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**COMPETITIVENESS, SENSATION SEEKING  
AND ANDROGEN HORMONES AMONG  
FEMALE ATHLETES**

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## ABSTRACT

**Background:** Previous research has suggested that there may be an association between levels of androgen hormones among female athletes, scores on competitiveness and sensation seeking (SS) and athletic performance. The aim of this study was to investigate the association between levels of androgen hormones and scores of competitiveness and sensation seeking among female athletes. In addition it analyzed the association between androgen hormones and the physical performance ( $VO_2$ -max) among the female athletes.

**Methods:** The study was a cross-sectional study of 72 female athletes from different sports in the middle part of Norway, between the age 18 and 38. The 13 items for the competitiveness scores from the Sport Orientation Questionnaire (SOQ), and the 40 items from the Sensation Seeking Score (SSS) were used to disclose the psychological traits of the females. A maximal oxygen uptake ( $VO_2$ -max) test was used to establish the athlete's physical capacity. For measurements of circulating androgen hormones (CAH), fasting serum samples were collected of the hormones free testosterone index (FTI) and 3-alfa-diol glucoronid (ADG). The athletes were analyzed all together and divided into three major sports groups (team sport, endurance and strength and technique). Statistics used were descriptive, linear regression, Pearson correlation test and independent t-test. P-values  $<0.05$  were considered significant.

**Results:** There was a statistical significant association between the androgen metabolite ADG and the experience seeking scale of SS among all the athletes. When dividing the athletes into the three sports group, there was an association between  $VO_2$ -max and the androgen metabolite ADG among the team sport group, and between FTI and  $VO_2$ -max in the endurance group. In the endurance group there was an association between FTI and competitiveness. There was also an association between  $VO_2$ -max and BMI.

**Conclusion:** There may be an association between levels of CAH and to want to try new experiences, like sports. There may therefore be an association between CAH and some types of sports at a certain level of  $VO_2$ -max. Also, there may be an association between CAH and competitiveness among endurance athletes. Further research on female athletes at higher levels in more homogenous groups, is suggested to get a better understanding of female athletes, physiological traits and hormones.

**Keywords:** Female athletes, competitiveness, sensation seeking (SS), circulating androgen hormones (CAH), maximum oxygen consumption ( $VO_2$ -max).



## PREFACE

This master thesis is a part of “The female competitiveness study”, a larger cross sectional study in Norwegian female top athletes from the middle part of Norway. The aim for the whole study is to investigate possible association between circulating androgen hormones, physical capacity (endurance and power), competitiveness, body composition, eating disorders, menstrual disturbances, mental health and sexual preferences. In this master thesis the association between circulating androgen hormones, competitiveness, sensation seeking and maximum oxygen uptake was analyzed.

In addition to Olympiatoppen in the middle part of Norway, there are three departments at the Norwegian University of Science and Technology involved in the project:

- The Department of Psychology, Faculty of Social Sciences and Technology Management.
- The Department of Movement Science, Faculty of Social Sciences and Technology Management (from 01.01.14 a part of the department of Neuroscience, The Medical Faculty).
- The Unit for Applied Clinical Research, Department of Endocrinology, The Medical Faculty.





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## TERMS AND ABBREVIATIONS

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

**3-alfa-diol glucoronid (ng/mL) (ADG):** is not a CAH, but is an androgen metabolite, derived from intracellular conversion of androgens. By many held to reflect intracellular androgen exposure

**Amenorrhea:** A menstrual disturbance, no menstrual cycle for 90days.

**Androgen hormones:** Hormones responsible for “male characteristics”, present in small amounts in the female body, and it may have direct effect on physiology like bone density and muscle growth.

**Androstenedione:** An androgen hormone that is precursors of estrogen, and testosterone may come from the peripheral conversion of this hormone.

**Body Mass Index (kg/m<sup>2</sup>) (BMI):** The ratio of weight to height squared.

**Boredom Susceptibility (BS):** A subscale of the SSS, indicating if you have intolerance for routine, repetitiveness and boredom.

**Circulating androgen hormones (CAH):** Androgen hormone levels (like FTI and androstenedione) in the blood.

**Competitiveness:** The desire to win in interpersonal situations and the desire to win and be better than others

**Competitiveness Score:** The score the subjects get after answering the competitiveness part of the Sport Orientation Questionnaire.

**Dehydroepiandrosterone (DHEA):** An androgen hormone and testosterone and ADG may come from peripheral conversion of this hormone.

**Dihydrotestosterone (DHT):** An androgenic hormone with an androgenic effect ten times that of testosterone. Produced by local conversion of testosterone to DHT. ADG is a metabolite of both testosterone and DHT.

**Disinhibition (Dis):** A subscale of the SSS, indicating if subjects are seeking sensation through parties, drinking, gambling and sexual variety.

**Experience Seeking (ES):** A subscale of the SSS, indicating if subjects are seeking after stimulation using the mind and senses.

**Free testosterone index (FTI):** An estimated measure of free testosterone in the circulation. Only free testosterone is able to bind to the testosterone receptor and exert testosterone effects at the cellular level. Calculated as  $(\text{testosterone nmol/L} / \text{SHGB nmol/L}) \times 10$ .

**Hirsutism:** Male pattern excessive hair growth in women. Held to reflect elevated levels of androgen hormones.

**Hyperandrogenism:** When a female have increased levels of androgen hormones.

**Maximal Oxygen Uptake (VO<sub>2</sub>-max):** A measure of endurance capacity, measured in ml/kg/min.

**Oligomenorrhea:** A menstrual disturbance, when the menstrual period is >35 days, with four to nine periods in one year.

**Oral Contraceptives (OC):** Birth controls pills containing female sex hormones like estrogen and progestin.

**Sensation seeking (SS):** Is a personality trait, and is the seeking of varied, novel, complex and intense sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences.

**Sensation seeking score (SSS):** The total score from the Sensation Seeking Score Questionnaire.

**Sexual orientation:** If the person see themselves as attracted to the same sex (homosexual), the opposite sex (heterosexual), both sexes (bisexual) or unsure.

**Thrill and adventure seeking (TAS):** A subscale of the SSS, indicate the desire to engage in activities with high sensations of speed and defiance of gravity.



# INTRODUCTION

## The female athletes

There are multiple factors that contribute to a person becoming the best in the world, either in sport, academics, art or music. The theory of “deliberate practice” with 10 000 hours of training over 10 years is widely known and a believed factor in the sport society to reach the top of the podium (Ericsson, Krampe, & Clemens, 1993). Other factors like genes, surroundings, technique, physiology and psychology are also important to influence an athlete’s ability to perform. Important factor in the psychological part is the inner drive to win, and the athlete’s competitiveness.

In the Olympic Games in London in 1908, 37 women participated, which were only 1.8 % of all the athletes. When the games again were held in London in 2012, 4676 women participated, which were 44 % of all the athletes (IOC, 2013a, 2013b). In London in 2012, it was the first time all countries had female athletes, and the first year females could compete in boxing, so women could finally compete in every Olympic sport in a summer Olympics. In Sochi in 2014, it is the first time females can compete in Ski jumping in an Olympic games.

In 2012 the Norwegian Sport Federation had 2 186 000 members, and about 40 % of these are females. The number of adult females that was a member of a sport club in Norway, was 258 472 in 2007 and 484 955 in 2012 (Fasting & Sand, 2009; NIF, 2013). Of all the women in Norway, 78 % exercise at least one time a week, but only 8.2 % of these competed in sport the last year. Among men 16 % of all active men had competed in a sport competition the last year (Fasting & Sand, 2009). Fasting, 2009, explain this difference in gender in competing in sport with masculinity and masculine values.

## Competitiveness in Sport

Competitiveness is the desire to win in interpersonal situations (Houston, Carter, & Smither, 1997). It is also stated that competitiveness is:

“The enjoyment of interpersonal and the desire to win and be better than others” (Mowen, 2004). Competitiveness is considered important for those athletes who are engaged in competitive sport, and the desire to enter, participate and win in sport events often reveal individual differences in competitiveness (Houston et al., 1997). Mowen, 2004, reports that competitiveness was positively related to sport interest, and that sport interest was positively

related to participating in sport games and matches. Not many studies focus solely on females and competitiveness. Most studies with women focus on comparing the genders. It is shown in several studies that men have a higher competitiveness than women in sport (Houston et al., 1997). However, Houston et al., 1997, showed that elite female tennis players scored higher on the sport-specific measure of competitiveness than their male peers. In general the study showed no sex difference in competitiveness among elite tennis players (Houston et al., 1997). Cashdan, 1998, showed that there were no difference among men and women with competitive feeling, except that women had higher scores on looking attractive and men had higher scores on athletics.

Using the Sport Orientation Questionnaire, it was found that male college athletes scored higher than female college athletes on competitiveness and win orientation (Gill & Dziewaltowski, 1988). They also found that athletes were significantly more competitive than non athletes, showing that the athletes like competitive sport and they strive to achieve in competitive sport which separates them from the non athlete (Gill & Dziewaltowski, 1988).

## **Sensation seeking**

Sensation seeking (SS) is a personality trait (Zuckerman, 2007). SS is defined as:

“The seeking of varied, novel, complex and intense sensations and experiences and the willingness to take physical, social, legal and financial risks for the sake of such experiences” (Jack & Ronan, 1998).

Sensation seekers usually are interested or choose a certain career that will stimulate their levels of sensation seeking. Occupations that provide new sensations and experiences, like a sportsman, will attract individuals with higher scores on general sensation seeking, and also elevates scores on thrill and adventure seeking (TAS) and boredom susceptibility (BS) (Roberti, 2004). Other factors that may influence the individuals sensation seeking is gender; males often have higher scores than females, age; the SS often decline with age and marital status; divorced males score higher than single and married males (Roberti, 2004). When it comes to sport participation, we may find persons with high SS in sports that involves high levels of personal risk (Zuckerman, 1983). Jack and Ronan, 1998, found among males and females, that high risk sports athletes (sky-diving, mountaineering, hang-gliding, automobile-racing), did score higher on the sensation seeking scale than did low risk sport athletes (swimming, marathon running, aerobics, golf).



