Torunn Haugen Breivik May 16. 2013

THE ASSOCIATION BETWEEN CIRCULATING ANDROGEN HORMONES, MAXIMAL OXYGEN UPTAKE AND THE SYMPTOMS OF EATING DISORDERS AMONG FEMALE ATHLETES

BEV 3901, Master Thesis
Department of Human Movement Science
Faculty of Social Science and Technology Management
Norwegian University of Science and Technology
Trondheim, 2013

TABLE OF CONTENTS

ABSTRACT

Aim of the study: The aim was to analyse the possible associations between circulating androgen hormones, maximal oxygen uptake, and symptoms of eating disorders among female athletes.

Method: In this cross-sectional study 72 female athletes participated. The scores from the 11 scales in Eating Disorders Inventory 2 (EDI 2) were used to disclose the symptoms in traits of eating disorders (ED). A maximal oxygen uptake (VO_2max) test stated the athlete's physical endurance capacity, while fasting serum samples were collected for the analysis of circulating androgen hormones (CAH). The mean VO_2max (53.4 ml/kg/min) divided the athletes in two groups, lower and higher VO_2max. Statistics used in the analysis were descriptive, correlations, linear regression and independent-samples t-tests (P-value <0.05 were considered significant).

Results: The athletes' scored higher on the scales Perfectionism (P), Body Dissatisfaction (BD) and Drive for Thinness (DT) compared with the other scales in EDI 2. In the linear regression analysis of the scale Perfectionism and the hormone andostenedione, the result was statistically significant ($p = 0.019$). The athletes with lower VO_2max (<53.4 ml/kg/min) tended to score higher on all the scales in EDI 2 and CAH compared with the athletes having higher VO_2max (>53.4 ml/kg/min), except in the scales Maturity Fears (MF) and Asceticism (A), but the results between the groups were not statistically significant.

Conclusion: The result was statistically significant between the scale Perfectionism and the hormone androstenedione. The female athletes with higher VO_2max tended to score lower on both EDI 2 and the CAH.

Keywords: Circulating androgen hormones (CAH), Eating Disorders (ED), Female Athlete, Maximal Oxygen Uptake (VO_2max), Eating Disorder Inventory 2 (EDI 2).

PREFACE

This master thesis is part of a larger study called ”The Female Competitiveness Study”. The aim for that study is to investigate the possible association between circulating androgen levels in female top athletes and physical capacity (power and endurance), competitiveness, body composition, bone density, eating disorders, menstrual disturbances, mental health and sexual preferences. At this stage totally 73 female athletes have been included in the study. In the master thesis only the association between eating disorders, circulating androgen hormones and physical endurance capacity will be analysed.

Departments that have been involved in this study are: Faculty of Social Sciences and technology Management- Department of Movement Science, Faculty of Social Sciences and technology Management- Department of Psychology, Faculty of Medicine- Unit for Applied Clinical Research- NTNU and Department of Endocrinology St. Olavs Hospital, Centre for Elite Sport Research- Faculty of Social Sciences and technology Management- Department of Movement Science and Olympiatoppen Mid-Norway.

AKNOWLEDGEMENT

First of all I would like to thank my supervisor Professor Liv Berit Augestad and co-supervisor Professor Sven M. Carlsen for allowing me to be a part of the study, and providing good instructions and guidance throughout the work with my master thesis. I would also like to thank Knut Skovereng for his contribution and helpfulness with the data collection.

I also appreciate the good teamwork and support from peer masters students, Brit Dregelid, Cathrine Aa Dahlen and Silje Øyre Slind throughout the master process.
My gratefulness goes to family, friends and fellow students for good support and encouragement throughout the year when writing my thesis.

Finally, I would like to thank the 72 female athletes for participating in this study.

TERMS AND ABBREVIATIONS

The following terms and abbreviations will be used in this thesis:

- Eating Disorders (ED)

- Bulimia Nervosa (BN): 1) Binge eating at least twice a week, 2) lack of control over eating behaviour during the binge, 3) self-induced vomiting, use of laxatives or diuretics, strict dieting or fasting, or vigorous exercise in order to prevent weight gain, 4) persistent over concern with body weight- and shape. The binge eating and inappropriate compensatory behaviours must occur at least twice a week for three months for being diagnosed (*DSM-IV ™, Diagnostic and Statistical Manual of Mental Disorders*, 2005).

- Anorexia Nervosa (AN): 1) Refuse to maintain a normal body weight, 2) intense fair to gain weight even though underweight, 3) disturbed experience with body weight, size or shape or, 4) amenorrhea in females (*DSM-IV ™, Diagnostic and Statistical Manual of Mental Disorders*, 2005).

- Eating disorder not otherwise specified (EDNOS): Reserved for those who not meet the criteria for a specific eating disorder but who for example; 1) engage in self-induced vomiting in the absence of binge eating, 2) have all of the features of BN, but fail to meet the frequency criterion for binge eating, or 3) meet all the criteria for AN except the absence of menses (*DSM-IV ™, Diagnostic and Statistical Manual of Mental Disorders*, 2005).

- Eating Disorder Inventory 2. (EDI 2): A Standardized self-reported questionnaire

- Body Dissatisfaction (BD): Measure the dissatisfaction with the overall shape and with the size of those regions of the body that are of greatest concern to those with eating disorders (i.e., stomach, hips, thighs).

- Drive for Thinness (DT): Manifestation of an intense drive to be thinner or fear of fatness, and assess excessive concern with dieting, preoccupation with weight, and fear of weight gain.

- Maturity Fears (MF): Access the desire to retreat to the security of childhood.

- Interoceptive Awareness (IA): Measure confusion and apprehension in recognising and accurately responding to emotional states.

- Perfectionism (P): Measure the extent to which ones believe that personal achievements should be superior.

- Interpersonal Distrust (ID): Assessing the individual´s general feeling of alienation and reluctance to form close relationships, and the person´s reluctance to express thoughts and feelings to others.

- Impulse Regulation (IR): Assessing the tendency towards impulsivity, substance abuse hostility, destructiveness in interpersonal relationships, and self-destructiveness.

- Social Insecurity (SI): Measures the belief that social relationships are tense, insecure, disappointing, unrewarding, and generally of poor quality.

- Asceticism (A): Measure the tendency to seek virtue through the pursuit of spiritual ideals such ass self-discipline, self-denial, self-restraint, self-sacrifice, and control of bodily urges.

- Amenorrhea: The absence of a menstrual period for more than 6 months in a woman of reproductive age (Lindeberg et al., 1984).

- Oligomenorrhea: Menstrual periods >35 days, with only four to nine periods within a year.
- Oral Contraceptives (OC)

- Progesterone: It is a steroid hormone involved in the female menstrual cycle and pregnancy.

- Estradiol: Is the most potent estrogen of a group of endogenous estrogen steroids.

- Hypoestrogenism: The state of having reduced estrogen levels.

- Androgen Hormones: Steroid hormones that control the development and maintenance of masculine characteristics.

- Hyperandrogenism: The state of having increased androgen levels.

- Fri Testosterone Index (FTI): Calculated as (testosterone nmol/L/SHGB nmol/L) • 10. FTI is considered a good measure of free testosterone in the circulation, i.e. testosterone that is biologically active and exerts testosterone effects.

- 3-alfa-diol glucoronid (ng/mL) (ADG): A metabolite of testosterone and androstenedione.

- Androstenedione (nmol/L): Common precursor of male and female sex hormones.

- Circulating Androgen Hormones (CAH): Refers to FTI, ADG and Androstenedione to in the blood.

- Maximal oxygen uptake (VO_2max): The most valid measure of endurance capacity, measured in ml/kg/min.

- Respiratory Exchange Ratio (RER): Refers to the ratio of carbon dioxide produced to oxygen consumed.

INTRODUCTION

Athletic participation may have preventive benefits and harmful effects considering eating disorders (ED) (J. Sundgot-Borgen & Torstveit, 2004). The athlete's positive outlook of life and high self-efficacy may work as protective factors for disordered eating (Martinsen, Bratland-Sanda, Eriksson, & Sundgot-Borgen, 2010). Good performance and the feeling of accomplishing one´s goal may increase an athlete's self-esteem and make them feel more successful. The positivity of being part of a group may provide a feeling of belongingness, enjoyment and well-being. However an athlete's life may be stressful, especially when considering their dieting, travelling, excessive training, physiological and psychological stress (Augestad & Flanders, 2002; M. Fogelholm & Hiilloskorpi, 1999).

In many sports female athletes may become concerned about their body shape even though adolescent athletes often represent the idealistic physical perfection (Martinsen et al., 2010). However, some athletes do not fulfil the demands of the sport specific "ideal" body composition, and may feel pressured to achieve the perfect body type (Augestad & Flanders, 2002). Body image disturbances may also cause distress and negatively affect athletes´ mental health (A. Rickenlund, Carlström, Brismar, von Schoultz, & Lindén Hirschberg, 2003).

The knowledge about the benefits of keeping a lean body and high body muscle mass to achieve optimal performance may push the limits of leanness (Augestad & Flanders, 2002; Davis & Cowles, 1989; Hagmar, Berglund, Brismar, & Hirschberg, 2009; Martinsen et al., 2010). In turn, this may get out of control and can unfortunately lead to a disturbed-eating pattern (J. Sundgot-Borgen & Torstveit, 2004). Female athletes, competing in aesthetic and endurance sports, may therefore have a higher prevalence of ED compared with non-athletes (Bennell, Malcolm, Wark, & Brukner, 1997; Smolak, Murnen, & Ruble, 2000; J. Sundgot-Borgen & Torstveit, 2004; Van Durme, Goossens, & Braet, 2011).

Eating Disorders

When researching the link between female athletes and why they may suffer from ED evidence suggests women with anorexia nervosa may self-select into competitive sports, as a low bodyweight is preferable. A link between ED and female athletes may therefore occur (Redman & Loucks, 2005). Risk factors that may trigger the development of eating-related disorders could be as follows; dissatisfaction with weight and body composition together with sport specific training, injury and couching behaviour (Martinsen et al., 2010).

There may also be several health risks associated with eating disorders, like lack of nutrients and the possible influence on bone health (Cobb et al., 2003). Further, psychological problems associated with disturbed eating patterns may include low self-esteem, depression, and anxiety disorders (Heather & Kimberly, 2004). Medical complications due to low energy availability may include cardiovascular, endocrine, reproductive, skeletal, gastrointestinal, renal, and central nervous system problems (Nattiv et al., 2007).

A disturbed eating pattern may affect the menstrual cycle (J. Sundgot-Borgen & Torstveit, 2004), which in turn may result in oligomenorrhea or amenorrhea (Rich-Edwards et al., 2002). Reproductive disorders like menstrual disturbances may occur, as the female reproductive system is highly sensitive (Gudmundsdottir, Flanders, & Augestad, 2011; Warren & Perlroth, 2001). Several studies conclude hypothalamic inhibition due to ED, low amount of body fat or caloric deficiency, chronic energy and carbohydrate deficiency to be main factors. (Jenkins et al., 1993; A. Loucks et al., 1992; A. B. Loucks, 2004; Myerson et al., 1991; Tomten & Høstmark, 2006). However, other explanations of what may cause menstrual disturbances are also possible.

