «*Conflicts have arisen between me and my family and/or my partner about the amount of exercise i do*» might be interpreted as other intra- and interpersonal conflicts in an athletes life, as they might experience conflict because of their demanding training regime, which is not the same conflict a person addicted to exercise might experience. In this thesis the majority of the athletes were not elite athletes, it can therefore be up to debate wether they should be discussed as elite athletes, sub elite/well trained or as recreational exercisers in terms of the interpretation of the above items. A question also arises if non-elite athletes might have more conflicts with friends and families than their elite counterparts.

The reconceptualization of EA have been proposed to be revisited since the disclosed high risk of EA in athletes might never materialize in pathological EA (Juwono, Tolnai, et al., 2021), and the observed values could reflect conceptual misinterpretation of the items and responses on the assesment tools (Kovácsik et al., 2021; Szabo, Griffiths, Marcos, Mervó, Demetrovics, et al., 2015). A preliminary protocol report by Granziol et al. (2021) have suggested to add three more items to the EAI with hypotheses to research differences in EA and associated personality measures in different sports.

Eating Disorder Examination Questionnaire

The participants were presented with a EDE-Q version with their respective languages. The EDE-Q has been used as a potential screening tool for Triad risks (Wagner et al., 2016). It has recently been validated in an athletic population (Lichtenstein, Haastrup, et al., 2021), and is seen as the gold standard for the diagnosis of EDs (de Oliveira Coelho et al., 2014). The EDE-Q is widely used in clinical and research settings worldwide, and the psychometric properties

of this instrument are well established (Rø et al., 2015), although it is not spesifically made for athletic populations it has been commonly used to measure athletic samples (Pope et al., 2015). It is based on the American Psychiatric Association (2013) definitions of EDs, and is capable of being completed within 10-15 minutes and yield preliminary evidence as to the severity of EDs and weight control behaviors present in an individual (Pope et al., 2015).

The use of other questionnaires might yield different results as certain tools which are validated in non-athlete population assesses mainly one ED, such as the Bulimia Test-Revised (Thelen et al., 1991) which measures BN and the Eating Attitudes Test (Garner & Garfinkel, 1979) which mainly adresses degree of AN behavior. The EDE-Q has subscales encompassing the assessment of both BN and AN tendencies and has 28-items across four subscales (Fairburn et al., 2008), whereas the other questionnaires such as the EDI-3 has 91-items across 12 subscales. Considering the participants in the FUEL-project had several other questionnaires to fill out in both pre-and posttest, the EDE-Q might yield good results as it is previously mentioned validated in athletic populations (Lichtenstein, Haastrup, et al., 2021), and it might deterr the participants from being victim of respondent fatigue and give honest answers (Encyclopedia of Survey Research Methods, 2008).

5.2 Discussion of Results

5.2.1 Risk of Exercise Addiction

The main findings in this thesis is that a 16-week intervention reduced EAI total score by 1.4% from pre- to posttest.

The mean for the pretest total score was 20.9 for the EAI, which was a small difference and moderate positive correlation for the risk of EA between pre-and posttest (mean 20.6). fifteen percent (n=5) of the participants were at high risk and the rest were at medium risk of EA at pre-and posttest. This is higher than what is observed in the general population (0.3%) and amongst athletes and regular exercisers (3-6%), although prevalence rates may reach over 20% in elite endurance athletes (Dumitru et al., 2018; Mónok et al., 2012). The pretest scores are comparable to other cross-sectional studies which have investigated EA, such as Youngman and Simpson (2014b) where 81% of females were at medium risk and 22% at high risk of EA. Lichtenstein, Melin, et al. (2021) showed a prevalence rate of 5.5% for female endurance athletes, Mayolas-Pi et al. (2016) identified 15.7% out of a sample of 108 female competitive amateur endurance cyclist, and the rest of the sample as low risk of EA. Here the

researcher classified a score between 0-23 as low, where other uses 13-23 as medium (Youngman & Simpson, 2014b) and since the mean was 17.9 for the EAI in the study by Mayolas-Pi et al. (2016), it can be postulated that a large amount of the sample is at medium risk. These cross-sectional studies have all used the EAI as a psychometric tool, and on female samples of endurance athletes. The differences in scores can still be attributed to inconsistencies in sample sizes and different sports (Lichtenstein et al., 2017a). As pointed out in the previous chapter 5.1.3, the EAI might be interpreted differently from an athletes point of view rather than one who is a general exerciser or subelite athlete (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015).