Zuckermann (1983), compared research on SS in different sports among males and females, and found that in high risk sports, skiers had higher SS than non skiers, and that skiers with previous accidents had higher SS than other skiers. In medium risk sports, like body contact team sport, they had higher sensation seeking score (SSS) on total SS, Disinhibition (Dis) and TAS than non athletes. And in a low risk sport like running, it was no significant difference between the runners and non-runners, and the female runners were actually significantly lower on TAS score than non-runners (Zuckerman, 1983).

## **Androgen hormones**

Hormones are chemical signals, which communicate within the body with certain types of cells who are equipped to respond. The hormones are secreted into the extracellular fluid, and carried by the circulatory system (Campbell & Reece, 2005). Hormones may influence three systems in the body that with specific stimuli will more likely elicit certain responses in the behavioral or social context. These systems are the input system (sensory systems), the integrators (the central nervous system) and the output system or effectors (like muscles) (Nelson, 2000).

Sex hormones consist of androgens and estrogens. Sex hormones are primarily made in the gonads, both testes and ovaries produce both androgens and estrogens. All hormones are found in both sexes, but in different proportions (Campbell & Reece, 2005). Androgens are produced in small amounts in the female body, and may have direct effect on physiology like bone density and muscle growth. The circulating androgen hormones (CAH) may be influenced by several biological factors like menstrual cycle, oral contraceptives, age, dietary intake, and physical activity (Enea, Boisseau, Fargeas-Gluck, Diaz, & Dugué, 2011).

Testosterone (T) is the most important androgen hormone, and most of the T in women comes from the peripheral conversion of androstenedione, that is a precursor of testosterone. On the other hand testosterone is a precursor for estrogen or it can be converted into 3- $\alpha$ -diol glucuronide (ADG). Dehydroepiandrosteron (DHEA) and Dehydroepiandrosterone sulfate (DHEAS) can be transformed into testosterone through androstenedione. Testosterone and androstenedione are secreted by the ovaries, and a small part by the adrenals, and DHEA and DHEAS from the adrenals (Consitt, Copeland, & Tremblay, 2002; Hadley, 2000). T has multiple effects, and similar effects in men and women. T is of importance for aspects of

competition ranging from muscle development, to neurocognitive processing (Hamilton, van Anders, Cox, & Watson, 2009). ADG (3-alfa-diol glucoronide) is an androgen metabolite, and it can therefore say something about the androgen levels in the body. It is derived from DHEA to androstenedione to T, and then derived from T in the cell, to dihydrotestosterone (DHT) and to ADG, before it diffuses in to the circulation. So ADG will reflect the intracellular T level. The ADG has been correlated to hirsutism, a common effect of hyperandrogenism (Horton, 1992; Labrie et al., 2006).

It has been reported that female prisoners with a conviction of violence have a higher level of T, and are also more likely to have a violence and aggressive behavior in prison than females with normal levels of testosterone (Hadley, 2000). Regarding T and female athletes, there have been found that there is a significant increase of salivary T among female rugby and soccer players, but no significant change in androgens levels among female rowers, handball and volleyball players (Hamilton et al., 2009). Several reports have looked at female athletes and hyperandrogenism, where females have elevated levels of androgen hormones which may improve physical performance. Higher levels of testosterone may increase the motivation to train and reflect greater loads demands in intensity and volume (Cook, Crewther, & Smith, 2012; Hagmar, Berglund, Brismar, & Hirschberg, 2009).

### **Androgen hormones, competitiveness and sensation seeking**

It is found that there is an association between gonadal hormones, specially testosterone, and SS (Zuckerman, Buchsbaum, & Murphy, 1980), and testosterone and risk taking (Buser, 2009). In males, a positive correlation between androgen and estrogen levels and the SS scale was found. In females, a positive correlation between follicular and luteal estrogens and the disinhibition scale was found (Roberti, 2004; Zuckerman et al., 1980).

Competitiveness and aggressiveness can be positive characteristic in sport, and studies from the animal world, suggest that androgens are responsible for competitive behavior (Pokrywka, Rachon, Suchecka-Rachon, & Bitel, 2005). It is also a suggested that females that engage in sport have a higher level of competitiveness, and that they have been exposed to high androgen levels in utero (Pokrywka et al., 2005). Oestradiol and androgens, including testosterone, are associated with assertive behavior in women, and this may affect the competitive behavior (Cashdan, 1998).

There are various findings regarding female athletes, and the role of testosterone and competitiveness. Mazur, Susman and Edelbrock (1997) found no significant similarities between competition and hormone production between men and women. A study of Cashdan (2003), however, found that women with low levels of testosterone were less likely to express their competitive feelings, and women with high level of the androgen hormone androstenedione were more likely to express their competitive feeling (Cashdan, 2003).

## **Sexual orientation**

A Norwegian report states that it is difficult to estimate an accurate number, but after asking 3141 women, 98,3 state themselves as heterosexuals (Normann & Gulløy, 2010).

Several studies have looked at human sexual orientation, and sexual orientation among athletes, both in a medical and a sociological view. There are studies from the 1970s and 80s that reported that homosexual females have higher levels of testosterone than heterosexual females (Baucom, Besch, & Callahan, 1985; Neave, 2008).

A study by Balthazart (2011) found that sexual orientation is not affected by activation effects of steroids in adulthood, but may depend on exposures to high concentrations of testosterone during critical phases of intrauterine development. This may lead to a male typical orientation (attraction to women) (Balthazart, 2011). Other studies have used ratio of the 2nd to 4th finger digits (the 2D:4D ratio), a measure often ascribed to the organizational actions of prenatal androgens, and found that that male, but not female sexual orientation was associated with 2D:4D ratios. This is consistent with recent theoretical speculations where aspects of female sexuality are relatively more affected by cultural, and social factors (Lippa, 2003).

To look at the sociological view in Norway, a Norwegian study of female football players found that several studies from different countries showed that female football players are being stigmatized as lesbians because they are playing what may be looked at a masculine sport (Skogvang & Fasting, 2013). And still today in Norway football is characterized as a masculine sport, and people tend to question female football players sexuality. Skogvang and Fasting (2013) state that today it is easier to come forward as an lesbian, and since football is considered a masculine sport it may be more accepted in that sport, compeered to other less masculine considered sports.

## **Maximum oxygen uptake among female athletes**

Female athletes with hyperandrogenism were found to have higher maximum oxygen uptake (VO<sub>2</sub>-max) than female athletes with normal levels of androgen hormones. Both groups of athletes had higher VO<sub>2</sub>-max than sedentary controls (Rickenlund et al., 2003). Androgen hormones may increase muscle strength and physical performance, and reports have findings that hormonal oral contraceptives (OC) may reduce maximal oxygen uptake (Hagmar et al., 2009; Rickenlund et al., 2004). Rickenlund et al. (2004) found that OC didn't affect the VO<sub>2</sub>-max among athletes, but may affect the physical performance among oligo-/amenorrhoeic female athletes.

## **Aim of the study**

The aim of this study was to analyze the possible association between competitiveness, sensation seeking, VO<sub>2</sub>-max, and androgen hormones among a sample of Norwegian female athletes.

## **METHOD**

### **Design**

The data collected was a part of the “The female competitiveness study”, among Norwegian female top athletes carried out from the Medical Faculty, Unit for Applied Clinical Research and the Department of Movement Science at the NTNU, Trondheim. This was a cross-sectional study of female top athletes from the middle part of Norway. The females competed in different sports.

The data used for this study was The Sport Orientation Questionnaire, Sensation Seeking Scale, questionnaire on sexual orientation, questionnaire on living condition and ambitions, maximal aerobic capacity ( $VO_2$ -max), BMI and blood samples (Circulating Androgen Hormones).

### **Participants**

The participants were 73 female athletes, living in Mid-Norway. They were in the highest level of their sport, either in the region or in the country. The subjects were between 18 and 38 years old. Women who were pregnant, breast feeding or unfit to participate for any reason were excluded from the study.

Due to incomplete data, one subject was left out of the analysis. The remaining 72 subjects filled out the questionnaires. Five of these did not take the blood samples, but they were still included since they completed the questionnaires. The number of responders therefore vary in some analysis.

### **Procedure**

Thirty-four of the participants was recruited to the project through Olympiatoppen in the middle part of Norway from September 2011 to February 2012. During the fall 2012, another 39 participants was recruited, both through Olympiatoppen, and recruited from club trainings after two of the representatives from the research project attended the training to inform about the project. The female athletes who wanted to participate in the study got information about the study (appendix I) by email, and were invited to physical testing and questionnaires at NTNU Dragvoll, the department of Human Movement Science. On the testing day at NTNU Dragvoll, the participants were given more information about the study, and given the consent sheet (appendix II).

Answering the questionnaires took between 45-60 minutes. The participants were also given an appointment for a DEXA scan at the St. Olavs hospital and were told to visit the same hospital to take the blood sample within 2-3 days after the tests at Dragvoll. After this info they went to the physical laboratory at NTNU Dragvoll to do the physical tests. The testing was done from December 2011 till February 2012 and from September 2012 and till November 2012.

## **Measurements**

### **Sport Orientation Questionnaire (SOQ).**

SOQ is a sport-specific measure of achievement orientation and personality or individual differences in approaches to competitive sport situations (Appendix III) (Gill, Dzewaltowski, & Deeter, 1988). The SOQ have three dimensions of sport achievements orientation: 1. Competitiveness, to those who like to compete, 13 items. 2. Win orientation, for those who like to win, and hate to lose, 6 items. 3. Goal orientation, for those who set goals and like to compete against themselves, 6 items (Gill & Dzewaltowski, 1988). In the questionnaire for this study, only the 13 items for the competitiveness were included. SOQ is a 5-point Likert-type scale with 25 statements who describe sport situations. A Likert scale lets respondents rate their reaction to a statement with Strongly Agree (score = 5), Agree, Neutral, Disagree or Strongly Disagree (score = 1). This gives the most competitive athletes the maximal score of 65 and the least competitive athlete the score of 13 (Gill et al., 1988).

