Sigrid Bjørnelv

Eating- and weight problems in adolescents

The Young-HUNT study.

Thesis for the degree of Philosophiae Doctor

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Norwegian University of Science and Technology
Faculty of Medicine
Department of Public Health and General Practice

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Spiseproblem og vektproblem hos ungdom

Ung-HUNT

Bakgrunn: Kroppens størrelse og form har gjennom tidene formidlet viktige budskap om både helse og sosial status. En velernært kropp har vært forbundet med rikdom og status, mens undervekt indikerte fattigdom og dårlig helse. Med den økende velferd som kom i årene etter den 2. verdenskrig syntes budskapet formidlet via kroppens form og størrelse å endre seg. Tynnhet ble idealet, overvekt og fedme ble forbundet med lavere sosial status og usunn livsførsel. I den samme tidsperioden har det vært betydelige endringer i kosthold og fysisk aktivitet, og forekomsten av spiseproblem hos ungdom i den vestlige verden har økt samtidig med en økt forekomst av overvekt og fedme.

For å bedre livskvalitet og hindre utvikling av alvorlig sykdom er det viktig å forebygge både spiseproblem og overvekt/fedme hos ungdom, og derfor er det også viktig å følge forekomsten av disse helseproblemene. I tidligere undersøkelser har spiseproblem vært definert på ulike måter, det samme gjelder overvekt og fedme. Spiseproblem har oftest vært studert hos jenter, og det har også vært lite fokus på kjønnsforskjeller i overvekt og fedme. For å følge utviklingen av disse problemene trengs gjentatte målinger over tid med samme målemetode.

Formål: Målet var å undersøke forekomsten av spiseproblem (Paper I) og vektproblem (Paper III) hos ungdom, å se på sammenhengen mellom vektproblem (undervekt, overvekt og fedme) og psykiske faktorer som angst, depresjon, selvfølelse, spiseproblem og personlighet, og å undersøke psykiske faktorers betydning for vektendringer i løpet av ungdomsårene (Paper IV). I tillegg var målet å se på endringer i BMI fordelingen og forekomst av overvekt og fedme over en 30 års periode (Paper II og III) i det samme geografiske område og i samme alder. Kjønnsforskjeller var i fokus ved alle problemstillingene.

Materiale og metode: Data fra Ung-HUNT 1 (ungdomsdelen av helseundersøkelsen i Nord-Trøndelag i 1995-97) ble benyttet for å se på forekomsten av og assosiasjon mellom vektproblem og spiseproblem. I alt 8090 ungdommer (4018 gutter og 4072 jenter) i aldersgruppen 13-18 år besvarte spørreskjemaet i Ung-HUNT og fikk høyde og vekt målt i den kliniske undersøkelsen. I tillegg ble dataene fra ungdom aldersgruppen 14-18 år (3307 gutter og 3367 jenter) sammenlignet med data fra Statens Helseundersøkelser i 1966-69 (4372

gutter og 4006 jenter i aldersgruppen 14-18 år) for å se på endringer i BMI-fordeling og forekomst av overvekt og fedme over en 30-års periode. Av de som deltok i Ung- HUNT 1 var også 1619 ungdommer (747 gutter og 872 jenter) med i Ung- HUNT 2 fire år senere (2000-01) og fikk høyde og vekt målt. Data fra Ung- HUNT 1 ble benyttet for å studere psykologiske faktorer som kunne påvirke vektendringer gjennom puberteten, fra Ung-HUNT 1 til Ung-HUNT 2.

Resultater: Forekomsten av spiseproblem varierte med definisjon, 47 % av jentene og 30 % av guttene fylte minst ett av kriteriene for spiseproblem, slanking var det hyppigste symptomet. Alle former for spiseproblem var hyppigere hos jenter enn hos gutter, og økte med alderen hos jenter. I 1995/97 var 17.2 % av ungdommene i Nord Trøndelag overvektig eller fete, en 60 % økning fra 1966-69 da forekomsten var 10.7%. Graden av overvekt og fedme hadde også økt, og økningen var størst hos gutter. BMI-fordelingen i den samme perioden viste en økt spredning og en tosidig endring med reduksjon i de laveste og en betydelig økning i de høyeste percentilene, dvs. de tynneste var blitt tynnere, mens de tykkeste var blitt betydelig tykkere. Gjennomsnittlig BMI hos jenter hadde ikke økt i denne perioden.