Circulating Androgen Hormones and Maximal Oxygen Uptake

Circulating androgen hormones (CAH) may be influenced by several factors, such as menstrual cycle phase, oral contraceptives, age, diet, and chronic physical activity (C. Enea, Boisseau, Fargeas-Gluck, Diaz, & Dugue, 2011).

Hyperandrogenism may be associated with athletes engaging in sports that emphasize strength over leanness (Warren & Perlroth, 2001). In swimming, muscle strength is necessary to achieve optimal performance compared with long-distance endurance athletes for example (Coste et al., 2011; A. Rickenlund et al., 2003). Hyperandrogenic symptoms have been found among high-level female swimmers (Coste et al., 2011). However, other scientists present findings of an association between menstrual disturbances and mild hyprandrogenism in female endurance athletes (Hagmar et al., 2009; A. Rickenlund et al., 2003). Rickenlund et al., claim it is surprising that both swimmers and long-distance endurance athletes may experience hyperandrogenism, as their body composition may differ from each other (2003). Further hyperandrogen conditions may be one of the underlying affection causing menstrual disturbances often seen in athletes (A. Rickenlund et al., 2003; Anette Rickenlund, Eriksson, Schenck-Gustafsson, & Hirschberg, 2005).

Female athletes with hyperandrogenism may be selected into competitive sports, as their physiological situation often provides athletic advantages. Androgen hormones may increase the chance of achieving a higher maximal oxygen uptake together with muscle strength (Hagmar et al., 2009; A. Rickenlund et al., 2004). These factors may lead to increased physical performance and increased performance in the athlete's sports. A. Rickenlund et al., suggest a correlation between short-term use of oral contraceptives (OC), which increase estrogen levels, and a reduction in the maximal oxygen uptake (2004). It is therefore possible that a reduction in estrogen may provide benefits considering increased maximal oxygen uptake.

It may be difficult to classify athletes and their performance on VO_2max as high or low, as there are different demands in each sport. Examples of VO_2max measured among female elite athletes are; Judo: 41.6 ± 4.2 ml/kg/min, Handball: 51.3 ± 2.3 –

53.8 ± 2.7 ml/kg/min and cross-country skiers: 57.9 ± 61.5 ±1.1 ml/kg/min (Heller et al., 1998; Jensen, Jacobsen, Hetland, & Tveit, 2007; Losnegard et al., 2011).

Evidence also promotes a possible association between circulating hormone levels and ED (Klump, Keel, Culbert, & Edler, 2008; Oinonen & Bird, 2012), and there may be a link between elevated testosterone and binge eating. Madrid, J.A et al., found increased food intake and body weight in female rats after being prenatally exposed to testosterone (1993). Dixon, D.P et al., found a correlation between circulating estrogens and a decrease in food intake together with increased physical activity (2003). As progesterone seems to cause increased food intake, the same patterns are seen in binge eating women. Binge-eating is often observed during the menstrual-cycle phase when estradiol levels are low and progesterone levels high (Klump et al., 2008; Roberts, Kenney, & Mook, 1972; Varma et al., 1999). Therefore, females with progesterone levels above normal may feel they eat too much due to increased hunger, which may trigger the development of disturbed eating.

Even though hyperandrogenism may be beneficial due to performance in sports, related health consequences may occur. Menstrual disturbances, increased risk of infertility, bone mineral density (A. Rickenlund et al., 2003), cardiovascular diseases (Legro, 2003), together with decreased psychological well-being (C. Enea et al., 2011), are some of the risks related with hyperandrogenism.

Aim of the Study

As there is evidence pointing towards a link between female athletes participating in competitive sports, circulating androgen levels and the risk of developing symptoms of eating disorders, this study aims to investigate the research questions following:

1) Is there an association between circulating androgen levels in female athletes and their likelihood of having symptoms of ED?
2) Is there an association between a female athlete's maximal oxygen uptake and the level of circulating androgen hormones?
3) Is there an association between the maximal oxygen uptake and the symptoms of ED among the female athletes?

METHOD

Design

This study is a cross sectional study of female athletes in Sør-Trøndelag County, Norway.

Participants

Thirty-four female athletes from competitive sports supervised by Olympiatoppen Mid-Norway, were recruited to the project from September 2011 to February 2012. In addition, 39 female athletes were invited to participate during the fall 2012. The participants were all located within Sør-Trønderlag, and belonged to different sports such as soccer, handball, triathlon, cross country skiing, biathlon, discus, figure skating, aerobics, taekwondo, bicycling and power lifting. Handball (n =17), football (n =24) and cross-country skiing (n =17) were the three main groups of sports.

Women that were pregnant, breast-feeding or unfit to participate for any reason were excluded from the study to avoid misleading results. In total 73 female athletes were recruited for this study. The participants were aged between 18 to 36 years, and the mean age was 22.6 years. Due to incomplete data, one subject was left out of further analysis. Final analyses therefore included 72 female athletes. Five of the participants did not take blood samples, but were still kept for further analysis. It was of primary interest to keep all of the participants that answered the EDI 2.

Procedure

First the athletes received information about the study. The participants meet at Dragvoll Sports Centre to sign the consent form. After an agreement to participate, the participants individually filled out and handed in questionnaires. The same master student was present through the whole process, and was able to clarify any misunderstandings in the questionnaire.

Thereafter physical tests were performed in the human movement laboratory at Dragvoll, NTNU. Three masters students shared the implementation of testing the

participants. At least two of the three masters students had to be present during the tests. Thereafter, participants were scheduled for collection of blood samples and DEXA scan.

Measurements

ANTHROPOMETRIC DATA

Both height and body weight were measured prior to the physical tests. Body weight was measured using a digital scale, weighted to the nearest kilogram (kg). The masters students also measured height by using a scale, measured to the nearest centimetre (cm). The body mass index (BMI) was calculated from measured height and weight, using a calculation for BMI: Weight (kg)/height^2 (m) (Shenkman, Shir, & Brodsky, 1993).

MAXIMAL OXYGEN UPTAKE

Maximal aerobic capacity was measured after a 15 min warm up, running with individual incline on the treadmill at proximally 60 % of maximal heart rate (HRmax). The HR was measured, using a Polar Rs800. VO_2max was measured according to a traditional method of monitoring elite endurance athletes in Norway (Sandbakk, Welde, & Holmberg, 2011). The test duration was two to six minutes, performed at a constant inclination of 10.5 %. Each subject had an individual starting speed, and the speed was increased with 1 km·h-1 every minute until "voluntary" exhaustion. VO_2max was measured through gas exchange, using an Oxycon Pro (Jaeger GmbH, Hoechberg, Germany), with a sample frequency at 0.1 Hz. All of the equipment was calibrated before use.

The test is considered to be a maximal effort test, and was counted as valid if two of the following three criteria were met: 1) a plateau in VO_2 with increased speed, 2) respiratory exchange ratio (RER) above 1.10, or 3) blood lactate concentration exceeding 8mmol·L-1. Oxygen uptake was measured continuously, but the average of the three highest 10-s consecutive measurements determined the VO_2max, and is presented as VO_2max throughout this thesis. Blood lactate samples were taken immediately after finishing the test.

SERUM SAMPLES OF HORMONES

Fasting serum samples were drawn for analyses within one to five days after completing physical tests. Serum samples used for analysis in this thesis are: ADG (3-alfa-diol glucoronide (ng/mL)), FTI (Free testosterone index nmol/L/SHGB nmol/L) • 10) and androstenedione (nmol/L). These are classified as CAH. Analyses were completed in a research laboratory at the Department of Laboratory Medicine, Women´s and Children´s Health, Faculty of Medicine, NTNU.

As different methods are used when analysing hormones, it may be misleading to use one specific reference value. ADG is an androgen metabolite, and is rarely used in routine practice, and a reference value was not available to us. For FTI, values >0.5 are usually classified as high values when testosterone is measured the way we did. The method for analysing androstenedione yeld values similar to the method used in St Olavs Hospital. Reference values for androstenedione was defined as 1.5- 7.9 nmol/L (St. Olavs lab manual).

Free Testosterone Index (FTI) ≥ 0.5 was defined as biochemical hyperandrogenism.

EATING DISORDER INVENTORY-2 (EDI-2)

This questionnaire is suitable only for screening purpose, and cannot be used in diagnosing eating disorders.

The first version of the Eating Disorder Inventory (EDI) comprised 64 items rated on a 6-point scale, and subdivided into eight subscales. Three of the subscales measure central eating disorder symptoms: Drive for Thinness (DT), Body Dissatisfaction (BD), and Bulimia (B), while the additional five subscales measure psychological correlations associated with eating disorders: Maturity Fears (MF), Ineffectiveness (I), Interoceptive Awareness (IA), Perfectionism (P) and Interpersonal Distrust (ID). The second version of the EDI, named Eating Disorder Inventory 2 (EDI-2) has been expanded with 27 items on three subscales: Impulse Regulation (IR), Social Insecurity (SI) and Asceticism (A) (Nevonen, Clinton, & Norring, 2006).

The EDI-2 is a valid multidimensional self-report instrument that values the characteristics of eating disorders and related psychological apprehensiveness (Ackard, Croll, & Kearney-Cooke, 2002). Is consists of a 91 item Likert scale

questionnaire, having 11 subscales which assess attitudinal, behavioural, and psychological symptoms of eating disorders (Heather & Kimberly, 2004).

The scoring system is divided in a range weighted from 0 to 3,where Always=3, Usually=2, Often=1, Sometimes=0, Rarely=0, Never=0, while reversed scores are opposite (Never =3, Rarely=2, Sometimes=1, Often=0, Usually=0, Always=0). A scoring key for EDI 2 was used to identify if the items were keyed in a positive or negative direction out of the options within each question. Each of the 11 scales provide continuous scores, and a higher score, regardless of the context, may disclose an increased concern related to eating and body shape as well as risk in traits of ED (Garner, 1990).

D. Garner (1990) suggests that females scoring high on the scales Drive for Thinness (DT) and Body Dissatisfaction (BD) may be at increased risk for developing eating disorders in the future. The cutoff score for DT is often set at >14. However, a specific cutoff score for DT may not be recommended. The same author suggests that norm samples of raw scores among non-patient college females (N=770) may be DT: 19, BD: 26, B: 14, MF: 11, I: 16, IA: 14, P: 15, ID: 11, IR: 16, SI: 12 and A: 10. All scores higher than the mentioned above may indicate an increased risk considering symptoms of ED, and may be comparable with the athlete's score on the scales in EDI 2.

Statistical Analysis

Statistical analyses were performed using IBM SPSS version_19. Results from EDI 2 were collected and computed into 11 subgroups. Descriptive measures were calculated and expressed as means, standard deviation (SD) and range. A scale of EDI 2 max score was created for further analysis. Missing values in EDI 2 were replaced with means from each of the scales in EDI 2, found by frequency analysis.

First correlations between all of the variables were done, viewed as Pearson correlation (r) and statistically significance values ($p < 0.05$). Linear scatter plots with regression lines presented variables of particular interest.

Then, a linear regression analysis was done, adjusted for BMI and age. The results from variables of primary of interests were presented in a table as β-value, p-value (statistical significant at <0.05) and 95% confidence interval (CI).

Further, the athletes were divided by the mean VO_2max (54.3 ml/kg/min), and classified with lower or higher VO_2max. The main reason for this was due to the fact it is possible not all of the participants were qualified as top athletes in their sport, especially among the handball players. Analyses included independent samples t-tests to study the difference between EDI 2 and CAH, with the participants being divided, classified with lower VO_2max (<53.4 ml/kg/min) and higher VO_2max (>53.4 (ml/kg/min). Values were presented as means ± SD and p-value (significant when <0.05).