### **Sensation Seeking Scale (SSS)**

In 1964 Marvin Zuckerman developed the first Sensation Seeking Scale form I (Zuckerman, Kolin, Price, & Zoob, 1964). The questionnaire has undergone a number of revisions since then (Zuckerman et al., 1980). In this project we use form V that consists of 40 items, representing four scales (Appendix IV). This version has been related to sport participation (Zuckerman, 1983). The SSS is used to measure individual sensation seeking tendencies. The items require forced-choice responses between two statements. The overall score of the 40 items is regardless as the general SS score (Jack & Ronan, 1998). Ten items are contained within each of the four subscales:

1. Thrill and Adventure Seeking (TAS): In this section the items indicate the desire to engage in activities with high sensations of speed and defiance of gravity, like parachuting and scuba diving. The TAS scale consists of the following items from the questionnaire: 3, 11, 16, 17, 20, 21, 23, 28, 38 and 40.

2. Experience Seeking (ES): Here the items represent seeking after stimulation using the mind and senses, like music, art, traveling and psychedelic drugs. The ES scale consists of the following items from the questionnaire: 4, 6, 9, 10, 14, 18, 19, 22, 26 and 37.

3. Disinhibition (Dis): Here the items look after if you seek sensation through parties, drinking, gambling and sexual variety. The Dis scale consists of the following items from the questionnaire: 1, 12, 13, 25, 29, 30, 32, 33, 35 and 36

4. Boredom Susceptibility (BS): The items here look after if you have intolerance for routine, repetitiveness and boredom. The BS scale consists of the following items from the questionnaire: 2, 5, 7, 8, 15, 24, 27, 31, 34 and 39 (Jack & Ronan, 1998; Zuckermann, 1979). It was 40 questions to answer, 10 in each subscale, and you got 1 or 2 point per question. Maximal score (high SS) is 80 point, and lowest score (low SS) is 40 points.

### **Questionnaire on sexual orientation**

This questionnaire was a single sheet, with one question that was formulated like this: What do you consider yourself to be? When in doubt, choose the one that fits best. They were given 5 options: 1. Bisexual, 2. Homosexual, 3. Heterosexual, 4. Unsure, 5. Do not want to answer (Appendix V).

### **Questionnaire on living condition and ambitions**

This questionnaire was a status questionnaire about demographic description and their ambitions in their sport (Appendix VI).

### **Biological data**

The blood samples were collected at the St. Olavs Hospital, after an overnight fast, from an antecubital vein, one to five days after completing the physical tests. The serum was stored in a -80 degrees freezer at Department of Endocrinology, St. Olavs Hospital. The blood samples collected for use in this thesis were FTI (Free testosterone index) calculated as  $(\text{Testosterone nmol/L} / \text{SHGB nmol/L}) \times 10$  and ADG (3-alfa-diol glucoronide ng/mL).

### **Anthropometric Data**

The body height and weight were measured prior to the physical tests. The body height was tested using a scale, measured to the nearest centimeter (cm). The weight was measured using a digital weight, weighted to the nearest kilogram (kg). The body mass index (BMI) was measured by  $\text{weight (kg)} / \text{height (m)}^2$ .

## **Maximal oxygen uptake**

The maximal aerobic capacity ( $\text{VO}_2\text{-max}$ ) was measured after 15 min warm up. The subjects were running on the treadmill, at approximately 60 % of maximal heart rate during the warm up. The heart rate was measured using a Polar Rx800 heart rate measurer. The test was performed at a constant incline of 10.5 %. The subjects could choose the starting speed, and the speed was increased by 1 km/h every minute until exhaustion. The tests lasted from two to eight minutes.  $\text{VO}_2\text{-max}$  was measured through gas exchange, using an Oxycon Pro (Jaeger GmbH, Hoechberg, Germany), with a sample frequency of 0.1 Hz. All the equipment was calibrated before use. This is considered a maximal effort test, and it was valid if two of the following three criteria were met: 1) a plateau in  $\text{VO}_2$  with increasing exercise intensity, 2) respiratory exchange ratio above 1.10, and 3) blood lactate concentration exceeding 8 mmol·L<sup>-1</sup>. The oxygen uptake was measured continuously, and the average of the six highest 10-second consecutive measurements determined the  $\text{VO}_2\text{-max}$ . The heart rate was also measured during the test. Blood lactate was taken right after completing the  $\text{VO}_2\text{-max}$  test.

## **Statistics**

Statistical analyses in this study were performed using the software IBM SPSS Statistic, version 20.

Results from SSS were divided into four subgroups. Results from SSS and SOC were calculated in max and min score, means, standard deviation (SD), range and p-value. Missing values in the SSS were replaced with means from each of the scales in SSS, found by frequency analysis.

Two possible outliers were identified. One was a women with very low results on the competitiveness scale (score=26), and the other women with very high ADG results (ADG=13,77 ng/mL). These observations may influence the rest of the results. The descriptive analysis were done without the outliers, and the linear regression analyzes were done with and without, to see if there were any differences. The tables presented are without the outliers.

Analyzes used were descriptive statistics to find the mean, range and standard derivations of the results. Linear regression analyze were used to find if there were any statistical significant associations between the variables. The linear regression analyses are expressed using p-values,  $\beta$ 's and Confidence Intervals (CI). Statistical significance was set to  $p < 0,05$  and



Confidence Interval at 95 %. There was also done a Pearson Bivariate Correlation analysis, and the results were expressed in p-values, Pearson Correlates (PC) and number of athletes (N). An Independent samples T-test was done on the descriptive results to find significant differences between groups. The results are expressed in t values (t), degrees of freedom (df) and p-values.

## **Ethics**

The project was approved by The Regional Ethical Committee in Mid-Norway in 2011 (Appendix VII). The participants signed an informed consent sheet before the tests began, and a sheet with information about the study. They could any time, and without giving a reason, withdraw from the study. All the data and results were handled anonymously. The participant's health was considered before the physical tests, and the study participation is a minimal health risk. The declaration of Helsinki was followed during the whole study.



## RESULTS

### Subjects characteristics

The mean, range and SD of the age, BMI, VO<sub>2</sub>-max, FTI and ADG of the subjects are presented in Table 1.

**Table 1:** Descriptive statistics of the body characteristics of the subjects.

Variables	N	Mean	Range	SD
Age	72	23.7	18-38	4.3
BMI (kg/m <sup>2</sup> )	71	23.0	19.0-30.6	2.7
VO2 max	71	54.9	39.9-69.9	7.8
FTI (Testosterone nmol/L /SHGB nmol/L)×10)	67	0.27	0.05-0.98	0.21
ADG (ng/mL)	66	3.34	1.26-7.79	1.52

Of all the 72 subjects, three were married, nine lived as a cohabitant and 56 were single. Only three of the subjects had children and 56 subjects were students. When it comes to the level in their sport, 25 (35 %) were ranked within the ten best in Norway in their sport, and 48 (67 %) were ranked among the ten best in the local area (middle of Norway). Of all the subjects 61.1 %, or 44 persons had ambitions to get on the national team in their sport, and 24 of the athletes had income of their sport today.

The 72 subjects competed in twelve different sports. The sports and number of subjects in each sport is presented in table 2. Cross country skiing, football and handball were the sports with most athletes.

**Table 2:** Types of sports among the athletes.

Type of sport	N = 72	%
Aerobic	1	1.4
Athletics Discus	1	1.4
Biathlon	1	1.4
Cross country	16	21.9
Cycling	5	7
Figure skating	1	1.4
Football	24	32.9
Handball	17	23.3
Power lifting	2	2.7
Taekwondo	3	4.1
Triathlon	1	1.4
Weight lifting	1	1.4

The twelve sports were divided into three sport groups; team sport, endurance and strength and technique. Table 3 presents the three groups.

**Table 3:** Dividing of the subjects into three sports group

<b>Sport group</b>	<b>Type of sports</b>	<b>N</b>	<b>%</b>
Team sport	Handball, Football	41	56.0
Endurance	Aerobic, biathlon, cross country, cycling, triathlon	23	33.0
Strength and technique	Athletic discus, figure skating, power lifting, taekwondo, weight lifting	8	11.0

The subject's subjective sexual orientation is presented in Table 4.

**Table 4:** Descriptive statistics of subjects' subjective sexual orientation.

<b>Variables</b>	<b>N=72</b>	<b>(%)</b>
Heterosexual	59	(81.9)
Homosexual	4	(5.6)
Bisexual	5	(6.9)
Unsure	3	(4.2)
Did not want to answer	1	(1.4)

Nine (12.5 %) of the subjects reported to be homosexual or bisexual. Divided into sport group, one person in the endurance group and eight persons in the team sport group reported being homosexual or bisexual. The mean level of FTI among the homosexuals and bisexual was 0.32 (SD: 0.28, N=8) and among the heterosexuals the mean level was 0.27 (SD: 0.20, N=55). The mean level of ADG among homosexuals and bisexuals was 3.78 (SD: 1.14, N=8) and among the heterosexuals the mean level was 3.24 (SD: 1.59, N=54). A t-test was done to see if there were any differences between the groups and there were no significant differences.

### **Sport Orientation Questionnaire**

The results show a mean of 59.7 with a SD of 4.4. The minimum result was 49 and the maximum result was 65.

## Sensation Seeking Scale

The results of the Sensation Seeking Scale (SSS) are shown in Table 5.

**Table 5:** The subjects Sensation Seeking Scale.

<b>SSS</b>	<b>Min - Max</b>	<b>Mean</b>	<b>SD</b>	<b>Range</b>
Thrill and Adventure Seeking (TAS)	10-20	14.5	1.1	12-17
Experience Seeking (ES)	10-20	13.9	1.2	12-17
Disinhibition (DIS)	10-20	15.1	1.1	12-18
Boredom Susceptibility (BS)	10-20	14.6	1.3	12-18
Total SSS	40-80	58.0	2.5	51-65

## Linear Regression between SSS, SOQ, VO2 max and CAH

Table 6 shows a linear regression analyzes of all the variables among all the athletes. There was a significant association ( $p < 0.05$ ) between  $VO_2$ -max and BMI. There was no significant association between the other variables. The linear regression analyze were also done including the two outliers. That showed only the significant association between  $VO_2$ -max and BMI, but no other significant or weak associations between the variables.