Spiseproblem var relatert til vektproblem, de to faktorene oral kontroll (EAT-A) og overopptatthet av mat (EAT-B) viste en motsatt assosiasjon, oral kontroll var assosiert med undervekt, mens overopptatthet av mat var assosiert med overvekt og fedme. Lavt selvbilde var også assosiert med overvekt og fedme. Oral kontroll beskyttet mot usunn vektøkning, men predikerte usunn vektreduksjon. Ingen psykologiske faktorer predikerte sunn vektreduksjon.

Konklusjon: Spise- og vektproblem av ulik alvorlighetsgrad finnes hos en stor del av ungdomsbefolkningen, og med klare kjønnsforskjeller. Spiseproblem var hyppigere hos jenter, mens overvekt og fedme hadde økte mest hos gutter. Å forebygge disse helseproblemene hos ungdom er viktig, og effektive strategier for forebygging må ta hensyn til kjønnsforskjeller og sammenhengen mellom psykiske faktorer og vektproblem.

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List of papers

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2: Bjørnelv S, Lydersen S, Mykeltun A, Holmen, TL
Changes in BMI-distribution from 1966-69 to 1995-97 in adolescents: The Young-HUNT Study, Norway
BMC Public Health, 7 (1) 279

3: Bjørnelv S, Lydersen S, Holmen J, Nilsen TIL, Holmen TL.
Sex-differences in time-trends for overweight and obesity in adolescents.
The Young-HUNT study.
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4: Bjørnelv S, Nordahl H, Holmen TL
Psychological factors and weight problems in adolescents. The role of eating problems, emotional problems and personality traits. The Young-HUNT study.
Submitted for publication.

Abbreviations and definitions

BMI	Body Mass index
DMR	Disturbed Meal Rhythm
EAT	Eating Attitude Test
EAT-A	Eating Attitude Teat, anorectic subscale (oral control)
EAT-B	Eating Attitude Test, bulimic subscale (bulimia and food preoccupation)
EAT-S	Eating Attitude Test, sum score
EBD	Extreme Body Dissatisfaction
EP	Eating problems
EPQ	Eysenc Personality Questionnaire
IOTF	International Obesity Task Force
MBD	Mild Body Dissatisfaction
NHANES	The National Health and Nutrition Examination Survey
NHS	The Norwegian National Health Service (NHS) (later: The National Health Screening Service)
RSES	Rosenberg Self-Esteem Scale
UD	Unnecessary Dieting (dieting when normal weight)

Summary

Background

Body shape and size have through centuries mediated important messages of both social status and health. A well-nourished body has been associated with status and wealth, while underweight has indicated poverty and poor health. The increasing welfare after the Second World War seemed to change the language of the body shape and size. The lean body became the ideal, and overweight and obesity became associated with lower social status and unhealthy lifestyle. Eating problems developed especially among adolescents in the western world in the same time-frame with substantial changes in diet and physical activity resulting in increased prevalence of overweight and obesity.

Both eating problems and weight problems reduce quality of life, and may lead to several serious disorders in adulthood. To be able to prevent these health problems in adolescents it is important to follow the prevalence of eating problems as well as overweight and obesity, using repeated measures with the same methods and definitions.

Little focus has been on sex differences in eating problems as this often has been treated as a female issue. There has also been little focus on sex differences in the prevalence of overweight and obesity.

Aim

With focus on sex differences, the aim of this study was first to assess the prevalence of eating problems in adolescents and the significance of different definitions used (Paper I). A second aim was to evaluate changes in the BMI-distribution and prevalence of overweight and obesity in the same geographical area during a period of 30 years (Paper II and III). The last aim was to evaluate the associations between weight problems (underweight, overweight and obesity) and psychological factors like anxiety, depression, self esteem, eating problems and

personality, and to study the significance of these psychological factors on weight change during adolescence (Paper IV).