Ethics

The Regional Ethical Committee in Mid-Norway (REK) approved the research project. All of the participants received a letter of information and all participants signed an informed consent before inclusion in the study. All data was analysed and treated confidentially, and the subjects had the opportunity to withdraw from the project at any time.

RESULTS

Demographic Characteristics

The main demographic characteristics of the participants are presented in Table 1. Further, 56 of the subjects were single, 3 married, and 9 living with their partners. Only 3 had children. In total, 25 of the subjects were ranked within the top 10 of their sport nationally, while 48 of the subjects were ranked within the top 10 of their sport regionally. Following the body mass index (BMI) definitions from World Health Organization (WHO) (Consultation, 2000), 54 of the subjects were classified with normal weight (BMI 18.5- 24.9 kg/m^2). Further, 16 subjects were classified as overweight (BMI 25.0- 29.9 kg/m^2), while one of the subjects (power lifting) was classified as obese with a BMI >30 kg/m^2. None of the subjects were classified as underweight (BMI<18.5 kg/m^2). Among the participants the VO_2max was lowest in handball and highest in bicycling.

Table 1. Descriptive statistics of study participants presented as mean ± SD and range

Female athletes (N = 72)	Mean ± SD	Range
Age (yr.)	22.6 ± 4.2	(18.0-36.0)
Body weight (kg) [a]	66.0 ± 9.6	(48.0-91.0)
Height (cm) [a]	169.2 ± 6.3	(156.0-183.0)
BMI (kg/m^2) [a]	23.1 ± 2.7	(19.1-30.6)
VO_2max (ml/kg/min) [aa]	53.4 ± 7.3	(38.8-67.7)

[a] = N 71, [aa] = N 70. Average of the three highest 10-seconds consecutive measurements determines the VO_2max.

Eating Disorder Inventory 2

The total scores for each of the 11 scales in Eating Disorder Inventory (EDI 2) are presented in Table 2. Drive for Thinness (DT) mean: 1.6 ± 3.5, Body Dissatisfaction (BD) mean: 4.6 ± 6.5, and Perfectionism (P) mean: 4.6 ± 2.9, were the three scales the athletes scored highest. Interestingly, the subjects with the highest score in DT (21) and BD (25) were both soccer players and were classified with a normal weight (BMI at 24.0 and 24.2 kg/m^2). The association between the scale DT and VO_2max is presented in a scatter plot in Figure 1A ($p = 0.93$, $r = 0.01$), while the association between BD and VO_2max is presented in Figure 1B ($p = 0.87$, $r = 0.02$). Statistically significant at <0.05.

Table 2. The female athletes scores of EDI 2 presented for each scale as mean± SD and range.

EDI 2 (N = 72) Scales	Max score on each scale	Mean ± SD	Range
Drive for thinness (DT)	21	1.6 ± 3.5	(0-21.0)
Body Dissatisfaction (BD)	27	4.6 ± 6.5	(0-25.0)
Bulimia (B)	21	0.5 ± 1.2	(0-8.0)
Maturity Fears (MF)	24	2.2 ± 2.3	(0-12.0)
Ineffectiveness (I)	30	1.0 ± 3.1	(0-20.0)
Interoceptive Awareness (IA)	30	1.1 ± 3.0	(0-20.0)
Perfectionism (P)	18	4.6 ± 2.9	(0-12.0)
Interpersonal Distrust (ID)	21	1.1 ± 2.2	(0-14.0)
Impulse Regulation (IR)	33	1.1 ± 1.9	(0-12.0)
Social Insecurity (SI)	24	1.4 ± 2.5	(0-15.0)
Asceticism (A)	24	2.7 ± 1.9	(0-10.0)
Total EDI 2	273	21.7 ± 22.4	(4.0-136.0)

Total EDI 2 = Summation of all the 11 scales in EDI 2
Max score on each scale = The highest possible score within each of the scales in EDI 2

Serum Samples of Circulating Androgen Hormones

Table 3 show the fasting serum samples of the Circulating Androgen Hormones (CAH). One outlier was found in each of the hormones. Nine of the participants had a FTI >0.5, and the highest value in FTI were found among the cross-country skiers. A football player scored highest in ADG, while the two next values was found among cross-country skiers (6.3 ng/mL and 7.6 ng/mL). A handball player scored highest in androstenedione, and when comparing values with the normal values presented by St Olavs Hospital lab manual, 44 of the female athletes had androstenedione values above the reference range.

Table 3. Fasting serum samples presented as mean ± SD and range

Hormones (N = 67)	Mean ± SD	Range
ADG (ng/mL)	3.4 ± 1.9	(1.26-13.77)
FTI	0.3 ± 0.3	(0.05-0.98)
Androstenedione (nmol/L)	10.3 ± 4.0	(5.62-32.13)

ADG (3-alfa-diol glucoronid nmol/L), FTI (testosterone nmol/L/SHGB nmol/L) • 10), Androstenedione_1 (ng/mL).

Linear Regression between CAH, VO_2max and EDI 2

Table 4 show the linear regression analysis between CAH, VO_2max and the scales of primary interest in EDI 2: Drive for Thinness (DT), Body Dissatisfaction (BD), Perfectionism (P) and total EDI 2. A positive statistically significant association was found between the hormone androstenedione and the scale Perfectionism (P) ($p = 0.019$, $\beta = 0.388$). The same result is also presented in Figure 1C as scatter plot ($r= 0.285$).

The linear regressions were adjusted for BMI and age, however the adjustments did not remarkably affect the variables.

Table 4. Linear regression between EDI 2, VO_2max and Circulating Androgen Hormones Presented as β, p-value and 95% Confidence Interval

Variables	β	p-value	95% CI
ADG [1]			
Drive for Thinness (DT)	-0.033	0.629	(-0.169-0.103)
Body Dissatisfaction (BD)	-0.016	0.686	(-0.097-0.064)
Perfectionism (P)	0.023	0.786	(-0.144-0.190)
Total EDI 2	-0.008	0.531	(-0.035-0.018)
FTI [1]			
Drive for Thinness (DT)	-0.001	0.898	(-0.015-0.013)
Body Dissatisfaction (BD)	-0.005	0.265	(-0.004-0.030)
Perfectionism (P)	0.013	0.130	(-0.004-0.030)
Total EDI 2	0.000	0.887	(-0.003-0.003)
Androstenedione [1]			
Drive for Thinness (DT)	-0.098	0.479	(-0.372-0.018)
Body Dissatisfaction (BD)	-0.101	0.213	(-0.262-0.060)
Perfectionism (P)	0.388	0.019*	(0.065-0.712)
Total EDI 2	-0.001	0.979	(-0.055-0.053)
VO_2max [1]			
ADG	-0.165	0.726	(-1.100-0.771)
FTI	-3.996	0.374	(-12.907-4.915)
Androstenedione	-0.199	0.393	(-0.661-0.263)
VO_2max [1]			
Drive for Thinness (DT)	0.021	0.933	(-0.473-0.515)
Body Dissatisfaction (BD)	0.022	0.876	(-0.253-0.296)
Perfectionism (P)	-0.419	0.168	(-1.020-0.181)
Total EDI 2	-0.022	0.574	(-0.100-0.056)
Total EDI 2 [1]			
FTI	-1.564	0.887	(-23.531-20.403)
ADG	-0.723	0.513	(-3.018-1.517)
Androstenedione	-0.015	0.979	(-1.153-1.123)
VO_2max	-0.211	0.574	(-0.958-0.536)

[1] = Dependent variable. FTI= (testosterone nmol/L/SHGB nmol/L • 10), ADG=3-alfa-diol glucoronid (ng/mL), Androstenedione= (nmol/L). VO_2max= ml/kg/min. *Results are statistically significant at <0.05. β= beta (standardised regression coefficient). Cl= 95% Confidence Interval.

Linear Scatter Plots of Drive for Thinness (DT), Body Dissatisfaction (BD) and Perfectionism (P)

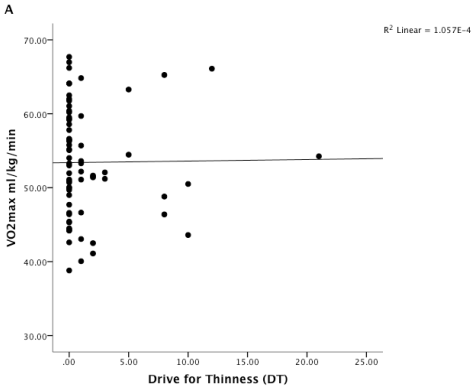

Figure 1 A
The association between the scale Drive for Thinness (DT) and VO_2max

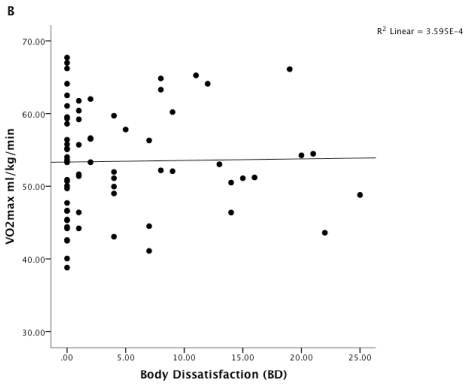

Figure 1 B
The association between the scale Body Dissatisfaction (BD) and VO_2max

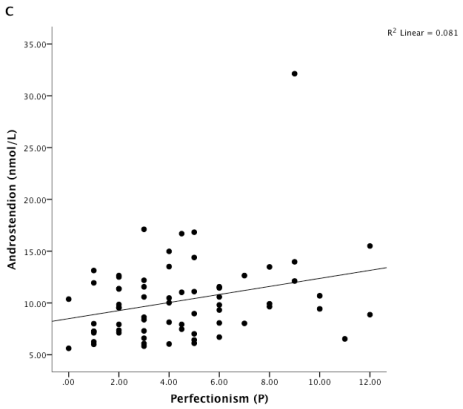

Figure 1 C
Statistically significant relationship between the scale Perfectionism (P) and the hormone androstenedione

The association between EDI 2, CAH and Lower or Higher VO_2max

Table 5 shows the difference between the scores on scales in EDI 2 and CAH, when VO_2max <53.4 ml/kg/min and VO_2max >53.4 ml/kg/min divided the athletes in two groups.

Out of the 11 scales in EDI 2, the athletes scored highest in the scales Drive for Thinness (DT), Body Dissatisfaction (BD), Perfectionism (P), Maturity Fears (MF) and Ascetisism (A). The athletes with VO_2max >53.4 ml/kg/min had higher mean scores on all the scales, except from the scales MF and A.

The athletes with VO_2max<53.4 ml/kg/min had higher mean values in androstenedione, FTI and ADG compared with the athletes having VO_2max >53.4 ml/kg/min. The largest mean difference was seen in the hormone androstenedione (see Table 5).