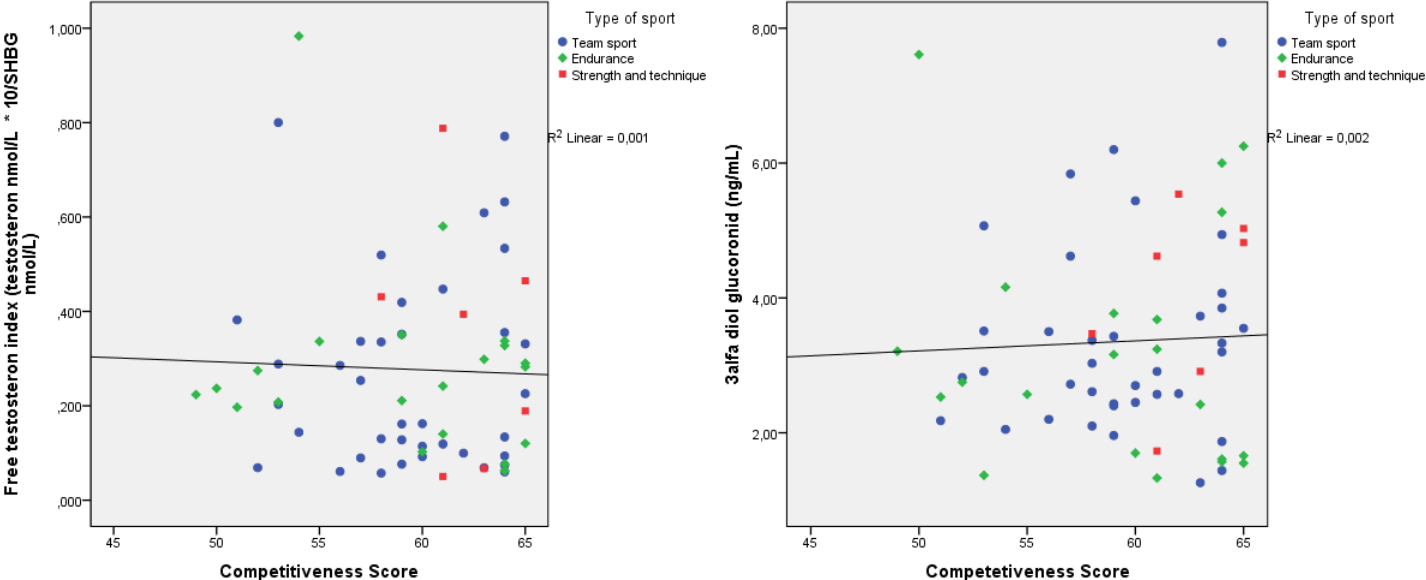
**Table 6:** Linear regression between FTI, ADG, SSS, Competitiveness Score, and VO<sub>2</sub> max. Presented as  $\beta$ , p-values and 95 % Confidence Intervals. Analyzes is without the two outliers.

Variables	$\beta$	p-value	95 % CI
<b>FTI<sup>1</sup></b>			
Thrill and Adventure Seeking (TAS)	0.09	0.48	-0.03 – 0.07
Experience Seeking (ES)	-0.19	0.14	-0.08 – 0.01
Disinhibition (DIS)	-0.11	0.41	-0.07 – 0.03
Boredom Susceptibility (BS)	-0.07	0.59	-0.05 – 0.03
Competitiveness Score	0.07	0.60	-0.02 – 0.01
<b>ADG<sup>1</sup></b>			
Thrill and Adventure Seeking (TAS)	0.05	0.72	-0.29 – 0.41
Experience Seeking (ES)	-0.25	0.06	-0.64 – 0.01
Disinhibition (DIS)	-0.01	0.95	-0.38 – 0.36
Boredom Susceptibility (BS)	-0.16	0.22	-0.48 – 0.11
Competitiveness Score	-0.01	0.96	-0.09 – 0.09
<b>VO<sub>2</sub> max<sup>1</sup></b>			
Thrill and Adventure Seeking (TAS)	-0.06	0.62	-2.26 – 1.36
Experience Seeking (ES)	-0.06	0.63	-2.04 – 1.24
Disinhibition (DIS)	-0.04	0.78	-2.03 – 1.52
Boredom Susceptibility (BS)	0.11	0.39	-0.84 – 2.12
Competitiveness Score	0.15	0.23	-0.18 – 0.72
<b>VO<sub>2</sub> max<sup>1</sup></b>			
FTI	-0.03	0.75	-8.20 – 5.91
ADG	-0.09	0.35	-1.42 – 0.52
BMI	-0.74	0.00*	-2.61 – -1.65
<b>Total SSS<sup>1</sup></b>			
FTI	-0.08	0.58	-4.33 – 2.44
ADG	-0.16	0.25	-0.74 – 0.20
VO <sub>2</sub> max	0.06	0.76	-0.10 – 0.14
BMI	0.11	0.57	-0.25 – 0.45
Competitiveness Score	-0.22	0.09	-0.28 – 0.02
<b>Competitiveness Score<sup>1</sup></b>			
FTI	-0.06	0.65	-7.14 – 4.50
ADG	0.04	0.76	-0.69 – 0.94
VO <sub>2</sub> max	0.20	0.29	-0.10 – 0.32
BMI	0.03	0.86	-0.55 – 0.65
Total SSS	-0.22	0.09	-0.82 – 0.06
Thrill and Adventure Seeking (TAS)	-0.18	0.14	-1.70 – 0.25
Experience Seeking (ES)	-0.19	0.12	-1.58 – 0.19
Disinhibition (DIS)	-0.06	0.65	-1.19 – 0.75
Boredom Susceptibility (BS)	0.02	0.88	-0.74 – 0.86

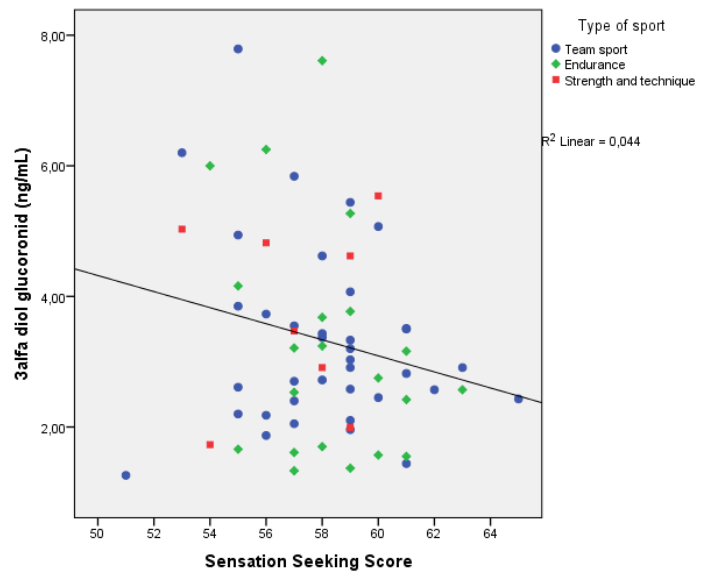
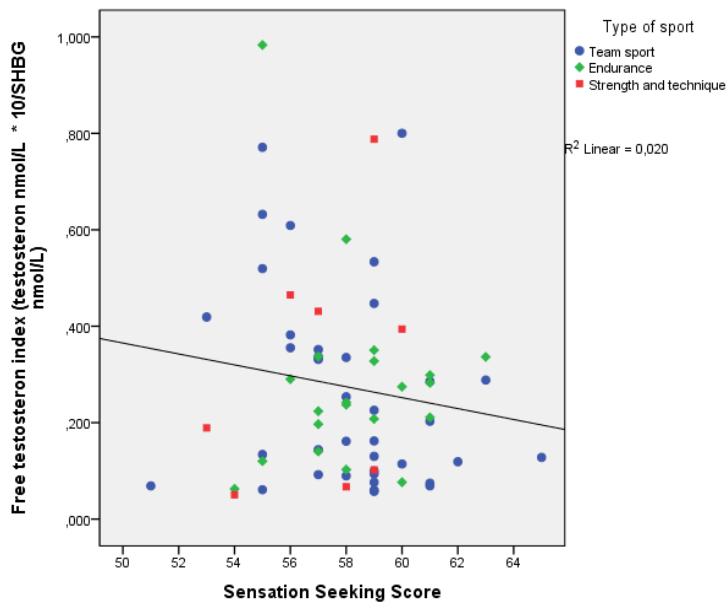
<sup>1</sup> = Dependent variable. FTI = Free Testosterone Index (Testosterone nmol/L /SHGB nmol/L)×10). ADG=3-alfa-dioli glucuronid (ng/mL). VO<sub>2</sub> max = ml/kg/min. BMI = Body Mass Index (kg/m<sup>2</sup>). Total SSS = Total Sensation Seeking Score.  $\beta$  = beta (Standardized regression coefficient). \*Results are statistically significant at p<0.05. CI= 95 % Confidence Interval.

A bivariate correlation analysis was done for all the variables tested in table 6. There were no statistical significant correlations except between ADG and the ES scale ( $p=0.04$ , Pearson correlation (PC)=  $-0.26$ ,  $N=66$ ), and  $VO_2$ -max and BMI ( $p=0.00$ ,  $PC=-0.74$ ,  $N=71$ ).