In this project there was a small significant difference in risk of EA from pre-to posttest, a small decrease in the total score. Although the subscales *Mood Modification, Tolerance* and *Withdrawal Symptoms* had small increases. At posttest, one participant who were at high risk at pretest did not answer, one remained at high risk, and three moved from high risk to medium, and three new participants moved from medium risk to high risk. *Tolerance* and *Withdrawal Symptoms* are key components when it comes to addiction, and neither are characteristics of compulsions which often occurs in females in a form of SEA (Cunningham et al., 2016). As mentioned previously in 5.1.3, there is a lack of and calls for more experimental design when it comes to EA research (Hausenblas & Downs, 2002; Simón Grima et al., 2019). Furthermore, no nutritional intervention studies have examined how EA may affect the recovery of RED-S, altough a negative association has been suggested among male athletes (Torstveit et al., 2019). There is great difficulty in explaining how this result has occured, one possibility is that there is a PEA present (De Coverley Veale, 1987) as the score for EDE-Q has greatly decreased relatively to the EAI, the total EAI mean score has not. Another possibility is that the use of EAI as the psychometric measure on athletes has its limitations, as it can be interpreted differently as an athlete (Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015).

A third possibility is the role of passion in athletes, higher risk of EA may merely reflect keen passion, commitment or dedication as motives to compete and participate in higher levels of competition have been reported to be positively associated with EA (Juwono, Tolnai, et al., 2021). The participants in the FUEL-project were recruited in their low-season, a mechanism for the low change in EA might be the participants reflection off motives to compete, as their high-season draws to a close during the intervention, there is scarce data on such argumentation, however in the study by Kovácsik et al. (2021) on students trying a new sport

over a duration of 12-week and 90min weekly sessions an intervention could significantly increase the risk of EA, it also saw an increase in both obsessive and harmonious passion and it is concluded that motivation is a partical predictor of the observed effect, also the authors discuss the possibility of the increase observed in the risk of EA could reflect conceptual misinterpretation of the items and responses on the assesment tools (Kovácsik et al., 2021).

5.2.2 Eating Disorder Symptoms

The participants who had a Global score of >2.5 were excluded from the project because of high risk of EDs and a non-compliance to the nutritional intervention.

The EDE-Q Global score decreased from pretest to posttest by 27.3%. The scores at both pre- and posttest in this thesis are lower than what is found in larger samples of young adult australian women (1.52), undergraduate women in the US between the ages of 18-22 (1.59) and a community sample of 3000 Norwegian women between 16-50 years of age (1.27) (Luce et al., 2008; Mond et al., 2006; Rø et al., 2012). Its is also lower than female college athletes from the US who competed without additional recreational exercise (1.39) and athletes who compete while engaging in additional recreational exercise (1.88) (Darcy et al., 2013). There are no clear cut-off scores for EDE-Q, but in samples with females who has a clinical ED the Global mean score has been shown to be 4.0 (SD = 1.32) and the control sample 1.25 (SD = 1.1). In Darcy et al. (2013) the optimal cut-off is set to 2.5, although scores above 4.0 is normally set at a clinical range (Rø et al., 2015). In samples with female athletes with current EDs a Global score of 4.0 (SD = 1.16) can also be observed (Plateau et al., 2017). Whether using a different cut-off score for the participants in the FUEL-project would be of significance is difficult to determine, this sample of participants are aged between 18 and 35 with a mean BMI of 20 kg/m2. It has been shown that females between the age of 16 to 19 and 20 to 29 has a slightly higher optimal cut-off on average than females between 30 to 39 and >40 (Rø et al., 2015) and females with BMI above 25 has an optimal cut-off score 26% higher than what is used in the FUEL-project. It is important to note that this sample in Rø et al. (2015), although quite large in size does represent a general population of females rather than an athletic one. Therefore, one can only postulate what the consequence on changing different cut-off for the EDE-Q would bring. Perhaps, in a different athletic population where leannes- or weight bearing sports are not represented, but rather sports with strength