Table 5. Female athletes spilt by lower and higher VO_2max: Scores of subscales in EDI 2 and circulating androgen hormones presented as mean ± SD, t-value, df and p-value

VO_2	VO_2max <53.4 (ml/kg/min) (N = 37)	VO_2max >53.4 (ml/kg/min) (N = 33)			
Scales EDI 2	Mean (SD)	Mean (SD)	T-value	df	p-value
Drive for Thinness	2.16 ± 4.39	1.06 ± 2.38	1.32	56.0	0.1
Body Dissatisfaction	5.18 ± 6.65	3.66 ± 6.14	0.99	68.0	0.3
Bulimia	0.59 ± 1.58	0.15 ± 0.44	1.62	42.1	0.1
Maturity Fears	2.10 ± 2.72	2.46 ± 2.06	-0.61	68.0	0.5
Ineffectiveness	1.53 ± 4.21	0.36 ± 0.99	1.64	40.4	0.1
Interoceptive Awareness	1.51 ± 4.03	0.67 ± 1.29	1.15	68.0	0.2
Perfectionism	4.68 ± 3.04	4.37 ± 2.87	0.45	68.0	0.6
Interpersonal Distrust	1.16 ± 2.56	0.96 ± 1.59	0.37	68.0	0.7
Impulse Regulation	1.44 ± 2.52	0.76 ± 1.06	1.49	49.5	0.1
Social Insecurity	1.65 ± 2.74	0.01 ± 2.10	1.09	68.0	0.2
Asceticism	2.68 ± 2.24	2.88 ± 1.35	-0.45	68.0	0.6
Total EDI 2	24.8 ± 29.16	18.4 ± 11.60	1.20	48.1	0.3
Hormones	(N=33)	(N=32)			
ADG (ng/mL)	3.61 ± 2.45	3.40 ± 1.42	0.42	63.0	0.6
FTI	0.29 ± 0.23	0.24 ± 0.17	0.84	63.0	0.4
Androstenedione (nmol/L)	10.81 ± 4.78	9.69 ± 3.04	1.13	63.0	0.2

*Results are statistically significant at <0.05. FTI =(testosterone nmol/L • 10/SHBG nmol/L), ADG= 3-alfa-diol glucoronid.

The Female Athletes Compared with Raw Scores Among College Females

One of the 72 athletes scored higher than 14 on the scale DT (Garner, 1990). In each of the separate scale one person was scoring above the raw score in the following subscales: Drive for Thinness (DT), Body Dissatisfaction (BD), Maturity Fears (MF), Interpersonal Distrust (ID), Social Insecurity (SI), and Asceticism (A), while two females athletes were scoring above the raw scores in each of the separate scales: Interoceptive Awareness (IA) and Ineffectiveness (I).

The highest scores in the 11 subscales, classified as high compared with the non-patient college females, was found among female athletes with VO_2max <53.4 ml/kg/min, except in the scale Perfectionism (P).

DISCUSSION

The aim was to analyse the possible association between circulating androgen hormones (CAH), VO_2max and the symptoms of eating disorders (ED) among female athletes. The main finding was statistically significant result between the scale Perfectionism (P) and the hormone androstenedione in the linear regression analysis. The athletes scored high on the scales Perfectionism (P), Body Dissatisfaction (BD) and Drive for Thinness (DT) in EDI 2. The female athletes classified with lower VO_2max (<53.4 ml/kg/min) tended to score higher on the scales in EDI 2 and CAH compared with those having higher VO_2max (>53.4 ml/kg/min).

The Association Between Levels of CAH and Symptoms of ED

The athletes scored high in the scale Perfectionism (P), and in the linear regression the scale P was statistically significant with androstenedione. The female athletes that had the highest sum score in EDI 2 also tended to have the highest levels of CAH.

Perfectionism has been defined as a setting of unrealistic, excessively high standards in relation to one´s goals and expectations (Haase, Prapavessis, & Glynn Owens, 2002). Even though perfectionism is viewed as eating-disorder related due to weight, shape concerns, and dieting (Rouveix, Bouget, Pannafieux, Champely, & Filaire, 2006), it is not surprisingly that the female athletes scored high on the scale. Athletes may strive towards perfectionism to maximise successful performance and accomplishing the balance between excessive hours of training, nutrition and recovery (Barnett, 2006). Athletic participation may help the athletes to cope with psychosocial challenges in life (Tamminen, Holt, & Crocker, 2012), and may be preventive considering the symptoms of ED. However, perfectionism may also have maladaptive outcomes (Flett & Hewitt, 2005), and a negative self-concept and the fear-of-failure-syndrome may be related.

When the athletes were divided into groups of lower and higher VO_2max, according to the mean (53.4 ml/kg/min), the group classified with VO_2max <53.4 ml/kg/min tended to scored higher on the scales in EDI 2 and levels of CAH. The two groups did

not differ considering the number of participants and BMI. However, the results between the groups may have been affected by limitations in addition to the athletes' body composition and what sport they represented. BMI may not be a valid measure for assessment of the female athletes body competition (Torstveit & Sundgot-Borgen, 2012), and may explain why sixteen of the athletes were classified as "overweight" (BMI >25.0 kg/m^2) according to the WHO classification (Consultation, 2000). The female athletes participated in 11 different sports, and the optimal body composition and oxygen uptake may differ among the athletes due to unlike competitive demands in the different sports (Fornetti, Pivarnik, Foley, & Fiechtner, 1999). Athletes with increased VO_2max due to excessive training, genetics and environmental factors may have less adipose tissue together with a muscular body, while athletes with lower levels of VO_2max may have more adipose tissue but also be more muscular in their body composition.

Enea et al., (2011) found that exercise may decrease circulating concentration of free and total testosterone in overweight postmenopausal women, as it seemed like weight loss may lead to a decrease in testosterone. They further suggested that when the females achieved a reduction in their adipose tissue due to exercise, the androgen concentration decreased. It is a question if the results will be the same among women in fertile age. Even though the association between levels of CAH and symptoms of ED was poor, our observation may support that there may be an association between levels of CAH and symptoms of ED among female athletes.

Only few of the female athletes scored high on the scales of EDI 2 compared with the raw scores from non-patient college females. However, patterns of scores may vary among different samples. Further, the use of cutoff scores in the scales of EDI 2 may be misleading due to classifying the athletes to have symptoms of ED. A high cutoff score may minimise the number of false positive, but increase the number of false negatives, while a low cutoff score may cause increased numbers of false positive but minimise the number of false negatives (Garner, 1990).

Further, questionnaires alone are not sufficient to classify the diagnostic criteria of clinically anorexia nervosa (AN), bulimia nervosa (BN) or subclinical eating disorders not otherwise specified (EDNOS). A clinical interview performed from an

expert is necessary to meet the gold standard for setting diagnosis. Female athletes may therefore be reported to have symptoms of ED (J. Sundgot-Borgen & Torstveit, 2004). However, the questionnaire (EDI 2) has been validated and used worldwide to screen for ED in the general population. In Norway, cultural differences have been detected. (Clausen, Rosenvinge, Friborg, & Rokkedal, 2011).

Overall the female athletes did not score high on the sum score or separate scales in EDI 2. One explanation may be misclassification of the athletes' score, as the number of high scores is lower than expected considering other publications (Redman & Loucks, 2005; Jorunn Sundgot-Borgen, 1994). Only few athletes showed symptoms of ED, as they scored high in the scales DT and BD. They were not athletes in endurance sports. The sample size of athletes participating in aesthetic and endurance sports may be too small to expect several athletes to have symptoms of ED (Patel, Greydanus, Pratt, & Phillips, 2003). Further, genetically and environmental factors may also work as protective factors considering levels of CAH and symptoms of ED.

The Association Between Maximal Oxygen Uptake and the Levels of CAH

Physical exercise may be a stimulus for the endocrine system, including type of exercise, intensity, duration and training status among the athletes (C Enea et al., 2009). There was no association between the maximal oxygen uptake and CAH among the female athletes, but females with higher VO_2max tended to score lower on the CAH. Rickenlund et al., (2003) suggests higher levels of androgen hormones to increase VO_2max and physical performance. However, Enea et al., (2009) support the results in our study, and suggest high physical activity to decrease the levels of CAH.

Nine of the athletes scored high on FTI (>0.5). In respond to the normal values for androstenedione presented by the St Olavs Hospital Lab Manual, 44 of the female athletes scored high (>7.9 nmol/L) on the hormone. If so, female athletes may tend to have higher levels of androstenedione compared with non-athletes. However those with higher level of androstenedione did not tend to have higher VO_2max, and may therefore mostly belong to team sport athletes.

The information about hormonal contraceptives or the female athletes menstrual status and was not included in this study. Rickenlund et al., (2004), found oral contraceptives (OC) had little impact on physical performance. Enea et al., (2009) claimed that OC may affect the changes in CAH. OC may decrease testosterone, free testosterone and DHEAS in healthy women at reproductive age (Davison, Bell, Donath, Montalto, & Davis, 2005; Miller et al., 2007). However, published articles documenting an association between OC´s and androgen hormones are limited and unclear.

On the other hand, the menstrual status does not remarkably affect changes in CAH, (C Enea et al., 2009). Even though there are uncertainties considering OC´s among the athletes, this study aims to analyse the association between EDI 2, CAH and VO_2max within the same period. The possible confounding due to OC´s should therefore not necessarily affect the results. However, menstrual disturbances may be related to ED (A. Rickenlund et al., 2003).

Some of the participants did not perform as we expected on the VO_2max test, especially among the handball players (Heller et al., 1998; Jensen et al., 2007; Losnegard et al., 2011). Those who performed best on the VO_2max test among the handball players may be on a higher performance level within their sport, compared to those with poorer test results. Among all the participants only 25 of the athletes were top 10 at national levels in their sport and 48 athletes were top 10 at a regional level. Again, this was one of the main reasons for dividing the group by their VO_2max. On the other hand, as we expected, the cross-country skiers provided the highest VO_2max values, and interestingly, some of them had also highest levels of the CAH. However, there was no statistically significant relationship between the levels of CAH and VO_2max. The widespread performance level among the participants may have affected the results.

The Association Between Maximal Oxygen Uptake and Symptoms of ED

The highest values on the VO_2max test were most common among the endurance athletes. Athletic participation where leanness and/or a specific weight are considered important due to performance or appearance has been associated with ED (Jorunn Sundgot-Borgen, 1994; Torstveit & Sundgot-Borgen, 2005). However, among the athletes in this study, an increased VO_2max may seem to prevent symptoms of ED. One explanation may be that increased VO_2max due to the athletic participation may provide a stable body weight, higher self esteem, improved mood, and a feeling of achieving goals together with successfulness (Fox, 1999). In contrast, as there were a widespread performance level among the athletes, evidences has suggested that lower competitive levels among athletes may reduce symptoms of ED (Martinsen et al., 2010).

The athletes did score higher on the scales DT, BD, compared with the other scales in EDI 2. Garner (1990) suggested high scores on the scale DT and BD to be most crucial due to the development of ED on a later stage in life, and classified scores above 14 on the scale DT as high. Only one athlete scored above 14 on the scale DT, even though thinness may be advantageous for achieving a higher VO_2max (Mikael Fogelholm, 1994). However, all of the participants may be in good shape due to their result on the VO_2max test (Heyward, 2010; McArdle, Katch, & Katch, 2006), compared to non-athletes at the same age (Vella, Ontiveros, Zubia, & Dalleck, 2011). At this stage, the participants may be satisfied with their body and may already feel they have achieved the optimal body size, and therefore don´t need to change for improved performance. On the other hand, if the athletic participation may prevent against symptoms of ED, injuries and long periods of specific training, together with end of their career may increase symptoms of ED (Martinsen et al., 2010) in a later stage of the athletes' life.