Material and Methods

Data from Young-HUNT 1 (the youth part of The Nord-Trøndelag Health Study1995-97) was used to assess the prevalence of eating problems and to study associations between weight problems and psychological factors including eating problems. Totally, 8090 adolescents (4018 boys and 4072 girls) aged 13-18 years completed the Young-HUNT questionnaire and had their height and weight measured in the clinical part of the study.

To evaluate changes in the BMI-distribution and the prevalence of overweight and obesity, data from adolescents aged 14-18 years in Young-HUNT 1 (3307 boys and 3367 girls) was compared to data from 4372 boys and 4006 girls in the same age group, collected in the same geographical area by the National Health Screening Service in 1966-69.

Among the participants in Young- HUNT 1, 1619 adolescents (747 boys and 872 girls) participated in Young- HUNT 2 four years later (2000-01), and had their height and weight measured. Data from Young- HUNT 1 was used to study the possible influence from psychological factors on weight change during adolescence (from Young-HUNT 1 to Young-HUNT 2).

Results

The prevalence of eating problems varied depending on the definitions used, with 47 % of the girls and 30% of the boys fulfilling at least one criterion for eating problem. The overlap between the different definitions was low indicating that the various definitions capture different eating features. The various definitions also gave different gender rations, but always with higher prevalence in girls compared to boys, and increasing with age in girls only.

In 1995-97 17.2 % of adolescents in Nord-Trøndelag fulfilled the criteria for overweight or obesity, a 60 % increase from 1966-69 when the prevalence in the same age group was 10.7%. The extent of overweight and obesity had also increased, and the increase in both prevalence and extent was most prominent in boys. The change in the BMI-distribution during the same time period showed an increased dispersion and a two-sided change with a significant increase in the upper percentiles and a trend towards a decrease in the lowest percentiles, i.e the thinnest adolescents were thinner, while the most overweight were fatter. Mean BMI in girls did not increase in this period.

Eating problems were associated with weight problems, and the two factors oral control (EAT-A) and food preoccupation (EAT-B) demonstrated an inverse association. Oral control was associated with underweight, while food preoccupation was associated with overweight and obesity. Low self-esteem was also associated with overweight and obesity. Oral control protected against unhealthy weight gain, but predicted unhealthy weight reduction. No psychological factors were found to predict healthy weight reduction.

Conclusions

Eating- and weight problems were common in the adolescent population, but varied with definition and in degree. Eating problems were more frequent in girls, but weight gain was more prominent in boys. Eating problems were associated with weight problems, and also with weight change. It is important to prevent these health problems in adolescents, and effective preventive strategies need to focus on sex differences and to bear in mind the associations between psychological factors and weight problems.

1. Introduction

1.1.1. The Ideal Body

Body shape and size have mediated important messages about both social status and health through centuries, messages that can be traced back 25 000 years. At that time the well known Venus statuette (1), showing a woman with abdominal adiposities was made (Fig.1). Overweight and obesity was prized, indicating status and wealth (2), and this was the situation up to the late 20th century. In some cultures, obesity still indicates high social status, while low body weight is a signal of poverty.

Fig 1: Venus from Willendorf

In the first decades after the Second World War, the increasing welfare seemed to change the language of the body shape and size in our western society. Thinness was no longer a result

of poverty, and the Ideal Body, especially for women, changed toward the skinny, more androgynous look (Fig. 2).

In 1966 Twiggy started her model career. She was 16 years old, had a weight of 41 kg, and her BMI is said to bee 14, 7 (The Independent). When her modelling pictures were made public, it was believed that she would die down within a month. However, Twiggy became an instant icon and supermodel, and it is said that she changed the world of fashion with her short-haired androgynous look (Wikipedia). The "Twiggy-period" indicates the start of the focus on the thin, androgynous female body and dieting became frequent among young girls, resulting in various forms of eating problems.

Fig.2: Twiggy

1.1.2 Weight and Health

Historically, lack of food, hunger and malnutrition has been a serious threat to public health, causing illness and death also among children and adolescents. According to a recent report from WHO, this is still the most devastating problem facing the majority of the worlds poor and needy people (3). Nearly 30 % of humanity is currently suffering form one or more of the multiple forms of malnutrition, and about 60% of the 10.9 million deaths each year among children less than 5 years of age in the developing world are associated with malnutrition.