characteristics, such as olympic weightlifting and powerlifting, or perhaps team sports where a higher BMI is present would call for a different EDE-Q cut-off score.

These studies above are all cross-sectional studies (Darcy et al., 2013; Luce et al., 2008; Mond et al., 2006; Plateau et al., 2017; Rø et al., 2012; Rø et al., 2015), therefore no clear causality is given for the scores. The abstract by Strock et al. (2021), by which the full article has yet to be published, highlights how a 12-month nutritional intervention effect on women with DE behaviors and oligo/amenorrhea who exercises. The women did not have their DE behavior worsened, despite having gained weight, no discussion is available where possible mechanism for this change is discussed (Strock et al., 2021). The FUEL-project has had a nutritional intervention which have shown to decrease the Global EDE-Q score in female endurance athletes. In the intervention by Becker et al. (2012), the EDE-Q subscales SC and WC were used before an educational intervention that lasted over three sessions with a total duration of 3-4 hours, and post-intervention, 6-week follow-up and one year follow-up. The female participants were allocated to two groups, one group followed an Athlete-modified dissonance-based prevention program, and the other an Athlete modified-healthy weight intervention. The score for the SC decreased by 26.2% and 21.8% and WC the scores were reduced by 25.8% and 16% after six weeks (Becker et al., 2012), compared to the participants in this study which SC and WC reduced by 33.3% and 23% after 16-weeks.

The Becker et al. (2012) study had a larger randomized sample and a more heterogenous group in regards to different sports which are represented compared to the sample presented in this thesis. The FUEL-project has solely females represented in endurance sports while Becker et al. (2012) has participants representing svimming, diving, softball, golf, soccer, cheerleading, track & field, tennis and cross-country, and this might explain the larger scores since the prevalence rates for EDs and DE are more prevalent in weight-bearing sports such as track and field and aesthetics sports such as gymnastics (Which can be compared to cheerleading) (Schaal et al., 2011; Tan et al., 2016).

Other prevention programs have been conducted on adolescent male and female elite athletes (Martinsen et al., 2014) throughout three years of high school, this one year intervention program focused on health, body and sports performance and it is the first to report that the development of EDs, by using the EDI-2 can be prevented among adolescent female elite athletes through a one year program. With posttest after the intervention and a followup posttest after one year, this study showed results after the one year posttest that the total prevalence of female athletes with EDs were 20.8% in the control group compared to 1.0% in

the intervention. The control group did not receive any lectures and were not given any practical or theoretical assignements which were there to promote mental training, self, esteem and self-confidence, there were 12 out of 13 athletes from the intervention group that had recovered from an EDs and only 4 of 13 in the control

The studies by Becker et al. (2012); Martinsen et al. (2014) and including others (Mathisen et al., 2020) have focused on self-regulations and self-efficacy as means to decrease the risk of EDs symptoms. The FUEL-project has used self-determination theory as a framework for the counseling of the participants (Deci & Ryan, 2012; Ryan & Deci, 2000) which may in turn have been important for the reduction of EDs symptoms. Other factors for the reduction of scores can be the participants are subject to performance bias, or the hawthorne effect (Polit & Beck, 2020) where the participants changes their responses or behavior in awareness to which group they are allocated to. As mentioned previously in **"5.1.3 Collection of Data"**, there is evidence to suggest that athletes significantly under-report eating psychopathology on self-report questionnaires, for reasons of concerns over potential restrictions to training and competition, loss of scholarships, governing body funding or concerns over the perceived stigma of mental illness (Plateau et al., 2017). Research suggest that possible facilitators of seeking help in young athletes are emotional support, mental health literacy, professional help and social encouragement (Gulliver et al., 2012) and intervention strategies should focus on reducing stigma, and increasing mental health literacy, and improving relations with providers, which were the goal of the nutritional counselors who followed the participants in this project.