The achievement and desire to win and conquer has traditionally been considered as a masculine, not feminine quality. The widespread belief that "the winning male athlete has just proved his masculinity, while the winning female often needs to justify her femininity" (Schuiteman & Knoppers, 1987), may no longer hold true. The female athlete today may be muscular and in good shape and still be accepted as feminine

considering the new evolution and quote “strong is the new skinny”. However, this new “trend” may not be positive considering female athletes and the female health, but may cause additional incidences of disturbed eating, as females both have to be thin and muscular at the same time.

Strength and Limitations

A cross sectional study design has limitations. Self-reported questionnaires may pose a weakness due to underreporting, bias, inaccurate reporting, defensiveness, or denial. However, EDI 2 is a standardized self-reported questionnaire, it is economical, and it takes little time to complete (Garner, 1990).

Even though there were many participants, not all of the athletes, especially the handball players, represented the fitness levels we wanted, and may have affected the results. The same masters degree students collected all data, and may have provided similar and stable data collection among all the participants.

CONCLUSION

There was a statistically significant association between the scale Perfectionism (P) and the hormone androstenedione. None of the other scales in EDI 2 were associated with the levels of CAH, and there was no association between the scores in EDI 2 and the athletes VO_2max. However, the female athletes with VO_2max <53.4 ml/kg min tended to score higher on the scales in EDI 2 and tended to have higher levels of CAH.

We aimed to research the association between the athletes' symptoms of ED, their levels of CAH and VO_2max in a cross sectional study. Longitudinal studies are recommended.

REFERENCES

Ackard, D. M., Croll, J. K., & Kearney-Cooke, A. (2002). Dieting frequency among college females: association with disordered eating, body image, and related psychological problems. *Journal of Psychosomatic Research, 52*(3), 129-136.

Augestad, L., & Flanders, W. (2002). Eating disorder behavior in physically active Norwegian women. *Scand J Med Sci Sports, 12*(4), 248-255.

Barnett, A. (2006). Using recovery modalities between training sessions in elite athletes. *Sports medicine, 36*(9), 781-796.

Bennell, K., Malcolm, S., Wark, J., & Brukner, P. (1997). Skeletal effects of menstrual disturbances in athletes. *Scand J Med Sci Sports, 7*(5), 261-273.

Clausen, L., Rosenvinge, J. H., Friborg, O., & Rokkedal, K. (2011). Validating the Eating Disorder Inventory-3 (EDI-3): A comparison between 561 female eating disorders patients and 878 females from the general population. *Journal of psychopathology and behavioral assessment, 33*(1), 101-110.

Cobb, K. L., Bachrach, L. K., Greendale, G., Marcus, R., Neer, R. M., Nieves, J., Luetters, C. (2003). Disordered eating, menstrual irregularity, and bone mineral density in female runners. *Medicine & Science in Sports & Exercise, 35*(5), 711-719.

Consultation, W. (2000). Obesity: preventing and managing the global epidemic. *World Health Organization technical report series, 894*.

Coste, O., Paris, F., Galtier, F., Letois, F., Maimoun, L., & Sultan, C. (2011). Polycystic ovary-like syndrome in adolescent competitive swimmers. *Fertil Steril, 96*(4), 1037-1042. doi: 10.1016/j.fertnstert.2011.07.006

Davis, C., & Cowles, M. (1989). A comparison of weight and diet concerns and personality factors among female athletes and non-athletes. *Journal of Psychosomatic Research, 33*(5), 527-536.

Davison, S., Bell, R., Donath, S., Montalto, J., & Davis, S. (2005). Androgen levels in adult females: changes with age, menopause, and oophorectomy. *Journal of Clinical Endocrinology & Metabolism, 90*(7), 3847-3853.

Dixon, D. P., Ackert, A. M., & Eckel, L. A. (2003). Development of, and recovery from, activity-based anorexia in female rats. *Physiology & behavior, 80*(2), 273-279.

DSM-IV ™, Diagnostic and Statistical Manual of Mental Disorders. (2005). (Fourth Edition ed.). Washington, DC: *American Psychriatric Association.*

Enea, C., Boisseau, N., Fargeas-Gluck, M. A., Diaz, V., & Dugue, B. (2011). Circulating androgens in women: exercise-induced changes. *Sports medicine, 41*(1), 1-15.

Enea, C., Boisseau, N., Ottavy, M., Mulliez, J., Millet, C., Ingrand, I., . . . Dugué, B. (2009). Effects of menstrual cycle, oral contraception, and training on exercise-induced changes in circulating DHEA-sulphate and testosterone in young women. *European journal of applied physiology, 106*(3), 365-373.

Flett, G. L., & Hewitt, P. L. (2005). The perils of perfectionism in sports and exercise. *Current directions in psychological science, 14*(1), 14-18.

Fogelholm, M. (1994). Effects of bodyweight reduction on sports performance. *Sports medicine, 18*(4), 249-267.

Fogelholm, M., & Hiilloskorpi, H. (1999). Weight and diet concerns in Finnish female and male athletes. *Med Sci Sports Exerc, 31*(2), 229.

Fornetti, W. C., Pivarnik, J. M., Foley, J. M., & Fiechtner, J. J. (1999). Reliability and validity of body composition measures in female athletes. *Journal of Applied Physiology, 87*(3), 1114-1122.

Fox, K. R. (1999). The influence of physical activity on mental well-being. *Public health nutrition, 2*(3a), 411-418.

Garner, D. M.-P. (1990). Eating Disorder Inventory-2; professional manual. Florida U.S.A.: *Psychological Assessment Resources, Inc.*

Gudmundsdottir, S. L., Flanders, W. D., & Augestad, L. B. (2011). A longitudinal study of physical activity and menstrual cycle characteristics in healthy Norwegian women–The Nord-Trøndelag Health Study. *Norsk epidemiologi, 20*(2).

Hagmar, M., Berglund, B., Brismar, K., & Hirschberg, A. L. (2009). Hyperandrogenism may explain reproductive dysfunction in olympic athletes. *Medicine & Science in Sports & Exercise, 41*(6), 1241.

Heather, A. H., & Kimberly, D. M. (2004). Eating disorder prevalence and symptoms for track and field athletes and nonathletes. *Journal of Applied Sport Psychology, 16*(3), 274-286.

Heller, J., Peric, T., Dlouha, R., Kohlikova, E., Melichna, J., & Novakova, H. (1998). Physiological profiles of male and female taekwon-do (ITF) black belts. *Journal of sports sciences, 16*(3), 243-249.

Heyward, V. H. (2010). *Advanced Fitness Assessment and Exercise Prescription* (Sixth edition ed.). United States: Human Kinetics, P.O Box 5076, Champaign, IL 61825-5076: Human Kinetics.

Haase, A. M., Prapavessis, H., & Glynn Owens, R. (2002). Perfectionism, social physique anxiety and disordered eating: A comparison of male and female elite athletes. *Psychology of Sport and Exercise, 3*(3), 209-222.

Jenkins, P., Ibanez-Santos, X., Holly, J., Cotterill, A., Perry, L., Wolman, R., . . . Grossman, A. (1993). IGFBP-1: a metabolic signal associated with exercise-induced amenorrhoea. *Neuroendocrinology, 57*(4), 600-604.

Jensen, J., Jacobsen, S., Hetland, S., & Tveit, P. (2007). Effect of combined endurance, strength and sprint training on maximal oxygen uptake, isometric strength and sprint performance in female elite handball players during a season. *International journal of sports medicine, 18*(05), 354-358.

Klump, K., Keel, P., Culbert, K., & Edler, C. (2008). Ovarian hormones and binge eating: exploring associations in community samples. *Psychological Medicine, 38*(12), 1749-1757.

Legro, R. S. (2003). Polycystic ovary syndrome and cardiovascular disease: a premature association? *Endocrine reviews, 24*(3), 302-312.

Lindeberg, J. S., Fears, W. B., Hunt, M. M., Powell, M. R., Daniel, B., & Wade, C. E. (1984). Exercise-induced amenorrhea and bone density. *Annals of internal medicine, 101*(5), 647-648.

Losnegard, T., Mikkelsen, K., Rønnestad, B., Hallén, J., Rud, B., & Raastad, T. (2011). The effect of heavy strength training on muscle mass and physical performance in elite cross country skiers. *Scand J Med Sci Sports, 21*(3), 389-401.

Loucks, A., Laughlin, G., Mortola, J., Girton, L., Nelson, J., & Yen, S. (1992). Hypothalamic-pituitary-thyroidal function in eumenorrheic and amenorrheic athletes. *Journal of Clinical Endocrinology & Metabolism, 75*(2), 514-518.

Loucks, A. B. (2004). Energy balance and body composition in sports and exercise. *Journal of sports sciences, 22*(1), 1-14.

Madrid, J. A., Lopez-Bote, C., & Martín, E. (1993). Effect of neonatal androgenization on the circadian rhythm of feeding behavior in rats. *Physiology & behavior, 53*(2), 329-335.

Martinsen, M., Bratland-Sanda, S., Eriksson, A. K., & Sundgot-Borgen, J. (2010). Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. *British journal of sports medicine, 44*(1), 70-76.

McArdle, W. D., Katch, F. I., & Katch, V. L. (2006). Essentials of Exercise Physiology (Third Edition ed.): *Lippincott Williams & Wilkins.*

Miller, K., Lawson, E., Mathur, V., Wexler, T., Meenaghan, E., Misra, M., Klibanski, A. (2007). Androgens in women with anorexia nervosa and normal-weight women with hypothalamic amenorrhea. *Journal of Clinical Endocrinology & Metabolism, 92*(4), 1334-1339.

Myerson, M., Gutin, B., Warren, M. P., May, M. T., Contento, I., Lee, M., Brooks-Gunn, J. (1991). Resting metabolic rate and energy balance in amenorrheic and eumenorrheic runners. *Med Sci Sports Exerc, 23*(1), 15.

Nattiv, A., Loucks, A. B., Manore, M. M., Sanborn, C. F., Sundgot-Borgen, J., & Warren, M. P. (2007). American College of Sports Medicine position stand. The female athlete triad. *Med Sci Sports Exerc, 39*(10), 1867-1882. doi: 10.1249/mss.0b013e318149f111

Nevonen, L., Clinton, D., & Norring, C. (2006). Validating the EDI-2 in three Swedish female samples: Eating disorders patients, psychiatric outpatients and normal controls. *Nordic Journal of Psychiatry, 60*(1), 44-50.

Oinonen, K. A., & Bird, J. L. (2012). Age at menarche and digit ratio (2D: 4D): Relationships with body dissatisfaction, drive for thinness, and bulimia symptoms in women. *Body image*.

Patel, D. R., Greydanus, D. E., Pratt, H. D., & Phillips, E. L. (2003). Eating disorders in adolescent athletes. *Journal of Adolescent Research, 18*(3), 280-296.

Redman, L. M., & Loucks, A. B. (2005). Menstrual disorders in athletes. *Sports medicine, 35*(9), 747-755.

Rich-Edwards, J. W., Spiegelman, D., Garland, M., Hertzmark, E., Hunter, D. J., Colditz, G. A., Manson, J. A. E. (2002). Physical activity, body mass index, and ovulatory disorder infertility. *Epidemiology, 13*(2), 184.