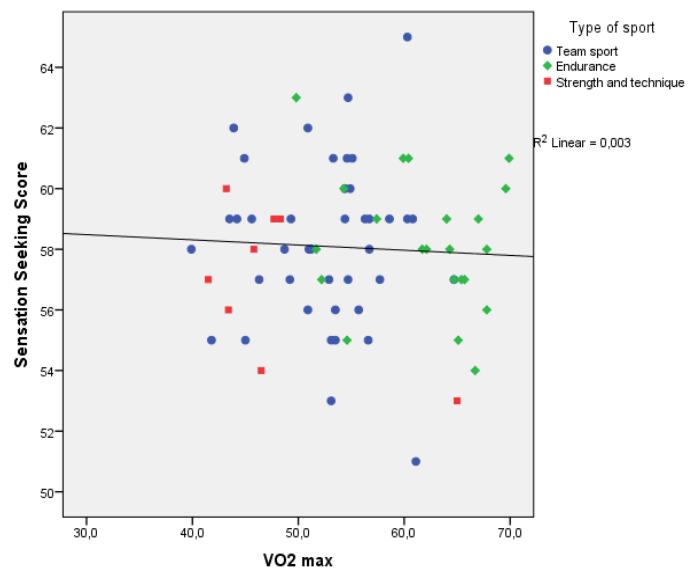
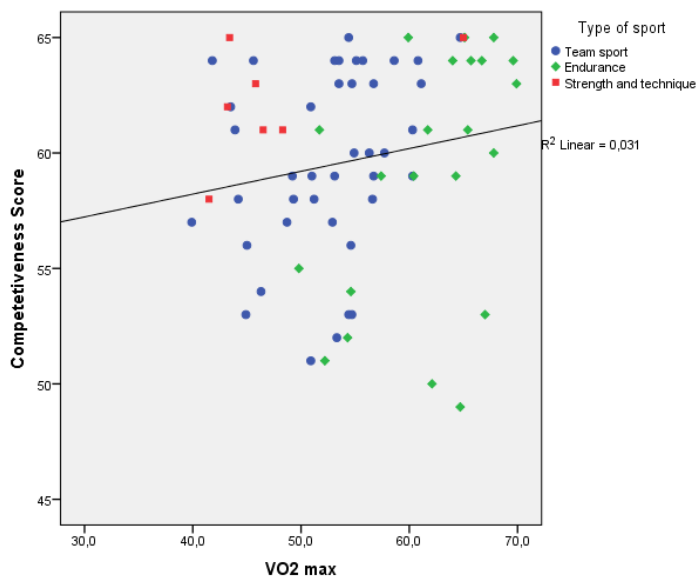
Figure 1 and 2 shows the correlation between the FTI and ADG, competitiveness and the total sensation seeking score in scatter dots plots. Figure 3 shows the correlation between FTI and ADG and  $VO_2$ -max.



**Figure 1:** The correlation between FTI (N=66), ADG (N=65) and Competitiveness Score.



**Figure 2:** The correlation between FTI (N=67), ADG (N=66) and Sensation Seeking Score for all subjects.



**Figure 3:** The correlation between Competitiveness Score (N=71), Total Sensation Seeking Score (N=72) and VO<sub>2</sub>-max for all subjects.



## Dividing of the subjects into the three different sport groups

In table 3 the different sports are divided into three different sports groups. To study if there were any differences between the three groups, the same analyzes were done.

**Table 7:** Descriptive statistics of the mean, minimum and maximum results of the VO<sub>2</sub> max, BMI, FTI, ADG, SSS and Competitiveness when divided into three sports group.

Variable	Strength and technique (N=8)			Endurance (N=23)			Team sport (N=41)		
	Mean	Range	SD	Mean	Range	SD	Mean	Range	SD
<b>VO<sub>2</sub> max</b>	47.6	41.5-65.0	7.4	61.9	49.8-69.9	6.0	52.5	39.9-64.7	5.8
<b>BMI</b>	24.6	19.1-30.5	3.4	21.2	19.0-25.3	1.7	23.6	19.5-29.7	2.6
<b>FTI</b>	0.31	0.05-0.78	0.26	0.28	0.06-0.98	0.20	0.26	0.05-0.80	0.21
<b>ADG</b>	3.76	1.73-5.54	1.45	3.21	1.33-7.61	1.78	3.31	1.26-7.79	1.40
<b>Total SSS</b>	57.0	53-60	2.5	58.3	54-63	2.2	58.2	51-65	2.7
<b>Competitiveness</b>	62.1	58-65	2.5	59.0	49-65	5.3	59.7	51-65	3.9

FTI = Free Testosterone Index (Testosterone nmol/L /SHGB nmol/L)×10). ADG =3-alfa-diol glucoronid (ng/mL). VO<sub>2</sub> max = ml/kg/min. BMI = Body Mass Index (kg/m<sup>2</sup>). Total SSS = Total Sensation Seeking Score.

A T-test was done to see if there were any significant differences between the groups. The only significant results involved VO<sub>2</sub>-max or BMI. Between team sport group and endurance group, the team sport group had a significant higher VO<sub>2</sub>-max ( $t=-6.02$ ,  $df=61$ ,  $p=0.00$ ) and BMI ( $t=3.89$ ,  $df=61$ ,  $p=0.00$ ). Between the team sport group and the strength and technique group there is a significant higher VO<sub>2</sub>-max ( $t=2.08$ ,  $df=47$ ,  $p=0.043$ ). The endurance group had significant higher VO<sub>2</sub>-max ( $t=5.36$ ,  $df=28$ ,  $p=0.00$ ) and BMI ( $t=-3.70$ ,  $df=28$ ,  $p=0.00$ ) than the strength and technique group. There were no significant differences between the groups in the other variables.

After dividing into sport groups, 51.2 % of the team sport athletes, 69.6 % of the endurance athletes and 87.5 % of the strength and technique athletes had ambitions to be on the national team. 9.8 % of the team sport athletes, 56.5 % of the endurance and 100 % of the strength and technique athletes were among the 10<sup>th</sup> best in the country last season. And 58.5 % of the team sport athletes, 78.3 % of the endurance athletes and 75 % (two persons missing an answer) of the strength and technique athletes were among the 10<sup>th</sup> best in the region last season.

A linear regression was done after dividing the subjects into three groups. Table 8 shows the results of the variables with significant association between variables ( $p < 0.05$ ). The variables not having any significant association are not shown in the table. The analyses were done without the two outliers.

**Table 8:** Results of linear regression analyzes according to sport groups. Same analysis as table 6, but table 8 only shows the results when one of the sport group get a p-value  $< 0,05$ . Presented as  $\beta$ , p-value and 95 % Confidence Interval.

Variable	Sport group	$\beta$	p-value	CI
<b>VO<sub>2</sub> max<sup>1</sup></b>				
ADG	Strength technique	0.52	0.21	-2.32-7.64
	Endurance	0.00	0.99	-1.20-1.21
	Team sport	-0.31	0.04*	-2.64- -0.07
BMI	Strength technique	-0.70	0.07	-3.20-0.18
	Endurance	-0.58	0.00*	-3.50- -0.79
	Team sport	-0.65	0.00*	-2.03- -0.87

<sup>1</sup> = Dependent variable. FTI = Free Testosterone Index (testosterone nmol/L/SHGB nmol/L\*10). ADG =3-alfa-diol glucoronid (ng/mL). VO<sub>2</sub> max = ml/kg/min. BMI = Body Mass Index (kg/m<sup>2</sup>). Total SSS = Total Sensation Seeking Score.  $\beta$  = beta (Standardized regression coefficient). \*Results are statistically significant at  $< 0.05$ . CI= 95 % Confidence Interval.

A bivariate correlation analysis was performed, and there was a statistical significant correlation between VO<sub>2</sub>-max and BMI in all the groups (TS:  $p=0.00$ , PC= -0.64, N=41, Endurance:  $p=0.00$ , PC= -0.69, N=22, ST:  $p=0.04$ , PC= -0.73). In the endurance group there was also a statistical significant correlation between VO<sub>2</sub>-max and FTI ( $p=0.02$ , PC= -0.52, N=21) and between VO<sub>2</sub>-max and competitiveness ( $p=0.03$ , PC=0.46, N=22).

## DISCUSSION

The aim was to analyze the possible association between circulating androgen hormones, competitiveness, sensation seeking and VO<sub>2</sub>-max among Norwegian female athletes. The main findings in all the athletes together was a significant association between VO<sub>2</sub>-max and BMI, which was an expected result, since it is well documented that body composition may influence the VO<sub>2</sub>-max (Högström, Pietilä, Nordström, & Nordström, 2012), and a significant association between ADG and experience seeking (ES). When dividing into sport groups, there was still a significant association between VO<sub>2</sub>-max and BMI in the endurance and team sport groups. In the team sport group there was also a significant association between ADG and VO<sub>2</sub>-max.

### Sensation seeking and competitiveness

The main competitiveness score of all the athletes was 59.7, which correspond with another study by Gill and Dzewaltowski (1998) on athletes and non athletes where the mean competitiveness score of the SOQ were 58.1 among athletes and 45.9 among non-athletes. The study was done on both women and men, but when separating the sports groups and gender, the female cross country skiers scored 61.2 and the female soft ball team scored 59.1. This is about the same as our findings, which may confirm that the athletes in our study are competitive athletes (Gill & Dzewaltowski, 1988). There were no significant differences between the three sports group.

The mean of sensation seeking scale (SSS) was 58.1, and compared to another study by Jack and Ronan (1998) on high and low risk sport, the SSS was about the same as in low risk sport, like marathon running and golf. This confirms that there may be low risk sport athletes we have as subjects. This was expected since none of the sports included are considered a high risk sport, or that the subjects do not score high on sensation seeking (SS) compared to high risk sport athletes.

Earlier research on SS have found that there was a link between TAS and BS to the engagement in competitive sport among females (Franken, Hill, & Kierstead, 1994). This doesn't fit with our findings, as there was no significant association between competitiveness and TAS and BS among the subjects.

After doing a correlation analysis we could see that there was an association between VO<sub>2</sub>-max and competitiveness among the endurance athletes. The endurance athletes are also the subjects with significant higher VO<sub>2</sub>-max, and 56.5 % of the endurance athletes were among the 10<sup>th</sup> best in the country last season, compared to 9.8 % in the team sport group. This may be an indicator that athletes with high VO<sub>2</sub>-max on a higher level within their sport also have a higher competitiveness. Among the strength and technique group, 100 % of the athletes were among the 10<sup>th</sup> best in the country, and there was no correlation between VO<sub>2</sub>-max and competitiveness, and this may indicate that the maximal oxygen level needs to be higher for this group to be an association. But we also have to consider the differences in sports. It is not all of the sports in the strength and technique group where you need high VO<sub>2</sub>-max to succeed.

Athletes are reported to have higher scores on competitiveness than non athletes (Gill & Dzewaltowski, 1988), and may also have higher scores on sensation seeking than non athletes. However, there may be a stronger association for athletes on a higher level. Both the scores on competitiveness and SS may be influenced by subjective factors. Only 61 % of all the athletes in our study had ambitions of being at the national team, and only 35 % were among the 10<sup>th</sup> best in the country last session, while 67 % were among the 10<sup>th</sup> best in the region last session. In addition to physical performance, this may indicate that we don't have the most ambitious female athletes in the region as subjects, and this may influence the results.