In the study by Becker et al. (2012), the authors were suprised that a three to four hour intervention reduced SC and WC at 6-weeks and one-year follow-up, and also that multiple students had come forward to their trainer reporting that they were concerned that they might have the Triad. Gulliver et al. (2012) explains how barriers for seeking help among adolescents and young adults include poor mental health literacy, which can be a feeling of being unsure about where to seek help. Although programs have shown to improve help-seeking in elite athletes (Purcell et al., 2019), the impact of such interventions have yet to be known (Rice et al., 2016). If an improvement in health literacy has been achieved among participants in this project is unknown, it can perhaps be postulated that an increase in knowledge about Triad symptoms, nutritional knowledge and conversations with counselors where self-determination, self-efficacy and self-regulation was important, might have had an

impact on reducing the symptoms of EDs. Since there is no control-group, this causality can be difficult to determine.

5.2.3 Relationship between EA and ED

In this study, there were at pretest a significant moderate positive relationship between the risk of EA and EDs symptoms, at posttest there was a non-significant weak positive relationship. Female athletes, including distance runners who score positive for risk of compulsive exercise are shown to have higher EDE-Q scores across all subscales including Global scores than participants who score negative for risk (Gorrell et al., 2020; Plateau et al., 2017). EDs can be associated with EA in the form of SEA, where weight loss is the objective and exercise is used as a role to change body weight and shape (Reardon et al., 2019), this association is present in studies where EDs are contributing significantly to ratings of EA where the perception of body shape is a non-significant mediating factor contributing between EDs and EA (Levit et al., 2018). As in the FUEL-project, the female participants at posttest had their overall EDE-Q score reduced, although the EAI score has only reduced slightly by 1.4%. Therefore, a presence of SEA might not be probable in this sample, although not improbable as SEA suggests a causality between EDs and maladaptive exercise behavior (Godoy-Izquierdo et al., 2021) in which the latter might be difficult to detect in samples of elite/subelite competitive athletes.

The female participants in the present study showed a significant positive relationship at pretest before the intervention of the nutritional education program, and a non-significant at posttest. Exercise is recognised as a significant factor in the aetiology, development and maintenance of EDs and DE (Godoy-Izquierdo et al., 2021; Meyer et al., 2011), and since exercise is a vital part of an athletes life, the reason for exercise is important as athletes with introjected (i.e., doing sports due to internal pressure) and external motivation (i.e., doing sports due to external pressures) may be associated with risk of EA (González-Cutre & Sicilia, 2013). Athletes who compete and participate in higher levels of competition are positively associated with EA in certain studies, this relationship can reflect an athletes dedication and passion to their chosen sports (Juwono, Tolnai, et al., 2021).

An interresting question arises then, if EDs and EA are so closely related, why would such a significant change occur on the Global score in the EDE-Q and not in the total score in the EAI at posttest? Mechanisms for the non-significant relationship observed in the posttest

might be due to factors which have previously been mentioned, such as the role of passion in EA, the presence of PEA, removing barriers and stigma in the prevention of EDs.

Previous research has seen significant correlations between EA and DE in both women and men, and in athlete populations, and problematic exercise and its narrow association with eating pathology, weight control and apperance management (Godoy-Izquierdo et al., 2021). To the authors knowledge, few studies has observed and tested an intervention where the aim is to reduce the risk of EA, so therefore there exist scarce litterature on the matter. Furthermore, EA is not listed in the DSM V (American Psychiatric Association, 2013), as such, no official diagnosis criteria exist and the use of questionnaires are not diagnostic tools (Juwono, Szabo, et al., 2021) therefore, the non-significant relationship may be due to a lack of proper clarification of the concept of EA, which might become more evident in athletic population due to factors such as passion, perfectionism and misinterpretation of the EAI (Çakın et al., 2021; Juwono, Tolnai, et al., 2021; Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015).