Rickenlund, A., Carlström, K., Brismar, T. B., von Schoultz, B., & Lindén Hirschberg, A. (2003). Hyperandrogenicity is an alternative mechanism underlying oligomenorrhea or amenorrhea in female athletes and may improve physical performance. *Fertility and sterility, 79*(4), 947-955.

Rickenlund, A., Carlström, K., Ekblom, B., Brismar, T. B., Von Schoultz, B., & Hirschberg, A. L. (2004). Effects of oral contraceptives on body composition and physical performance in female athletes. *Journal of Clinical Endocrinology & Metabolism, 89*(9), 4364-4370.

Rickenlund, A., Eriksson, M. J., Schenck-Gustafsson, K., & Hirschberg, A. L. (2005). Amenorrhea in female athletes is associated with endothelial dysfunction and unfavorable lipid profile. *Journal of Clinical Endocrinology & Metabolism, 90*(3), 1354-1359.

Roberts, S., Kenney, N. J., & Mook, D. G. (1972). Overeating induced by progesterone in the ovariectomized, adrenalectomized rat. *Hormones and behavior, 3*(3), 267-276.

Rouveix, M., Bouget, M., Pannafieux, C., Champely, S., & Filaire, E. (2006). Eating attitudes, body esteem, perfectionism and anxiety of judo athletes and nonathletes. *International journal of sports medicine, 28*(04), 340-345.

Sandbakk, Ø., Welde, B., & Holmberg, H.-C. (2011). Endurance training and sprint performance in elite junior cross-country skiers. *The Journal of Strength & Conditioning Research, 25*(5), 1299.

Schuiteman, J., & Knoppers, A. (1987). An examination of gender differences in scholarly productivity among physical educators. *Research Quarterly for Exercise and Sport, 58*(3), 265-272.

Shenkman, Z., Shir, Y., & Brodsky, J. (1993). Perioperative management of the obese patient. *British journal of anaesthesia, 70*(3), 349-359.

Smolak, L., Murnen, S. K., & Ruble, A. E. (2000). Female athletes and eating problems: a meta-analysis. *Int J Eat Disord, 27*(4), 371-380.

Sundgot-Borgen, J. (1994). Risk and trigger factors for the development of eating disorders in female elite athletes. *Medicine & Science in Sports & Exercise, 26*(4), 414-419.

Sundgot-Borgen, J., & Torstveit, M. K. (2004). Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med, 14*(1), 25-32.

Tamminen, K. A., Holt, N. L., & Crocker, P. R. (2012). Adolescent athletes: psychosocial challenges and clinical concerns. *Current opinion in psychiatry, 25*(4), 293-300.

Tomten, S., & Høstmark, A. (2006). Energy balance in weight stable athletes with and without menstrual disorders. *Scand J Med Sci Sports, 16*(2), 127-133.

Torstveit, M. K., & Sundgot-Borgen, J. (2005). The female athlete triad: are elite athletes at increased risk? *Medicine & Science in Sports & Exercise, 37*(2), 184-193.

Torstveit, M. K., & Sundgot-Borgen, J. (2012). Are Under-and Overweight Female Elite Athletes Thin and Fat? A Controlled Study. *Medicine & Science in Sports & exercise: Official Journal of the American College of Sports Medicine, 44*(5), 949-957.

Van Durme, K., Goossens, L., & Braet, C. (2011). Adolescent aesthetic athletes: A group at risk for eating pathology? *Eating behaviors*.

Varma, M., Chai, J. K., Meguid, M. M., Laviano, A., Gleason, J. R., Yang, Z. J., & Blaha, V. (1999). Effect of estradiol and progesterone on daily rhythm in food intake and feeding patterns in Fischer rats. *Physiology & behavior, 68*(1), 99-107.

Vella, C. A., Ontiveros, D., Zubia, R. Y., & Dalleck, L. (2011). Physical activity recommendations and cardiovascular disease risk factors in young Hispanic women. *Journal of sports sciences, 29*(1), 37-45.

Warren, M. P., & Perlroth, N. E. (2001). The effects of intense exercise on the female reproductive system. *J Endocrinol, 170*(1), 3-11.

APPENDIX I

David M Garner, Ph.D

Eating Disorder Inventory 2

EDI 2

I punktene nedenfor spørres det om dine holdninger, følelser og adferd. Noen av punktene handler om mat og spising. Andre punkter dreier seg om dine følelser i forhold til deg selv.
Du skal ved hvert punkt bestemme deg for i hvilken grad utsagnet passer på deg: **A**LLTID, **V**ANLIGVIS, **O**FTE, **I**BLANT, **S**JELDEN eller **A**LDRI. Hvis du f.eks. mener at ditt svar på et utsagn er ofte, sett da et kryss i ruten i kolonnen under OFTE for det gjeldende utsagn.

Svar på alle punktene idet du forvisser deg om at du setter kryss i den ruten som best gjenspeiler hvordan du føler det nå for tiden. VISK IKKE UT !
Hvis du har bruk for å forandre et svar kan du streke ut det som er feil og sette et nytt kryss i den riktige ruten.

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri
001.	Jeg spiser søtsaker og kullhydrater uten å føle meg	☐	☐	☐	☐	☐	☐
002.	Jeg mener magen min er for stor.	☐	☐	☐	☐	☐	☐
003.	Jeg ønsker jeg kunne vende tilbake til barndommens	☐	☐	☐	☐	☐	☐
004.	Jeg spiser når jeg blir opprørt.	☐	☐	☐	☐	☐	☐
005.	Jeg stapper i meg mat.	☐	☐	☐	☐	☐	☐
006.	Jeg skulle ønske jeg var yngre.	☐	☐	☐	☐	☐	☐
007.	Jeg tenker på slanking.	☐	☐	☐	☐	☐	☐
008.	Jeg blir redd når følelsene mine blir for sterke.	☐	☐	☐	☐	☐	☐
009.	Jeg synes at lårene mine er for tykke.	☐	☐	☐	☐	☐	☐
010.	Jeg kjenner meg udugelig som person.	☐	☐	☐	☐	☐	☐
011.	Jeg får dårlig samvittighet når jeg har spist for mye.	☐	☐	☐	☐	☐	☐
012.	Jeg mener at magen min er passe stor.	☐	☐	☐	☐	☐	☐
013.	Bare topp prestasjoner er gode nok i min familie.	☐	☐	☐	☐	☐	☐
014.	Barndommen er den lykkeligste tiden i livet.	☐	☐	☐	☐	☐	☐
015.	Jeg er åpen når det gjelder følelsene mine.	☐	☐	☐	☐	☐	☐
016.	Jeg er livredd for å legge på meg.	☐	☐	☐	☐	☐	☐

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri

017.	Jeg stoler på andre.	☐	☐	☐	☐	☐	☐
018.	Jeg føler meg alene i verden.	☐	☐	☐	☐	☐	☐
019.	Jeg er fornøyd med figuren min.	☐	☐	☐	☐	☐	☐
020.	Jeg har stort sett kontroll over livet mitt.	☐	☐	☐	☐	☐	☐
021.	Jeg blir forvirret og usikker på hva jeg føler.	☐	☐	☐	☐	☐	☐
022.	Jeg ville heller være voksen enn barn.	☐	☐	☐	☐	☐	☐
023.	Jeg har lett for å snakke med andre.	☐	☐	☐	☐	☐	☐
024.	Jeg ønsker at jeg var en annen.	☐	☐	☐	☐	☐	☐
025.	Jeg overvurderer vektens betydning.	☐	☐	☐	☐	☐	☐
026.	Jeg vet hva jeg føler.	☐	☐	☐	☐	☐	☐
027.	Jeg føler meg utilstrekkelig.	☐	☐	☐	☐	☐	☐
028.	Jeg har hatt spiseorgier hvor jeg har følt at jeg ikke har kunne slutte	☐	☐	☐	☐	☐	☐
029.	Som barn anstrengte jeg meg mye for ikke å skuffe foreldrene eller lærerene mine.	☐	☐	☐	☐	☐	☐
030.	Jeg har nære venner.	☐	☐	☐	☐	☐	☐
031.	Jeg liker fasongen på rumpen min.	☐	☐	☐	☐	☐	☐
032.	Jeg er svært opptatt av å bli tynnere.	☐	☐	☐	☐	☐	☐

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri

033.	Jeg vet ikke hva som foregår inni meg.	☐	☐	☐	☐	☐	☐
034.	Jeg har vansker med å uttrykke følelsene mine overfor andre.	☐	☐	☐	☐	☐	☐
035.	Det kreves for mye av voksne.	☐	☐	☐	☐	☐	☐
036.	Jeg avskyr ikke å være best.	☐	☐	☐	☐	☐	☐
037.	Jeg føler meg trygg på meg selv.	☐	☐	☐	☐	☐	☐
038.	Jeg tenker på det å overspise.	☐	☐	☐	☐	☐	☐
039.	Jeg er glad for at jeg ikke er et barn lengere.	☐	☐	☐	☐	☐	☐
040.	Jeg kan bli forvirret på om jeg er sulten eller ikke.	☐	☐	☐	☐	☐	☐
041.	Jeg har lave tanker om meg selv.	☐	☐	☐	☐	☐	☐
042.	Jeg føler at jeg kan nå målene mine.	☐	☐	☐	☐	☐	☐
043.	Foreldrene mine har krevd topp- prestasjoner av meg.	☐	☐	☐	☐	☐	☐
044.	Jeg er bekymret for å miste kontrollen over følelsene mine.	☐	☐	☐	☐	☐	☐
045.	Jeg mener at hoftene mine er for brede.	☐	☐	☐	☐	☐	☐
046.	Sammen med andre spiser jeg moderat, og stapper i meg når jeg er alene.	☐	☐	☐	☐	☐	☐
047.	Jeg føler meg oppblåst etter et vanlig måltid.	☐	☐	☐	☐	☐	☐
048.	Jeg føler at folk er mest lykkelige når de er barn.	☐	☐	☐	☐	☐	☐

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri
049.	Hvis jeg går opp noen hundre gram i vekt er jeg redd for at jeg vil fortsette å gå opp.	☐	☐	☐	☐	☐	☐
050.	Jeg føler meg som et verdifullt menneske.	☐	☐	☐	☐	☐	☐
051.	Når jeg er opprørt vet jeg ikke om jeg er trist, redd eller sint.	☐	☐	☐	☐	☐	☐
052.	Jeg føler at jeg må gjøre saker og ting perfekt ellers får det være.	☐	☐	☐	☐	☐	☐
053.	Jeg kan få det for meg at jeg skal kaste opp for å gå ned i vekt.	☐	☐	☐	☐	☐	☐
054.	Jeg har behov for å holde folk på en viss avstand, og føler meg uvel hvis noen vil komme	☐	☐	☐	☐	☐	☐
055.	Jeg føler at lårene mine er passe store.	☐	☐	☐	☐	☐	☐
056.	Følelsesmessig er jeg helt tom innvendig.	☐	☐	☐	☐	☐	☐
057.	Jeg kan snakke om mine personlige tanker og følelser.	☐	☐	☐	☐	☐	☐
058.	Den beste tiden er når du blir voksen.	☐	☐	☐	☐	☐	☐
059.	Jeg mener at rumpen min er for stor.	☐	☐	☐	☐	☐	☐
060.	Jeg har følelser som jeg ikke helt kan gjenkjenne.	☐	☐	☐	☐	☐	☐
061.	Jeg spiser eller drikker i hemmelighet.	☐	☐	☐	☐	☐	☐
062.	Jeg mener at hoftene mine er akkurat passe brede.	☐	☐	☐	☐	☐	☐
063.	Jeg setter meg svært høye mål.	☐	☐	☐	☐	☐	☐
064.	Når jeg er opprørt er jeg redd for at jeg skal begynne å spise.	☐	☐	☐	☐	☐	☐