If we think of the naturals of the sports, playing handball and football have more aspects of action and sensation seeking than for instance cross country skiing. But there were no differences between the sports in SS and competitiveness. This may indicate selection bias, and that the selection of the athletes may not be good enough.

### **Association between androgen hormones, SSS and Competitiveness**

Both Cashdan (1998) and Pokrywka et al. (2005) found an association between competitiveness and androgen hormones in females. This is not in correspondence with our findings, where there was no association between competitiveness and the FTI and ADG level tested. Our results correlate with Mazur (1997), which did not find any associations. We have to consider the level of our athletes here, and since they were not the very best girls in the

sport, they may also have lower levels of hormones and competitiveness. There is not much previous research on competitiveness and androgen hormones among female athletes; most of what exists compares the genders. More research on the subject is needed, and with homogenous groups of athletes.

Previous research on sensation seeking have shown that gonadal hormones are related to certain sensation seeking scales (Roberti, 2004). When we look at the entire group, there was a correlation between ADG and ES after a correlation analyses, and we see in the linear regression analysis that the p-value was 0.06, a weak association. This may indicate that the subjects with higher ADG levels also have more needs to try out new experiences, and that is why they like to participate in sport. But we found no association between the FTI and SSS, which earlier research has found (Buser, 2009; Zuckerman et al., 1980). There has also been shown a large and significant effect of female sex hormones on competitiveness. Females with natural menstrual cycle and normal levels of female sex hormones is less likely to choose a tournament (Buser, 2009). We don't have any information or analyses of which of the athletes taking oral contraceptive (OC), and since that may affect the female sex hormone levels, this may affect their competitiveness.

### **Association between androgen hormones, SSS, competitiveness and VO<sub>2</sub>-max**

When it comes to female athletes and androgen hormones, Mazur et al. (1997) did not find a change in testosterone level among females before, during and after a competition (Mazur, Susman, & Edelbrock, 1997). Consitt et al. (2002) found that there was a rise in testosterone level after a short term endurance exercise, but not after a short term resistance exercise. After long-term training, however, Consitt et al. (2002) found both decreased testosterone levels, and no change in testosterone levels after endurance training. Long-term resistance training, may increase strength, but not increase the testosterone levels. If the levels of testosterone increase, it is only after a long period of training. This may indicate that a certain amount of training is necessary before exercise will induce a hormonal response (Consitt et al., 2002). Our results indicate no correlation between FTI or ADG and VO<sub>2</sub>-max among all the athletes, which is the same as Mazur et al. (1997) and parts of the studies of Consitt et al. (2002).

When dividing all the subjects into three groups, depending on what sport they belonged to, the endurance athletes had a higher mean  $VO_2$ -max than the two other groups. The T-test showed a significant difference in  $VO_2$ -max and BMI between the team sport and endurance groups, and between the endurance and strength and technique groups. And there was a significant difference between the team sport and strength and technique groups. This shows that the physical fitness level may be different between the groups, with the endurance group having the highest  $VO_2$ -max. Considering the nature of the sports, this was an expected result. Rickenlund et al. (2003) found that female athletes with higher levels of androgen hormones have a higher  $VO_2$ -max than female athletes with normal levels of androgen hormones. After a correlation analyses we found an association between FTI and  $VO_2$ -max among the endurance athletes, and this correlate with what Rickenlund et al. (2003) found. Even though this was not the results after the regression analysis, this may indicate that there is an association. There was also a significant association between ADG and  $VO_2$ -max among the team sport athletes. This also correlate with what Rickenlund et al. (2003) found, that it might be in sports that demands strength and endurance, like handball, that have higher levels of hyperandrogenism. The handball athletes did vary much in physical levels, some of them had a low  $VO_2$ -max, and a few of those were goal keepers (3 persons). This may again affect the results, and the association between more of the variables could have been stronger if the goal keepers' results been cut.

All of these results indicate that the physical level of the athletes is an important factor to consider when doing analyzes. If the level of the subjects had been higher, and they had all had ambitions to be best, and had been among the top ten in the country, maybe other results had been found. To have a control groups of non-athletes and athletes on lower levels might also make analyzes and comparing among female athletes easier.

## **Sexual orientation**

Normann (2010) found that among 3141 Norwegian women, 98.3 % state themselves heterosexuals, and 1.7 % as homosexuals, bisexuals, other or uncertain. Among or participants 12.5 % reported that they were homosexual or bisexual, which differs markedly from Normann's report. This may support Skogvang and Fastings (2013) report that say it may be easier to come forward as homosexual in the football environment, since eight of the nine homosexuals and bisexuals are team sport players.

The mean hormone level was not significantly higher among the homosexuals compared to the heterosexuals. Our findings do not correlate with earlier findings (Baucom et al., 1985; Neave, 2008) saying there may be an association between homosexuals and androgen hormone levels. They did not study only athletes, which this study did, so there is a difference in the group of females studied. The theory that hormone influence in pre birth development, and that 2D:4D ratio may be an indicator for higher androgen hormone levels, was not investigated in this thesis. It is an interesting topic to investigate why there might be a high number of homosexual women in team sports. Nevertheless, any research on homosexuality is a sensitive topic, and any research should be carefully considered.

### **Strengths and limitations of the study**

The procedures and methods were proven to be good and all measurements were done on the same machines. The questionnaires, except for sexual orientation, are reliable and valid and used in many other studies before (Gill & Deeter, 1988; Gill et al., 1988; Jack & Ronan, 1998; Zuckerman, 1983; Zuckerman et al., 1964).

The number of subjects may be acceptable, but the results showed mixed performance level in the  $VO_2$ -max test. This may have affected the results; specially some of the subjects had low  $VO_2$ -max. The reason for this difference may also be the big variety of sports of the athletes, not all of the sports demand a high score on  $VO_2$ -max to perform well. When the subjects were divided into three groups, there were few subjects in the strength and technique group, compared with the other two groups. Also within the team sport group, some of the handball players (goal keepers), had a lower level of  $VO_2$ -max than the other subjects in the group, and may have affected the results in that group. As discussed earlier, selection bias may also be a limitation of the study.

By using questionnaires the subjects can underreport or over report, report inaccurate and deny behavior or feelings. It is also a possibility of bias, and because there were many questionnaires to answer at the same time, subjects may not take the time to read and answer the questions properly.

When doing research on females, and using biological data as hormone levels, it could be interesting to know where in their menstrual status they were during the blood samples and the physical tests. Also if they were on any oral contraceptive (OC) is interesting, because that may influence their hormone levels. We could have made an estimation on which part of the menstrual cycle they were in, and if they were on OC, from the blood samples, but this were not done. There have been studies that have shown both significant difference in exercise-induced changes and no significant changes during different phases of the menstrual cycle (Consitt et al., 2002). We also have to consider the possibilities of menstrual irregularities when doing research on female athletes, because strenuous training can be associated with amenorrhea or oligomenorrhoea (Consitt et al., 2002). Rickenlund et. al, 2004, have showed that the ovarian androgens, like testosterone, may be suppressed among female athletes that start on oral contraceptive (OC). OC may also have a significant effect on body composition, but little impact on the physical performance (Rickenlund et al., 2004). Buser, 2009, found that female sex hormone had a large significant effect on competitiveness. The women not using hormonal contraceptives were less competitive during the fourth phase of the menstrual cycle, and women taking hormonal contraceptives were significantly more competitive during the pill break (Buser, 2009). A limitation to this study is that we do not have any data on the subjects menstrual status, or if they took any contraceptive, and that may influence the hormonal, the psychological and physical performance results.

There was no control group in this study to compare the results of the athletes, with non athletes, which can make it difficult to conclude if there is a difference in the results among the athletes compared to the non athletes.



## CONCLUSION

There was a significant association between the androgen metabolite 3-alfa-diol glucuronid (ADG) and experience seeking (ES) scale of sensation seeking (SS). After comparing with VO<sub>2</sub>-max there was an association between VO<sub>2</sub>-max and BMI. This indicates that androgen hormones may have something to do with wanting to try new experiences, like sports. There were no other associations among all the athletes.

When dividing the subjects into three major sports group, there was a significant association between ADG and VO<sub>2</sub>-max among the team sport athletes, and between the androgen hormone free testosterone index (FTI) and VO<sub>2</sub>-max among the endurance athletes. Among the endurance athletes there was also a significant association between competitiveness and FTI. There may therefore be an association between androgen hormones and some types of sports at a certain level of VO<sub>2</sub>-max. Also, there may be an association between androgen hormones and competitiveness among endurance athletes.

More research is needed to investigate the possible association between androgen hormones and psychological traits like competitiveness and sensation seeking among female athletes. To do a longitudinal study and focus more on top athletes, in a more homogenous group with athletes on the same level in the country is recommended. Then it might be possible to see if there is a stronger association between androgen hormones and psychological traits, and to maybe answer who the females choosing to train the 10 000 hours to achieve their goals are.



## SOURCES

- Balthazart, J. (2011). Minireview: Hormones and Human Sexual Orientation. *Endocrinology*, 8(152), 2937-2947.
- Baucom, D. H., Besch, P. K., & Callahan, S. (1985). Relation Between Testosterone Concentration, Sex Role Identity and Personality Among Females. *Journal of Personality and Social Psychology*, 48(5), 1218-1226.
- Buser, T. (2009). The impact of female sex hormones on competitiveness. *Tinbergen Institute Discussion Paper*, 082/3.
- Campbell, N. A., & Reece, J. B. (2005). Hormones and the Endocrine System. In B. Wilbur (Ed.), *Biology* (7 ed.). United States of America: Pearson Education.
- Cashdan, E. (1998). Are men more competitive than woman? *British Journal of Social Psychology*, 37, 213-229.
- Cashdan, E. (2003). Hormones and Competitive Aggression in Women. *Aggressive behavior*, 29, 107-115.
- Consitt, L. A., Copeland, J. L., & Tremblay, M. S. (2002). Endogenous Anabolic Hormone Responses to Endurance Versus Resistance Exercise and Training in Women. *Sports Medicine*, 32(1), 1-22.
- Cook, C. J., Crewther, B. T., & Smith, A. A. (2012). Comparison of Baseline Free Testosterone and Cortisol Concentrations Between Elite and Non-Elite Female Athletes. *American Journal of Human Biology*, 24, 856-858.
- Enea, C., Boisseau, N., Fargeas-Gluck, M. A., Diaz, V., & Dugué, B. (2011). Circulating Androgens in Women Exercise-Induced Changes. *Sports Medicine*, 41(1), 1-15.
- Ericsson, K. A., Krampe, R. T., & Clemens, T.-R. (1993). The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review*, 100(3), 363-406.
- Fasting, K., & Sand, T. S. (2009). *Kjønn i endring, en tilstandsrapport om norsk idrett* (Vol. 1). Norway: Akilles Forlag.
- Franken, R. E., Hill, R., & Kierstead, J. (1994). Sport Interest as Predicted by the Personality Measures of Competitiveness, Mastery, Instrumentality, Expressivity, and Sensation Seeking. *Personality and Individual Differences*, 17(4), 467-476.
- Gill, D. L., & Deeter, T. E. (1988). Development of the Sport Orientation Questionnaire. *Research Quarterly for Exercise and Sport*, 59(3), 191-202.
- Gill, D. L., & Dzewaltowski, D. A. (1988). Competitive orientations among intercollegiate athletes: Is winning the only thing? *The Sport Psychologist*, 2, 212-221.