The presence of a global pandemic which results in lockdown with less availability for practise, competition preparation and meeting with teammates and coaches in person can have impacted the results. As the results have slightly increased in some subscales and the overall decrease is quite small, the participants responses to the EAI can have been affected by other factors which have existed in their daily lifes during lockdowns and times of uncertainty. Certain studies have noticed the possibility of increased risk and symptoms of EA and ED during the COVID-19 pandemic (Rodgers et al., 2020; Scharmer et al., 2020). The lockdown as a result of the pandemic has also greatly increased the prevalence of depression and anxiety because of various factors such as fear of infections, anger, confusion, helplessness, sadness and frustration (Li et al., 2021; Onyeaka et al., 2021). Therefore, this might have affected the results from the observed results in this thesis.

6.0 Conclusion

This masters thesis was part of a bigger multicenter study based at the Institute of Sports and Physical Education at the University of Agder (www.uia.no/fuel). The aim of the FUEL-projects was to develop, implement and evaluate a 16-week practice orientated sports nutrition education and counselling program to improve symptoms of LEA in female endurance athletes.

Investigating the effect of a 16-week intervention showed a reduction in both risk of EA and symptoms of EDs in female competitive endurance athletes. Although, a quite larger reduction in percentages in the EDE-Q Global score than the EAI total score was observed, all the subscales in the EDE-Q revealed a reduction from pre-to posttest, which might be explained by factors such as the removal of health barriers and stigma, and the increase of health literacy. The subscales *Mood Modification*, *Tolerance*, *Withdrawal Symptoms* and *Relapse* in the EAI significantly increased from pre- to posttest, which might be explained by factors such as passion, the presence of PEA, misinterpretation of the psychometric tools used or historic threats such as the presence of the COVID-19 pandemic with lockdowns and restrictions influencing the end result. A significant relationship between risk of EA and symptoms of EDs was found at pretest, this relationship was not present at posttest, which might be explained by factors mentioned above.

This thesis has shown that a reduction in risk of EA and symptoms of EDs can be achieved through a 16-week intervention aimed at educating female athletes at risk for RED-S.

7.0 Practical Implications and Future Research

This thesis highlights the importance of interventions and educational programs for female athletes which are at risk for RED-S. As both EA and EDs can be harming and cause distress in an athletes everyday life both physically and mentally it is important to develop tools in order to prevent and reduce risk of EA and symptoms of EDs, as such it can be implemented and developed with better quality to an athletes life, both through family, coaches and the organization they are a part of.

Future research may implement this intervention with a control group and larger samples for more generalizibility across cultures and sports, it would also be important to research the effect of the nutritional lectures and counseling in itself to understand if both factors are important for best effect by also using qualitative research methods such as interviews in order to more clearly understand the effect. It might also be conducted where there is an absence of a pandemic with social restrictions and lockdowns which affect the normal daily cycle of athletes of organized training and meeting with staff and coaches of their respective clubs and organizations. Future research may also consider creating a educational programme for male athletes, athletes in different age groups, other sports that are not mainly endurance oriented, but rather more aesthethic and weight oriented. Future research may also consider including coaches or staff with responsibilities of the athletes in order to prevent further development of EDs and DE behavior and create an enviroment where athletes will accept treatment and evaluation.

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Appendix I

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

The Project Manager Monica Torstveit

Regional Committee for Medical & Health Research Ethics
South East Norway, Section C
Postbox 1130 Blindern
NO-0318 Oslo
Norway

Phone: + 47 22 84 55 98
E-mail: t.t.mosling@medisin.uio.no

Our ref.: 31640C

Webportal:
http://helseforskning.etikkom.no

To whom it may concern,

Date: 04st of September 2020

Re: REC Letter of Confirmation

I am writing in reference to a request from Monica Torstveit via e-mail dated 02th of September 2020, regarding a Letter of Confirmation in English.