Overweight as a problem has emerged in the recent decades, and is found not only in the industrialized countries, but also parallel to malnutrition in the developing countries. Already Hippocrates (460 – 370 BC) acknowledged the association between obesity, infertility and early death, but the fact that overweight also can cause health problems was recognized less than 100 years ago.

1.1.3 Adolescence, Ideal Body and Weight

The explanatory factors for increased prevalence of overweight and obesity among children and adolescents range from sociocultural to genetics. The rapid change in number of overweight and obese children indicate that genetic factors are not the primary reasons for change, but the genes for overweight are expressed where the environment allows and encourages their expression (4). Changes in amount and type of food available, changes in meal pattern and also changes in the pattern of physical activity during the last decades contribute substantially to the increased prevalence of overweight and obesity (Fig. 3). At the same time, young people experience an increased impact of mass media and fashion industry, focusing on the slim and healthy body. The increased gap between the real body size and shape and the Ideal Body is one of the ethological factors of eating problems. Since 1970 eating- and weight problems in adolescents has emerged in two opposite directions, the underweight dieter with excessive exercise and the obese, inactive overeater. In clinical settings we meet anorexic and bulimic girls (and some boys) (5), but also obese adolescents of both sexes with binge eating disorder and depression. In their obesity clinics, paediatricians also meet obese adolescents without eating problems or other obvious psychological or psychiatric co-morbid symptoms. This is true also in our country, though the problems may be more pronounced in countries like USA.

The McDonald's-generation.

A typical meal for western adolescents?

Changes in food availability.

Changes in meal pattern.

Changes in type of food eaten.

Fig. 3

1.2. Health Surveys among adolescents in Norway

The first extensive study to evaluate the health of school children in Norway was carried out in 1891/92 (6), and since 1920, initiated by C. Schiötz (7), height and weight in school children were measured annually to follow their nutritional status, trying to detect and prevent health problems connected to malnutrition.

With increasing welfare, the risk for malnutrition was reduced, and the health authorities lost focus on monitoring height and weight to follow adolescent health. The latest published article (8) is from the Oslo-study in 1970, written by the previous Prime Minister of Norway and later leader of WHO, Gro Harlem Brundtland. The conclusion was that: "Norwegian (Oslo) children have reached a stature higher than any found in comparable studies from other parts of the world". The study also revealed that mean values of weight had increased 0,3-1,4 kg from Sundals material 20 years earlier (9).

Public Health Nurses still measured height and weight, but the results were not regularly reported, and this part of the health control of Norwegian children gradually disappeared during the 80-ies. Today the recommendation from the Norwegian Directory for Health (Hdir) (10) is that height should be measured at 6 months, 18 months, 5, 8 and 12 years, while weight should be measured at 6 weeks, and controlled if the child is under the 2,5th percentile or above the 97,5th percentile, and if there are other indications. To monitor the weight-development is still not advised, probably because of fear of inducing dieting and eating problems.(9;10). However, new guidelines are under consideration, and a new project, "The growth of Norwegian children" has just started as a part of WHO European Childhood Obesity Surveillance Initiative (11).

In Norway, the first adolescent health study with focus on eating problems was conducted in 1987-89 (UNG-forsk), concluding that 8-9 % of girls scored above the chosen cut-off on EAT-12 (12). In the Young in Norway study (Ung i Norge) conducted in 1992, 6.2 % of girls and 1.2 % of boys scored above the cut-off defining eating problems. Here height and weight was reported, but prevalence of weight-problems was not assessed.

A report from The National Council of Nutrition 1993 includes self-reported height and weight from adolescents, and reports mean BMI, but no figures for overweight and obesity. Overweight and obesity in adolescents were reported from a national nutritional survey of men and women 16-79 years old (Norkost 97) (13). Self-reported anthropometric measures showed that among adolescents 16-19 years, 7 % of boys were overweight and 2 % were obese, compared to 9 % overweight and 1 % obesity in girls.