- Gill, D. L., Dzewaltowski, D. A., & Deeter, T. E. (1988). The Relationship of Competitiveness and Achievement Orientation to Participation in Sport and Nonsport Activities. *Journal of Sport and Exercise Psychology, 10*, 139-150.
- Hadley, M. E. (2000). *Endocrinology* (P. F. Corey Ed. 5th ed.). USA: Prentice-Hall, Inc.
- 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), 1241-1248.
- Hamilton, L. D., van Anders, S. M., Cox, D. N., & Watson, N. V. (2009). The Effect of Competition on Salivary Testosterone in Elite Female Athletes. *International Journal of Sports Physiology and Performance, 4*, 538-542.
- Horton, R. (1992). Dihydrotestosterone Is a Peripheral Paracrine Hormone. *Journal of Andrology, 13*(1), 23-27.
- Houston, J. M., Carter, D., & Smither, R. D. (1997). Competitiveness in elite professional athletes. *Perceptual and Motor Skills, 84*, 1447-1454.
- Högström, G. M., Pietilä, T., Nordström, P., & Nordström, A. (2012). Body composition and performance: influence of sport and gender among adolescents. *Journal of Strength and Conditioning Research, 27*(7), 1799-1804.
- IOC, T. I. O. C. (2013a). Olympic Games. Retrieved 04.05.12 and 25.11.2013, from <http://www.olympic.org/olympic-games>
- IOC, T. I. O. C. (2013b). Factsheet, Women in the Olympic Movement. In T. I. O. C. IOC (Ed.). [http://www.olympic.org/Documents/Reference\\_documents/Factsheets/Women\\_in\\_Olympic\\_Movement.pdf](http://www.olympic.org/Documents/Reference_documents/Factsheets/Women_in_Olympic_Movement.pdf).
- Jack, S. J., & Ronan, K. R. (1998). Sensation seeking among high- and low-risk sports participants. *Personality and Individual Differences, 25*(6), 1063-1083. doi: 10.1016/S0191-8869(98)00081-6
- Labrie, F., Bélanger, A., Patrick, B., Bérubé, R., Martel, C., Cusan, L., . . . Leclaire, J. (2006). Androgen glucuronides, instead of testosterone, as a new markers of androgenic activity in women. *Journal of Steroid Biochemistry & Molecular Biology, 99*, 182-188.
- Lippa, R. A. (2003). Are 2D:4D Finger-Length Ratios Related to Sexual Orientation? Yes for Men, No for Women. *Journal of Personality and Social Psychology, 85*(1), 179-188.

- Mazur, A., Susman, E., & Edelbrock, S. (1997). Sex difference in testosterone response to a video game competition. *Evolution and Human Behavior*, *18*, 317-326.
- Mowen, J. C. (2004). Exploring the Trait of Competitiveness and Its Consumer Behavior Consequences. *Journal of Consumer Psychology*, *14*(1&2), 52-63.
- Neave, N. (2008). *Hormones and Behavior* (1st ed.). USA: Cambridge University Press, New York.
- Nelson, R. J. (2000). *An Introduction to Behavioral Endocrinology*. (2 ed.). Massachusetts, USA: Sinauer Associates, Inc.
- NIF, N. I. o. O. o. P. k. (2013). Årsrapport 2012. Norge: Norges Idrettsforbund.
- Normann, T. M., & Gulløy, E. (2010). Seksuell indentitet og levekår. Evaluering av levekårsrelevans og datafangst. . Statistisk sentralbyrå. Statistics Norway.: Statistisk sentralbyrå. Statistics Norway.
- Pokrywka, L., Rachon, D., Suchecka-Rachon, K., & Bitel, L. (2005). The Second to Fourth Digit Ratio in Elite and Non-Elite Female Athletes. *American Journal of Human Biology*, *17*, 796-800.
- Rickenlund, A., Carlström, K., Ekblom, B., Bismar, T. B., von Schoultz, B., & Hirschberg, A. L. (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., Bismar, T. B., Von Schoultz, B., & Hirschberg, A. L. (2004). Effects of Oral Contraceptives on Body Composition and Physical Performance in Female Athletes. *The Journal of Clinical Endocrinology & Metabolism*, *89*(9), 4364-4370.
- Roberti, J. W. (2004). A review of behavioral and biological correlates of sensation seeking. *Journal of research in personality*, *38*, 256-279.
- Skogvang, B. O., & Fasting, K. (2013). Football and sexualities in Norway. *Soccer & Society*. doi: 10.1080/14660970.2013.843924
- Zuckerman, M. (1983). Sensation seeking and sports. *Personality and Individual Differences*, *4*(3), 285-292. doi: 10.1016/0191-8869(83)90150-2
- Zuckerman, M. (2007). *Sensation seeking and risky behavior* (First edition ed.). Washington, DC: American Psychological Association.

- Zuckerman, M., Buchsbaum, M. S., & Murphy, D. L. (1980). Sensation seeking and its biological correlates. *Psychological Bulletin*, *88*(1), 187-214. doi: 10.1037/0033-2909.88.1.187
- Zuckerman, M., Kolin, E. A., Price, L., & Zoob, I. (1964). Development of a sensation-seeking scale. *Journal of Consulting Psychology*, *28*(6), 477-482. doi: 10.1037/h0040995
- Zuckermann, M. (1979). *Sensation Seeking: Beyond the Optimal Level of Arousal*. Hillsdale, New Jersey, United States of America: Lawrence Erlbaum Associates, Publishers.

## APPENDIX I

### 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 deltagelse 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<sub>2</sub> max, laktat, maksimal muskelkraft ved spenstopp 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 toppidrettskvinnens 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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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 oppfølging. 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 aidentifisert 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 aidentifiserte 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

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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  
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## APPENDIX II

### 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 meg 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<sub>2</sub>max)
- 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

## APPENDIX III

Initialer:

Studiedeltager nr.

The Female Competitiveness Study:

### SPORT ORIENTATION QUESTIONNAIRE (SOQ)

De følgende utsagnene beskriver reaksjoner på idrettssituasjoner. Vi vil vite hva du vanligvis føler angående idrett og konkurranse. Les hvert utsagn og kryss av i boksen som indikerer hvor enig eller uenig du er med utsagnet på skalaen: a, b, c, d eller e. Det er ingen riktige eller gale svar, bare svar ærlig det du føler. Ikke bruk for lang tid på noen av utsagnene. Husk å svare det du vanligvis føler.

	A Veldig enig	B Litt enig	C Verken enig eller uenig	D Litt uenig	E Veldig uenig
1. Jeg er en bestemt konkurrent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Jeg er en konkurrerende person.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Jeg prøver på det hardeste å vinne.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Jeg ser frem til å konkurrere.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Jeg liker å konkurrere mot andre.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Jeg vokser på konkurranse.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Målet mitt er å være den best mulige atleten.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Jeg vil være suksessfull i sport.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Jeg jobber hardt for å bli suksessfull i sport.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Den beste testen på mine evner er konkurranse mot andre.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Jeg ser frem til muligheten til å teste mine ferdigheter i konkurranse.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Jeg presterer mitt beste når jeg konkurrerer mot en motstander.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Jeg vil være den beste hver gang jeg konkurrerer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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## APPENDIX IV

Initialer:

Studiedeltager nr.

The Female Competitiveness Study:

### SPØRRESKJEMA OM SPENNINGSSØKING

Instruksjoner: Hver av emnene under inneholder to valg, A og B. Vær vennlig og sett ett kryss ved alternativet som best beskriver dine ønsker eller følelser. I noen tilfeller kan du finne alternativer som både beskriver dine ønsker og følelser. I andre tilfeller kan du oppleve og ikke like noen av alternativene. I disse tilfellene markerer du alternativet du misliker minst. Ikke etterlat noen emner blanke.

Det er viktig at du besvarer alle emnene med bare ett alternativ. Vi er bare interessert i dine ønsker og følelser, ikke hvordan andre føler eller hva man burde føle rundt emnene. Det finnes ingen riktige eller gale svar. Vær rett fram og gi din ærlige oppfatning av deg selv.

- A Jeg liker "ville" uhemmede fester.  
 B .Jeg foretrekker milige fester med gode samtaler
- A Noen filmer trives jeg med å se to, eller til og med tre, ganger.  
 B Jeg holder ikke ut å se en film jeg har sett før.
- A Jeg skulle ofte ønske at jeg kunne være en fjellklatrer.  
 B Jeg kan ikke forstå mennesker som risikerer livet sitt på fjellklatring.
- A Jeg misliker alle kroppslukter.  
 B Jeg liker noen av de jordnære kroppsluktene.
- A Jeg kjeder meg når jeg møter de samme gamle fjesene.  
 B Jeg liker den komfortable fortroligheten med hverdagsvenner.