Confirmation

We hereby confirm that Regional Committee for Medical & Health Research Ethics, Section C, South East Norway, approved the Research Project: "Effects of a practice-oriented recovery program in female endurance athletes with relative energy deficiency - The FUEL recovery program" (Norwegian title: "The FUEL program") at its Committee Review Meeting on the 14th of January 2020.

The Project Manager for the study is Monica Torstveit, and the Institution Responsible for Research is Universitetet i Agder.

The approval has been given on the basis that Research Project will be implemented as described in the Research Protocol.

Ethics Committee System

The Ethics Committee System in Norway consists of seven Independent Regional Committees with authority to either approve or disapprove Medical Research Studies conducted within Norway, or by Norwegian Institutions, in accordance with the Act on Medical and Health Research (2008).

Please do not hesitate to contact the Regional Committee for Medical and Health Research Ethics Section South East C (REK Sør-Øst C) if further information is required, as we are happy to be of assistance.

Yours faithfully,

Britt-Ingjerd Nesheim

Chair of the Regional Committee for Medical & Health Research Ethics of South East Norway,

Section C

Tone Transeth Mosling

Executive Officer

Appendix II

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

The Project Manager Monica Torstveit

Regional Committee for Medical & Health Research Ethics
South East Norway, Section C
Postbox 1130 Blindern
NO-0318 Oslo
Norway

Phone: + 47 22 84 55 98
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Yours faithfully,

Britt-Ingjerd Nesheim

Chair of the Regional Committee for Medical & Health Research Ethics of South East Norway,

Section C

Tone Transeth Mosling

Executive Officer

Appendix III

REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst C	Anders Strand		26.04.2021	31640
			Deres referanse:	

Monica Klungland Torstveit

The FUEL program

Forskningsansvarlig: Universitetet i Agder

Søker: Monica Klungland Torstveit

REKs vurdering

REK viser til endringsmelding mottatt 20.04.2021, for prosjekt 31640 «The FUEL program». Komiteleder for REK sør-øst C har vurdert meldingen på fullmakt fra REK sør-øst C, med hjemmel i helseforskningsloven §11.

De omsøkte endringene er begrunnet ved behov for dels omfattende justeringer og tilpasninger som følge av den pågående Covid-19 situasjonen. Endringene er godt oppsummert i endringsmeldingen, og inkluderer:

- Bård Erlend Solstad (UiA), Finn Skårderud (UiA) og Siri-Marte Hollekim Strand (NTNU) inkluderes som prosjektmedarbeidere. Komiteen har ingen forskningsetiske innvendinger til dette.
- Endringer av selve FUEL programmet, slik at dette kan gjennomføres under de gjeldende smittevernsrestriksjoner. Dette innebærer blant annet at flere laboratorieundersøkelser utgår. Oversikt over endringene fremgår av endringsmeldingen med vedlegg.

I lys av den pågående Covid-19 situasjonen vurderer komiteen endringene som hensiktsmessige og forsvarlige, og godkjenner derfor disse.

Videre viser komiteen til sitt svar på fremleggingsvurdering 267365, av 26.04.2021, hvor en kvalitativ delstudie, som ble omsøkt i en tidligere versjon av endringsmeldingen, vurderes til å falle utenfor helseforskningslovens virkeområde.

Vedtak

Godkjent

Komitéen har vurdert endringsmeldingen og godkjenner prosjektet slik det nå foreligger med hjemmel i helseforskningslovens § 11.

Tillatelsen er gitt under forutsetning av at prosjektendringen gjennomføres slik det er beskrevet i prosjektendringsmeldingen og endringsprotokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Vennligst oppgi vårt referansenummer i korrespondanse.

Med vennlig hilsen,

Britt Ingjerd Nesheim
Prof. Dr.med
Komiteleder, REK sør-øst C

Anders Strand
Seniorrådgiver, REK sør-øst C

Klageadgang

Du kan klage på komiteens vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes til REK sør-øst C. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst C, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering.