As a psychiatrist working with adolescents and adults with eating disorder, my primary intention was to study eating problems and their association with other psychological factors in the Young- HUNT population. However, when studying the data, weight-problems emerged in a quantity impossible to neglect, and eating- and weight problems among adolescents in Nord-Trøndelag county, a county without large cities, became the main focus for my work. Eating problems and weight problems will in many instances be two different expressions of the same problem, and to explore and understand both common and separate ethological factors is important in order to prevent these problems and related disorders.

2. Background

2.1. Eating disorders and eating problems

Eating disorders and eating problems are often used interchangeably and with little precision. In an adolescent population, we often find symptoms in a continuum from minor problems to severe disorders.

2.1.1. History

Eating disorders are not modern disorders, and from history, we can read about epidemic anorexia. Catharina from Sienna and the holy anorexia in the medieval abbeys is well known, so is the romantic anorexia resulting from Lord Byron's poetry. Bulimia is also well known, an example is Elisabeth (Sissy), the Empress of Austria (14;15). Also from Norway we have case-reports from medical journal describing what is later believed to be anorexia nervosa (16).

2.1.2. Definitions

Eating disorders

According to the diagnostic systems ICD-10 or DSM-IV, eating disorders are relatively well-defined disorders fulfilling the diagnostic criteria for anorexia nervosa, bulimia nervosa or atypical eating disorders (Fig. 4).

Fig. 4.: Definitions of Eating Disorders (17)**.**

Anorexia nervosa:
A syndrome in which the individual maintains a low weight as a result of preoccupation with low body weight, construed either as a fear of fatness or pursuit of thinness. Weight is maintained at least 15 percent below the expected or body mass index (weight/height^2) is below 17.5. Weight loss is self-induced by exercise, vomiting or purgation, and avoidance of fattening foods. A widespread endocrine disorder involving the hypothalamo-pituitary-gonadlaaxis is present. In female, this is manifested as amenorrhoea and in males by loss of sexual interest and impotence. Other psychosocial features such as mood disorders, obsessive-compulsive symptoms and social withdrawal are common.

Bulimia nervosa:
A syndrome characterised by recurrent episodes of binge eating and by compensatory behaviour (vomiting, purging, fasting or exercising) in order to prevent weight gain. – binge eating is accompanied by a subjective feeling of loss of control over eating. This is a normal weight syndrome in which BMI is maintained above 17.5 kg/m^2.

Eating Disorders not Otherwise Specified (EDNOS).
Eating disorders that closely resemble anorexia nervosa and bulimia nervosa, but are considered atypical, as they do not meet the precise diagnostic criteria for these conditions.

Eating disorders include a cognitive, a behavioural and a physiological component. The cognitive component may be disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight. The behavioural component may involve dieting, avoiding fat, binge eating, compensatory behaviours as purging or excessive exercising, while the physiological component are weight problems, menstrual disturbance or other somatic complications.

Eating problems

Eating problems, however, are not well defined, but like eating disorders, include cognitive, behavioural and physiological elements, and the severity range from sub-threshold eating disorders to mild eating problems not qualified for an eating disorder diagnoses. Different descriptors as disordered eating, disordered eating habits, disordered eating attitudes, eating disturbances, eating dysfunction, eating disorder symptoms and partial syndromes of eating disorders are terms used to describe problems, and using the same descriptor does not always indicate a common definition of eating problems. This makes comparisons between prevalence and associations reported in different studies difficult.

2.1.3 Screening-instruments to assess eating problems

EAT (Eating Attitude Test)

The Eating Attitude Test (EAT) was first developed by Garner and Garfunkel in the late 1970s as a self-reporting questionnaire, indicative, but not diagnostic, of the symptoms of eating disorders (18). The instrument exists in three versions, EAT-40, EAT-26 and EAT-12. The original instrument, the 40-item-version consisted of the following seven factors: 1) food preoccupation, 2) body image for thinness, 3) vomiting and laxative abuse, 4) dieting, 5) slow eating, 6) clandestine eating and 7) perceived social pressure to gain weight. The instrument was abbreviated by the original authors including the 26 items loading on three factors labelled “dieting”, “bulimia and food preoccupation” and “oral control” (19). The fourteen items extracted did not load on any of these factors.