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6.  A Jeg liker å utforske en fremmed by eller en del av en by på egenhånd, selv om det innebærer at jeg går meg bort.
- B Jeg foretrekker å ha en guide når jeg er på et sted jeg ikke kjenner godt.
7.  A Jeg misliker folk som sier eller gjør ting bare for å sjokkere eller gjøre andre mennesker opprørt.
- B Når man kan forutsi nesten alt en person kommer til og gjøre eller si må han eller hun være kjedelig.
8.  A Jeg liker vanligvis ikke en film eller et teaterstykke hvor jeg kan forutsi hva som vil skje på forhånd.
- B Jeg har ikke noe imot å se en film eller et teaterstykke hvor jeg kan forutsi hva som vil skje på forhånd.
9.  A Jeg har prøvd, eller kan tenke meg å prøve, marihuana.
- B Jeg ville aldri røyket marihuana.
10.  A Jeg kunne aldri tenke meg å prøve noe dop som kan gi meg rare og farlige virkninger.
- B Jeg kan tenke meg å prøve noen av de nye stoffene som forårsaker hallusinasjoner.
11.  A En fornuftig person unngår aktiviteter som er farlige.
- B Noen ganger liker jeg å gjøre ting som er litt skremmende.
12.  A Jeg misliker "swingers" (mennesker som er uhemmet og frie angående sex)
- B Jeg trives i selskap med ekte "swingers".
13.  A Jeg opplever at stimulerende stoffer gjør meg ukomfortabel.
- B Jeg liker ofte å bli beruset (drikke brennevin eller røyke marihuana).
14.  A Jeg liker å prøve matretter jeg aldri har smakt før.
- B Jeg bestiller matretter jeg kjenner, sånn at jeg unngår skuffelse og ubehageligheter.



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15.  A Jeg liker å se på hjemmefilmer, reiselysbilder eller hjemmevideoer.  
 B Å se på noens hjemmefilmer, reiselysbilder eller hjemmevideoer kjeder meg veldig.
16.  A Jeg kunne tenke meg å begynne med vannski.  
 B Jeg kunne ikke tenke meg å begynne med vannski.
17.  A Jeg ville likt å prøve surfing.  
 B Jeg ville ikke likt å prøve surfing.
18.  A Jeg ville likt å dra på en tur uten forhåndsplanlagte eller definerte ruter og timeplaner.  
 B Når jeg drar på en tur liker jeg å planlegge ruten og tidsskjemaet temmelig nøye.
19.  A Jeg foretrekker jordnære mennesker som venner.  
 B Jeg ville likt å bli venner med noen mennesker i uvanlige grupper som artister eller "punkere".
20.  A Jeg kan ikke tenke meg å lære å fly et fly.  
 B Jeg kunne tenke meg å lære å fly et fly.
21.  A Jeg foretrekker overflaten av vannet fremfor dypet.  
 B Jeg ville like å dykke.
22.  A Jeg kunne tenke meg å møte personer som er homoseksuelle (menn eller kvinner).  
 B Jeg holder meg unna alle jeg mistenker for å være "homo" eller "lesbisk".
23.  A Jeg ønsker å prøve fallskjermhopping.  
 B Jeg ville aldri prøvd å hoppe ut av et fly med eller uten fallskjerm.



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24.  A Jeg foretrekker venner som er spennende uforutsigbare.  
 B Jeg foretrekker venner som er pålitelige og forutsigbare.
25.  A Jeg er ikke interessert i opplevelser for sin egen del.  
 B Jeg liker nye og spennende erfaringer og opplevelser/følelser selv når de er litt skremmende, ukonvensjonelle eller ulovlige.
26.  A Essensen av god kunst er i dens klarhet, symmetri av form og harmoni av farger.  
 B Jeg finner ofte skjønnhet i virvaret av farger og uregelmessige former i moderne malerier.
27.  A Jeg liker å tilbringe tid i de kjente omgivelsene hjemme.  
 B Jeg blir veldig rastløs hvis jeg må være nær hjemmet over tid.
28.  A Jeg liker å stupe fra stupebrett.  
 B Jeg liker ikke følelsen jeg får av å stå på et stupebrett (eller jeg går ikke nær et stupebrett i hele tatt).
29.  A Jeg liker å date medlemmer av det motsatte kjønn som er fysisk spennende.  
 B Jeg liker å date medlemmer av det motsatte kjønn som deler verdiene mine.
30.  A Overdreven drikking ødelegger vanligvis festen fordi noen personer blir høylytte og bråkete.  
 B Å holde drinkene fulle er nøkkelen til en god fest.
31.  A Den verste sosiale synden er å være uhøflig.  
 B Den verste sosiale synden er å være kjedelig.
32.  A En person bør ha en betydelig mengde seksuell erfaring før ekteskap.  
 B Det er bedre hvis to gifte personer begynner den seksuelle erfaringen sin med hverandre.



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33.  A Selv om jeg hadde pengene ville jeg ikke brydd meg om å assosiere meg med flyktige, rike personer i "jet set"-livet.
- B Jeg kunne sett meg selv søke glede rundt i verden med "jet settere".
34.  A Jeg liker personer som er skarpe og vittige selv om de noen ganger fornærmer andre.
- B Jeg misliker personer som har det gøy på bekostning av andres følelser.
35.  A Det er alt i alt for mye sex vist i filmer.
- B Jeg nyter å se mange av de sexy scenene i filmer.
36.  A Jeg føler meg best etter å ha tatt et par drinker.
- B Noe er galt med mennesker som trenger brennevin for å føle seg bra.
37.  A Folk burde kle seg etter noen standarder av smak, netthet og stil.
- B Folk burde kle seg på individuelle måter selv om av det noen ganger medfører rare resultater.
38.  A Å seile lange distanser i små seilbåter er dumdrilig.
- B Jeg kunne tenke meg å seile en lang distanse i en liten, men sjødyktig seilbåt.
39.  A Jeg har ingen tålmodighet med kjipe eller kjedelige personer.
- B Jeg finner noe interessant ved nesten alle personer jeg snakker med.
40.  A Hurtig skikjøring ned en høy fjellside er en bra måte å ende opp på krykker.
- B Jeg tror jeg ville nytt følelsen av å kjøre fort ned en høy fjellside på ski.





## APPENDIX V

Initialer:

Studiedeltager nr.

The Female Competitiveness Study

### SPØRRESKJEMA OM SEKSUELL ORIENTERING

Dette er et enkelt spørreskjema om seksuell orientering. Dersom du ikke ønsker å svare på skjemaet ber vi deg likevel krysse av nederst på skjemaet så vi kan se av skjemaet ikke er blitt oversett.

Hva anser du deg selv for å være?

Ved tvil velger du det som passer best, sett kun ett kryss:

- 1. Biseksuell
- 2. Homoseksuell
- 3. Heteroseksuell
- 4. Usikker
- 5. Ønsker ikke å svare

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## APPENDIX VI

Initialer:

Studiedeltager nr.

The Female Competitiveness Study:

### BOSITUASJON OG AMBISJONER

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. På spørsmål der du skal skrive svaret selv ber vi deg om å bruke blokkbokstaver og skrive tydelig slik at det er lett å lese

Idrett \_\_\_\_\_ Født år   Mann  
 Kvinne

1. Er det barn under 12 år i ditt hushold som du har ansvar for?  Ja  Nei
2. Bosituasjon:  alene  med partner  med foresatte  med andre
3. Sivilstatus:  gift  ugift  enke  samboer  separert/skilt
4. Er du student?  Ja  Nei
5. Har du inntektsgivende arbeid?  Ja  Nei  
Hvis ja, stilling \_\_\_\_\_  
Og prosentandel?  %
6. Har du inntekt av idretten din?  Ja  Nei
7. Har du i dag ambisjoner om å være på landslaget i din idrett?  Ja  Nei
8. Ta utgangspunkt i siste konkurransesesong og angi om dine prestasjoner ligger innenfor disse sjiktene:  
10 beste i Norge  Ja  Nei 10 beste i kretsen  Ja  Nei
9. Hvor gammel var du da du begynte med din hovedidrett?  år
10. Konkurrerer du i dag også i andre idretter enn din hovedidrett?  Ja  Nei
11. Hvis ja, hvilke/hvilken? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

12. Etter at du ble 12 år, har du konkurrert andre idretter?  Ja  Nei

13. Hvis ja, hvilke? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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## APPENDIX VII

### Copy of the approval letter from Regional Ethics Committee

2011/1460 Konkurranseninstinkt hos toppidrettsutøvere

Prosjektleder: Professor Sven Magnus Carlsen

Forskningsansvarlig: St. Olavs Hospital, Medisinsk klinikk w/klunikksjef Eiliv Brenna

Med hjemmel i lov om behandling av etikk og redelighet i forskning § 4 og helseforskningsloven (hfl.) § 10 har Regional komité for medisinsk og helsefaglig forskningsetikk Midt-Norge vurdert prosjektet i sitt møte 21. oktober 2011. Komiteen viser til prosjektprotokoll, målsetting og plan for gjennomføring, og finner at prosjektet har et forsvarlig opplegg som kan gjennomføres under henvisning til evt. merknader og vilkår for godkjenning, jf. hfl. § 5.

#### Merknader og vilkår:

- -Komiteen ber om at grunnlagsdata ikke blir anonymisert, slettet eller destruert, men blir oppbevart på en betryggende måte i minimum 5 år etter prosjektslutt av kontrollhensyn. Instanser som kan tenkes å kontrollere grunnlagsmaterialet er f.eks. forskningsansvarlige, Uredelighetsutvalget for forskning og Helsetilsynet.
- -Komiteen minner om at de aller fleste kliniske studier skal registreres i det offentlig tilgjengelige registeret [www.clinicaltrials.gov](http://www.clinicaltrials.gov). Prosjektleder er ansvarlig for å avgjøre om forskningsstudien omfattes av kravet til registrering.
- -Prosjektleder skal sende sluttmelding til den regionale komiteen for medisinsk og helsefaglig forskningsetikk når forskningsprosjektet avsluttes. I sluttmeldingen skal resultatene presenteres på en objektiv og etterrettelig måte, som sikrer at både positive og negative funn fremgår, jf. hfl. § 12.

Vedtak

**"Regional komité for medisinsk og helsefaglig forskningsetikk, Midt-Norge godkjenner at prosjektet gjennomføres med de vilkår som er gitt."**

Vennlig hilsen

Sven Erik Gisvold

Professor, dr.med.

Leder, REK midt

Arild Hals