Appendix IV

Nedenfor står 6 utsagn om din nåværende trening.

Marker den verdi, som passer best for deg. Angi på en skala fra 1-5, hvor 1=sterkt uenig og 5=helt enig.

	1 Sterkt uenig	2 Uenig	3 Hverken enig eller uenig	4 Enig	5 Helt enig
Trening er det viktigste i mitt liv	○	○	○	○	○
Det har oppstått konflikter mellom meg og min familie og/eller min partner om hvor mye jeg trener	○	○	○	○	○
Jeg bruker trening som en måte å regulere mitt humør (for eksempel å få et kick eller slippe unna)	○	○	○	○	○
Over tid har jeg økt mengden av trening jeg gjør på en dag	○	○	○	○	○
Hvis jeg er nødt til å gå glipp av en trening, blir jeg humørsyk og irritabel	○	○	○	○	○
Selv om jeg reduserer treningsmengden min, ender jeg allikevel opp med å trene like ofte som før	○	○	○	○	○

Appendix V

Følgende spørsmål omhandler ditt forhold til mat og vekt. Spørsmålene handler kun om de siste fire ukene (28 dager).

På hvor mange av de siste 28 dagene...

Velg et svaralternativ for hvert spørsmål

	Ingen dager	1-5 dager	6-12 dager	13-15 dager	16-22 dager	23-27 dager	Alle dager
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)?	○	○	○	○	○	○	○
Har du i lengre perioder (8 våkne timer eller mer) ikke spist noe i det hele tatt for å påvirke din figur eller vekt?	○	○	○	○	○	○	○
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)?	○	○	○	○	○	○	○
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)?	○	○	○	○	○	○	○
Har du hatt et klart ønske om å ha tom mage for å påvirke din figur eller vekt?	○	○	○	○	○	○	○
Har du hatt et klart ønske om å ha en helt flat mage?	○	○	○	○	○	○	○

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)?	○	○	○	○	○	○	○
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)?	○	○	○	○	○	○	○
Har du hatt en klar frykt for å miste kontroll over spisingen din?	○	○	○	○	○	○	○
Har du hatt en klar frykt for at du kan gå opp i vekt?	○	○	○	○	○	○	○
Har du følt deg tykk?	○	○	○	○	○	○	○
Har du hatt et sterkt ønske om å gå ned i vekt?	○	○	○	○	○	○	○

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)? *

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

I løpet av de siste 28 dagene, hvor mange DAGAR 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)? *

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

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

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? *

Velg det alternativet som du synes passer best. Vær oppmerksom på at i disse spørsmålene brukes begrepet "overspisingsepisode" om å spise det andre ville synes var en uvanlig stor mengde mat i den situasjonen du var i, samtidig med en følelse av å ha mistet kontroll over spisingen.

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

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 halv-parten
- ○ Halvparten
- ○ Mer enn halv-parten
- ○ De fleste gangene
- ○ Hver gang

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)
- ○ Ikke i det hele tatt (1)
- ○ Litt (2)
- ○ Litt (3)
- ○ Ganske Mye (4)
- ○ Ganske Mye (5)
- ○ Veldig mye (6)

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)?

I løpet av de siste 28 dagene ...

	Ikke i det hele tatt (0)	Ikke i det hele tatt (1)	Litt (2)	Litt (3)	Ganske mye (4)	Ganske mye (5)	Veldig mye (6)
Har vekten din påvirket hvordan du tenker om (bedømmer) deg selv som person?	○	○	○	○	○	○	○
Har figuren din påvirket hvordan du tenker om (bedømmer) deg selv som person?	○	○	○	○	○	○	○
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?	○	○	○	○	○	○	○
Hvor misfornøyd har du vært med vekten din?	○	○	○	○	○	○	○
Hvor misfornøyd har du vært med figuren din?	○	○	○	○	○	○	○
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)?	○	○	○	○	○	○	○
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)?	○	○	○	○	○	○	○