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri
065.	Mennesker som jeg liker godt skuffer meg alltid.	☐	☐	☐	☐	☐	☐
066.	Jeg skammer meg over mine menneskelige svakheter.	☐	☐	☐	☐	☐	☐
067.	Andre mennesker vil si at jeg er følelsesmessig ustabil.	☐	☐	☐	☐	☐	☐
068.	Jeg ville gjerne ha full kontroll over mine legemlige drifter.	☐	☐	☐	☐	☐	☐
069.	Jeg føler meg avslappet i de fleste gruppesituasjoner.	☐	☐	☐	☐	☐	☐
070.	Jeg sier ting impulsivt, som jeg etterpå angrer at jeg har sagt.	☐	☐	☐	☐	☐	☐
071.	Jeg anstrenger meg mye for å oppleve nytelse.	☐	☐	☐	☐	☐	☐
072.	Jeg må være forsiktig med min tendens til å misbruke stoffer.	☐	☐	☐	☐	☐	☐
073.	Jeg er utadvendt i forhold til de fleste mennesker.	☐	☐	☐	☐	☐	☐
074.	Jeg føler meg fanget i faste forhold.	☐	☐	☐	☐	☐	☐
075.	Selvfornektelse får meg til å føle meg sterkere åndelig.	☐	☐	☐	☐	☐	☐
076.	Folk forstår alvoret i problemene mine.	☐	☐	☐	☐	☐	☐
077.	Jeg får ikke merkelige tanker ut av hodet mitt.	☐	☐	☐	☐	☐	☐
078.	Å spise for fornøyelsens skyld er tegn på moralsk svakhet.	☐	☐	☐	☐	☐	☐
079.	Jeg kan ha sinne eller raseriutbrudd.	☐	☐	☐	☐	☐	☐
080.	Jeg mener folk gir meg den anerkjennelse jeg fortjener.	☐	☐	☐	☐	☐	☐

		Alltid	Vanligvis	Ofte	Iblant	Sjelden	Aldri
081.	Jeg må være på vakt over min tendens til å misbruke alkohol.	☐	☐	☐	☐	☐	☐
082.	Avslapning er simpelthen bortkastet tid.	☐	☐	☐	☐	☐	☐
083.	Andre vil si at jeg lett blir irritert.	☐	☐	☐	☐	☐	☐
084.	Det føles som om jeg alltid kommer til kort.	☐	☐	☐	☐	☐	☐
085.	Jeg opplever markante humørsvingninger.	☐	☐	☐	☐	☐	☐
086.	Jeg er flau over mine legemlige drifter.	☐	☐	☐	☐	☐	☐
087.	Jeg vil hellere tilbringe tid alene enn med andre.	☐	☐	☐	☐	☐	☐
088.	Å lide gjør deg til et bedre menneske.	☐	☐	☐	☐	☐	☐
089.	Jeg vet at andre mennesker elsker meg.	☐	☐	☐	☐	☐	☐
090.	Jeg føler at jeg må såre meg selv eller andre.	☐	☐	☐	☐	☐	☐
091.	Jeg føler jeg vet hvem jeg virkelig er.	☐	☐	☐	☐	☐	☐

APPENDIX II

S K Å R I N G S N Ø K K E L EDI- 2

1.	Drive for Thinness	0 0 0 1 2 3	40.	Interoceptive Awareness	3 2 1 0 00
2.	Body Dissatisfaction	3 2 1 0 0 0	41.	Ineffectiveness	3 2 1 0 0 0
3.	Maturity Fears	3 2 1 0 0 0	42.	Ineffectiveness	0 0 0 1 2 3
4.	Bulimia	3 2 1 0 0 0	43.	Perfectionism	3 2 1 0 0 0
5.	Bulimia	3 2 1 0 0 0	44.	Interoceptive Awareness	3 2 1 0 0 0
6.	Maturity Fears	3 2 1 0 0 0	45.	Body Dissatisfaction	3 2 1 0 0 0
7.	Drive for Thinness	3 2 1 0 0 0	46.	Bulimia	3 2 1 0 0 0
8.	Interoceptive Awareness	3 2 1 0 0 0	47.	Interoceptive Awareness	3 2 1 0 0 0
9.	Body Dissatisfaction	3 2 1 0 0 0	48.	Maturity Fears	3 2 1 0 0 0
10.	Ineffectiveness	3 2 1 0 0 0	49.	Drive for Thinness	3 2 1 0 0 0
11.	Drive for Thinness	3 2 1 0 0 0	50.	Ineffectiveness	0 0 0 1 2 3
12.	Body Dissatisfaction	0 0 0 1 2 3	51.	Interoceptive Awareness	3 2 1 0 0 0
13.	Perfectionism	3 2 1 0 0 0	52.	Perfectionism	3 2 1 0 0 0
14.	Maturity Fears	3 2 1 0 0 0	53.	Bulimia	3 2 1 0 0 0
15.	Interpersonal Distrust	0 0 01 2 3	54.	Interpersonal Distrust	3 2 1 0 0 0
16.	Drive for Thinness	3 2 1 0 0 0	55.	Body Dissatisfaction	0 0 0 1 2 3
17.	Interpersonal Distrust	0 0 0 1 2 3	56.	Ineffectiveness	3 2 1 0 0 0
18.	Ineffectiveness	3 2 1 0 0 0	57.	Interpersonal Distrust	0 0 0 1 2 3
19.	Body Dissatisfaction	0 0 0 1 2 3	58.	Maturity Fears	0 0 0 1 2 3
20.	Ineffectiveness	0 0 0 1 2 3	59.	Body Dissatisfaction	3 2 1 0 0 0
21.	Interoceptive Awareness	3 2 1 0 0 0	60.	Interoceptiv Awareness	3 2 1 0 0 0
22.	Maturity Fears	0 0 0 1 2 3	61.	Bulimia	3 2 1 0 0 0
23.	Interpersonal Distrust	0 0 0 1 2 3	62.	Body Dissatisfaction	0 0 0 1 2 3
24.	Ineffectiveness	3 2 1 0 0 0	63.	Perfectionism	3 2 1 0 0 0
25.	Drive for Thinness	3 2 1 0 0 0	64.	Interoceptive Awareness	3 2 1 0 0 0
26.	Interoceptive Awareness	0 0 0 1 2 3	65.	Impulse Regulation	3 2 1 0 0 0
27.	Ineffectiveness	3 2 1 0 0 0	66.	Asceticism	3 2 1 0 0 0
28.	Bulimia	3 2 1 0 0 0	67.	Impulse Regulation	3 2 1 0 0 0
29.	Perfectionism	3 2 1 0 0 0	68.	Asceticism	3 2 1 0 0 0
30.	Interpersonal Distrust	0 0 0 1 2 3	69.	Social Insecurity	0 0 0 1 2 3
31.	Body Dissatisfaction	0 0 0 1 2 3	70.	Impulse Regulation	3 2 1 0 0 0
32.	Drive for Thinness	3 2 1 0 0 0	71.	Asceticism	0 0 0 1 2 3
33.	Interoceptive Awareness	3 2 1 0 0 0	72.	Impulse Regulation	3 2 1 0 0 0
34.	Interpersonal Distrust	3 2 1 0 0 0	73.	Social Insecurity	0 0 0 1 2 3
35.	Maturity Fears	3 2 1 0 0 0	74.	Impulse Regulation	3 2 1 0 0 0
36.	Perfectionism	3 2 1 0 0 0	75.	Asceticism	3 2 1 0 0 0
37.	Ineffectiveness	0 0 0 1 2 3	76.	Social Insecurity	0 0 0 1 2 3
38.	Bulimia	3 2 1 0 0 0	77.	Impulse Regulation	3 2 1 0 0 0
39.	Maturity Fears	0 0 0 1 2 3	78.	Asceticism	3 2 1 0 0 0
79.	Impulse Regulation	3 2 1 0 0 0			
80.	Social Insecurity	0 0 0 1 2 3			

81. Impulse Regulation	3 2 1 0 0 0
82. Asceticism	3 2 1 0 0 0
83. Impulse Regulation	3 2 1 0 0 0
84. Social Insecurity	3 2 1 0 0 0
85. Impulse Regulation	3 2 1 0 0 0
86. Asceticism	3 2 1 0 0 0
87. Social Insecurity	3 2 1 0 0 0
88. Asceticism	3 2 1 0 0 0
89. Social Insecurity	0 0 0 1 2 3
90. Impulse Regulation	3 2 1 0 0 0
91. Social Insecurity	0 0 0 1 2 3

APPENDIX III

Forespørsel om deltagelse i forskningsprosjekt:

"The Female Competitiveness Study" – er det sammenheng mellom hormonnivåer og konkurranseinstinkt hos kvinnelige toppidrettsutøvere?

Bakgrunn og hensikt

Toppidrettsutøvere presser sin fysiske og psykiske kapasitet til det ytterste. De fysiske og psykiske aspektene og sammenhengen med hormonnivåer har vært studert tidligere, spesielt hos menn. Sammenhengen mellom hormonnivåer, fysisk kapasitet og mentale faktorer hos kvinner er derimot lite studert.

Nivået av androgene hormoner (hormoner med testosteronvirkning) og spesielt testosteron er noe forhøyet hos kvinner med polycystisk ovarialsyndrom (PCOS). Kvinner med PCOS utgjør 10-15 % av kvinner i fruktbar alder, de synes å ha høyere konkurranseinstinkt og delta mer i idrett enn kvinner uten PCOS. Det synes også å være en svak sammenheng mellom PCOS, humørsvingninger og spiseadferd. Vi tror mye av dette kan ha sammenheng med de noe økte nivåene av hormoner med testosteronvirkning og at kvinner med økte testosteronnivå i spesiell grad trekkes mot idrett generelt og toppidrett spesielt.

Vi henvender oss til deg fordi du er en kvinnelig toppidrettsutøver for å be om ditt samtykke til deltakelse i dette forskningsprosjektet. Formålet med studien er å få økt kunnskap om sammenhengen mellom hormonnivåer hos kvinnelige toppidrettsutøvere og konkurranseinstinkt, muskelmasse, fysisk kapasitet, beintetthet, mentale forhold inkludert seksuell orientering og forekomsten av PCOS. Studien er et samarbeidsprosjekt mellom Avdeling for endokrinologi, St. Olavs hospital, Institutt for Bevegelsesvitenskap og Psykologisk Institutt, Norges teknisk- naturvitenskaplige universitet (NTNU) og Olympiatoppen Midt-Norge. Denne forespørselen går til toppidrettskvinner mellom 18 og 40.

Hva innebærer deltagelse i studien?