In a former Norwegian study, Ung i Norge (UIN, Young in Norway) (12), a 12-item version was constructed selecting four items from each of the three factors in EAT-26. The items selected had high factor loadings on the three factors isolated, and in addition seemed

clinically meaningful. EAT-26 applies a 6-point scale, while a 4-point scale was used in EAT-12.

In Young-HUNT-1, seven of the 12 items from EAT-12 are used. The dieting factor was removed, and the items used consists only the two factors "oral control" (EAT-A) and "bulimia and food preoccupation" (EAT-B). At the time when EAT-12 was constructed (1991), vomiting was a very infrequent behaviour in adolescents and gave little in the analyses. This item from the original factor "bulimia and food preoccupation" was therefore omitted in Young-HUNT, resulting in a 7-item version (EAT-7) where EAT-A is identical with the 4 items in the "oral control" factor in EAT-12, and EAT-B consists of 3 of the 4 items forming the "bulimia and food-preoccupation"-factor in EAT-12 (Fig.5).

The psychometric properties of EAT-7 was validated in Young-HUNT-1, and in Paper 1 data from a former study, "Ung i Norge (UIN, Young in Norway) (20) was used to accomplish a validation of EAT-7(21). This was done by a factor analyses of the UIN-sample for both the EAT-12 and the EAT-7 version on this material.

In addition, a test of the sensitivity and specificity of the EAT-7 sum-score (EAT-S) versus EAT-12 sum score was done, and the contribution of the subscales to the sum score of ETA-12 was evaluated. We found that EAT-7 and EAT-12 shared 59% of the variance, indicating that the two scales did not measure exactly the same features of EP, an obvious result of deleting one factor.

The items in EAT-12 (and also EAT-7) had 4 alternative answers: "*never*", "*seldom*", "*often*", and "*always*". In this thesis "*never*" and "*seldom*" were recoded to zero (0), "*often*" as one (1) and "*always*" as two (2), giving a maximum score on 8 for EAT-A and 6 for EAT-B.

A large literature has documented the use of EAT, especially the 26-item version as a screening instrument for eating problems in a variety of cultures (22). The EAT has good psychometric properties of reliability and validity, and reasonable sensitivity and specificity for eating disorders, but very low positive predictive value. In the reduction of number of items from EAT-26 to EAT 12, the three-factor structure is retained. EAT-26 has a cut-off of 20/21, a score above 20 should therefore correspond to a score of 9.7 or more on EAT-12. The comparison is not perfect, because use of different scales. However, this should have no impact on the results from Young- HUNT where we only studied the two factors EAT-A and EAT-B.

Fig. 5. The factors and items in the different versions of EAT.

<table>
<tr><th><u>EAT-40</u></th><th><u>EAT-26</u></th><th><u>EAT-12</u></th><th><u>EAT-7</u></th></tr>
<tr><td>Body image for thinness</td><td rowspan="3">Oral control
(7 items)</td><td rowspan="3">Oral control
(4 items)</td><td rowspan="3">Oral control
(4 items)</td></tr>
<tr><td>Slow eating</td></tr>
<tr><td>Perceived social pressure to gain weight</td></tr>
<tr><td>Vomiting and laxative abuse</td><td rowspan="3">Bulimia and food preoccupation
(6 items)</td><td rowspan="3">Bulimia and food preoccupation
(4 items)</td><td rowspan="3">Bulimia and food preoccupation
(3 items)</td></tr>
<tr><td>Food preoccupation</td></tr>
<tr><td>Clandestine eating</td></tr>
<tr><td>Dieting</td><td>Dieting
(13 items)</td><td>Dieting
(4 items)</td><td></td></tr>
</table>

Other screening instruments for eating problems

Eating problems are also assessed using other instruments. Eating Disorder Inventory (EDI) is a reliable and valid 91-item multidimensional self-report instrument, and the whole instrument or subscales as DT (drive for thinness), BD (body dissatisfaction) and B (bulimia) is used (23). Other instruments as BASS (Body Area Satisfaction Scale), BEDT (Branched Eating Disordered Test) (24), WIC (weight and image concern) and PEC (Problematic eating conduct) have also been used to study the prevalence of eating problems (25). To assess bulimic symptoms, Bulimic Investigatory Test, Edinburgh (BITE) (26) and the Bulimia Test-Revised (BUILT-R) has been used.