Den enkelte deltager vil få utført en DEXA-scan og taking av fastende blodprøve ved Avdeling for endokrinologi, St. Olavs hospital. Ved DEXA-scan ligger man stille i truse på ryggen i 10 minutter og det hele er helt smertefritt. Ved denne undersøkelsen bestemmes fettmasse, muskelmasse, beinmasse og beintetthet. I tillegg besvares spørreskjema om konkurranseinstinkt, spenningssøking, spiseadferd, mental helse og seksuell orientering. Vi vil også registrere resultatene fra fysiske tester (VO_2 max, laktat, maksimal muskelkraft ved spensthopp og benkpress). Medisinbruk, spesielt hormonpreparater (p-pille, p-stav, p-sprøyte, hormonspiral etc.) vil bli registrert.
I tillegg håper vi å kunne tilby en gynekologisk undersøkelse for deltagerne i studien.

Mulige fordeler og ulemper
Som deltager har du mulighet til å bidra til ny kunnskap om sammenhengen mellom forhold knyttet til idrettsprestasjoner og toppidrettskvinners helse. Deltagelse i prosjektet medfører testing og analyse av blant annet beintetthet og muskelmasse. Lav beintetthet og menstruasjonsforstyrrelser kan være et problem hos kvinner som trener mye. Dersom dette påvises kan fagpersonene i prosjektgruppen vurdere spesielle tiltak dersom du ønsker det.

Opplever du noen av spørsmålene som ubehagelige er det greit å unnlate å besvare dem. Data vil uansett ikke kunne spores tilbake til enkeltpersoner etter at de er registrert i en database. Vi har dessverre ikke anledning til å gi deltagerne økonomisk kompensasjon så deltagere i prosjektet må selv dekke eventuelle reiseutgifter.

Den fysiske testingen vil bli gjennomført etter standard prosedyrer for slik fysiologisk testing og risikoen for at noe kan skje er minimal. VO_2 max kan oppleves som anstrengende, men gi nyttig informasjon som kan brukes til videre treningsplanlegging. Prestasjonstester vil også være standard og gjennomføres i tråd med trening du som utøver gjennomfører til daglig. Den eneste reelle forskjellen fra den daglige trening og testing er at dataene fra testene vil bli systematisert og lagret for brukt i prosjektet.

Viktig! Dine forberedelser
Blodprøvene vil bli tatt om morgenen, og du må faste 8 timer (dvs. fra midnatt) i forkant (inkludert røyk/snus-avhold). Dersom du er veldig tørst kan du evt. drikke et halvt glass vann morgenen før prøvene tas.

Hva skjer med testene og informasjonen om deg?
Dine resultater fra undersøkelsene vil bli behandlet i ikke identifiserbar form, dvs. uten navn, fødselsnummer eller andre identifiserende opplysninger. En kode knytter deg til dine opplysninger og prøver, gjennom en navneliste. Denne koden oppbevares uavhengig av selve databasen med alle opplysningene fra studien. Det er kun autorisert helsepersonell knyttet til prosjektet som har adgang til navnelisten og som eventuelt kan finne tilbake til deg. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres. Når prosjektet er avsluttet vil også koden som knytter deg til enkeltdata i databasen slettes.

Dersom du ønsker det kan vi gi deg tilbakemelding på testresultatene (som for eksempel kroppssammensetning, VO_2 max, styrketestene, og evt. gynekologisk undersøkelse). Vi kan eventuelt også informere om eventuelle andre helseproblemer vi måtte påvise ved de undersøkelsene du gjennomgår. Dette vil foregå ved studiemedarbeiderne (kroppssammensetning, VO_2 max, styrketestene) eller lege (gynekologisk undersøkelse, beintetthet, evt. andre forhold). Olympiatoppen, trenere eller andre vil ikke på noe tidspunkt få tilgang til informasjon om enkeltpersoner utover resultater fra de fysiske testene Olympiatoppen får tilgang på slik de gjør ved tilsvarende rutinetesting av utøvere.

Studien er vurdert og godkjent av Regional komité for medisinsk forskningsetikk, Midt-Norge og vil bli gjennomført etter de regler og retningslinjer som er nedfelt i Helsinkideklarasjonen. Når studien er avsluttet vil resultatene bli publisert i et engelskspråklig internasjonalt medisinsk tidsskrift.

Frivillig deltakelse
Studien er frivillig, du kan på hvilken som helst tidspunkt trekke deg uten nærmere begrunnelse eller uten at det får noen negative konsekvenser for deg. Dette gjelder selvfølgelig også videre oppfølging fra Olympiatoppen. Dersom du trekker deg fra studien har du rett til innsyn i data registrert om deg. Du kan også trekke tilbake samtykket. Da vil alle innsamlede opplysninger om deg bli slettet og frosne blodprøver vil bli destruert med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskaplige publikasjoner.

Vi ber også om tillatelse til eventuelt å kontakte deg senere for oppfølgning. Dette er kun en forespørsel om vi får lov å ta kontakt med deg senere og ikke noe løfte fra deg om at du vil stille opp. Dette er ingen forutsetning for å delta i studien. Hvis du samtykker i å delta i studien må du undertegne en samtykkeerklæring lik den som er vedlagt før du deltar. Personopplysninger som knytter deg til data vil bli oppbevart til utgangen av 2014 og deretter slettet.

Personvern
Opplysninger som registreres om deg er:

- Helseopplysninger som du selv gir oss
- Opplysninger om din aktuelle medisinbruk
- Resultater av blodprøveanalyser som tas
- Opplysninger om de tester og undersøkelser du gjennomgår
- Svar på de spørreskjema du besvarer
- Enkle kliniske data (høyde, vekt, blodtrykk etc.)

Opplysningene legges inn i en database ved Enhet for anvendt klinisk forskning, NTNU i avidentifisert form, dvs. ikke med ditt navn eller fødselsnummer men kun med ditt deltagernummer.

Alt personell som er involvert i studien og behandlingen av innsamlede data har taushetsplikt.

Representanter for kontrollmyndigheter kan få utlevert studieopplysninger og gis innsyn i relevante deler av din journal. Dette er lovpålagt. Formålet er å kontrollere at studieopplysningene stemmer overens med tilsvarende opplysninger i din journal. Alle som får innsyn i informasjon om deg har taushetsplikt.

Forskningsbiobank

Blodprøvene som blir tatt og informasjonen utledet av dette materialet vil bli lagret i en forskningsbiobank som professor Sven M. Carlsen er ansvarlig for. De vil bli lagret i ikke personidentifiserbar stand, dvs. bare identifisert med deltagernummer.

Utlevering av materiale og opplysninger til andre

Hvis du sier ja til å delta i studien, gir du også ditt samtykke til at prøver og avidentifiserte opplysninger kan utleveres til våre samarbeidspartnere i forskning.

Innsynsrett og oppbevaring av materiale
Hvis du sier ja til å delta i studien, har du rett til å få innsyn i hvilke opplysninger som er registrert om deg. Du har videre rett til å få korrigert eventuelle feil i de opplysningene vi har registrert. Dersom du trekker deg fra studien, vil det ikke samles inn flere opplysninger eller mer materiale. Opplysninger som allerede er innsamlet fra deg vil ikke bli slettet.

Finansiering

Studien og biobanken er søkt finansiert av forskningsmidler fra Olympiatoppen og forskningsmidler som professor Sven M. Carlsen har innestående ved Unimed Innovation. Sponsor (ansvarlig myndighet for studien) er Institutt for kreftforskning og molekylærmedisin, NTNU.

Forsikring
Du er forsikret gjennom Pasientskadeerstatningsordningen.

Med vennlig hilsen

_____
Sven M. Carlsen
Professor dr. med. Prosjektleder

Prosjektgruppe:

Prosjektleder og medisinsk ansvarlig: Sven M. Carlsen, professor, spesialist i indremedisin og endokrinologi,
Enhet for anvendt klinisk forskning, NTNU og Avdeling for endokrinologi, St. Olavs hospital
Email: sven.carlsen@ntnu.no.

Veileder og forskningsmedarbeider: Kirsten Rasmussen, professor, Fakultet for samfunnsvitenskap og teknologiledelse, Psykologisk institutt, NTNU
Email: kirsten.rasmussen@svt.ntnu.no.

Veileder og forskningsmedarbeider: Liv Berit Augestad, professor, Fakultet for samfunnsvitenskap og teknologiledelse, Institutt for Bevegelsesvitenskap, NTNU
Email: liv.berit.augestad@svt.ntnu.no.
Prosjektmedarbeider, Øyvind Sandbakk, Ph.D, Senter for toppidrettsforskning, Fakultet for samfunnsvitenskap og teknologiledelse, Institutt for bevegelsesvitenskap
Email: oyivind.sandbakk@svt.ntnu.no.
Prosjektmedarbeider: Torunn Haugen Breivik, masterstudent, Institutt for Bevegelsesvitenskap, SVT-Fak., NTNU
Email: torunbr@stud.ntnu.no.

Prosjektmedarbeider: Cathrine Aa Dalen, masterstudent, Institutt for Bevegelsesvitenskap, SVT-Fak., NTNU
Email: cathrid@stud.ntnu.no.

Prosjektmedarbeider: Silje Øyre Slind, masterstudent, Institutt for Bevegelsesvitenskap, SVT-Fak., NTNU
Email: siljeosl@stud.ntnu.no.

Prosjektmedarbeider: Brit Dregelid, masterstudent, Institutt for Bevegelsesvitenskap, SVT-Fak., NTNU
Email: britd@stud.ntnu.no.

APPENDIX IV

SAMTYKKEERKLÆRING

For deltakeren:
Jeg bekrefter med dette at jeg har fått den informasjon jeg ønsker om og er villig til å delta i *"The Female Competitiveness Study"*. Jeg vet at jeg uten nærmere begrunnelse kan trekke med fra studien på et hvert tidspunkt dersom jeg skulle ønske det uten at det vil ha konsekvenser for meg. Jeg er klar over at de innsamlede data brukes utelukkende til forskning og eventuell egen nytte ved økt kunnskap om meg selv.

Jeg samtykker i å delta i prosjektet som innebærer følgende:

- Testing av fysisk kapasitet (maksimal muskelkraft og VO_2max)
- Dexa-scan av kroppssammensetning
- Blodprøvetaking for hormonanalyser
- Spørreskjema angående konkurranseinstinkt, spenningssøking, spisevaner, mental helse og seksuell orientering
- Gynekologisk undersøkelse (ingen betingelse for å delta i resten av studien)
- Enkel klinisk undersøkelse (høyde, vekt, blodtrykk etc.)
- Fotokopi av hendene

Dersom du godkjenner at vi kontakter deg for eventuell oppfølgende forskning på et senere tidspunkt, vennligst kryss av her: ☐

Dersom du ønsker å bli kontaktet dersom blodprøver eller andre av undersøkelsene gir mistanke om spesielle medisinske problemer hos deg, vennligst kryss av her:

☐

Sted:_____ Dato:___/___- 2011

Navn:_____
(Deltakers fulle navn med BLOKKBOKSTAVER)

_____
Deltagers underskrift

Jeg bekrefter med dette at deltageren har fått muntlig og skriftlig informasjon om studien, har fått svar på de muntlige spørsmål hun hadde og har underskrevet på

denne deltagerformasjonen:

Sted: _____ Dato:___/___- 2011

Studiemedarbeider: _____

Ansvarlige lege for undersøkelsen:
Sven M. Carlsen,
_____Professor, Enhet for anvendt klinisk forskning, NTNU
Overlege,
Avdeling for endokrinologi, St. Olavs hospital