Dieting is frequent among adolescents, and is also often used as an indicator of eating problems. In epidemiological studies, dieting and dieting frequency is assessed using different questions, usually questions especially designed for the specific study.

2.1.4. Prevalence

Eating disorders

Eating disorders are relatively uncommon; the reported prevalence for anorexia nervosa is about 0.3%, bulimia nervosa 1.0 %, while atypical eating disorders are found in 2-3 % of young women (27). The validity of many epidemiological studies of eating disorders is questioned due to different methodological problems concerning both selection of population and identification of cases. A two-stage screening approach is the most widely accepted method, in the first stage the population is screened using a screening questionnaire, followed by a second stage where definite cases are established based on a personal interview with subjects from both the at-risk population and the population not at risk. Most studies are conducted in the western world, and the prevalence rates are about the same.

The prevalence of eating disorders in young men is about 1/10 of the prevalence in women (28-30).

Eating problems

Due to different definitions, the prevalence of eating problems differs between studies, from 1.8 %, to 22.3 % in girls and 1.8- 7.0 % in boys (31). The lowest prevalence is found in studies where the definition of eating problems is narrow and the severity is close to clinical eating disorders.

If dieting is the target question, the prevalence is up to 45 % of girls and 13 % of boys (32;33). In Young- HUNT, the frequency of dieting behaviour or thoughts was 20.3 % in girls and 5.1 % in boys, increasing with age in girls, but not in boys.

2.2 Weight problems

Weight problems include underweight, overweight and obesity. Until recently, underweight has not been focused on as a weight problem, but as an indicator of malnutrition and poverty in the developing countries, and anorectic eating disorders in the western world.

2.2.1 History

As weight-scales during the 19th century became an easily accessible tool, researchers started to collect data about people's weight. To define the "normal man" with the correct ratio between weight and height, Adolphe Quetelet (1796- 1874) established Quetelets Index (QI), the ratio between weight and height we today know as BMI (weight/(height) ^{2}). The original Quetelets index was 1/10 of today's BMI, a normal QI would therefore be 1.85-2.49.

Surveying Medline for the descriptors overweight, prevalence and epidemiology restricted to adolescents, the first article on adolescent obesity as a public health problem was published in 1968 (34). In the conclusion, the author said:" We need more prevalence data to find out if adolescent obesity is a nutrition problem in the United States. The scanty information available indicates that 10-15 % of the teenage population is obese."

2.2.2 Definitions

Already in 1968 Hueneman (34) argued that "Researchers are bound by the lack of consensus about what constitutes obesity and how to assess it". However, studies of overweight and obesity since then and up until today also have used different definitions making it difficult to compare prevalence and trends.

Percentiles

Growth has been studied using sex specific national percentile charts including height by age and weight by height. Percentiles are used to characterize the spread of the distribution of a certain parameter in a defined population (e.g. weight, height or BMI). In statistics, percentiles have the advantage over range of being less sensitive to outliers and of not being greatly affected by the sample size, and there is no limit to the number of percentiles that can be computed. The distribution studied may be weight for height, height for age, weight for age or BMI, and the given percentile defines a given proportion of the specific population below or over this value. An example: The 25^{th} BMI-percentile is the BMI-value where 25 % of the studied population has a BMI lower than this value, while 75 % has a BMI above this value.

To define overweight and obesity according to BMI-reference data, different definitions have been used. Often the age- and sex-specific 85th percentile has been seen as the cut-off for overweight or at risk for obesity, while the corresponding 95th percentile has been the definition of obesity. However, in some studies other percentiles have also been used, both the 90th and 97th percentile have been used to define either overweight or obesity, or both. National age- and gender specific BMI-reference values may have different cut-off values for percentiles, implying that a given BMI could be classified as normal in one nation, but overweigh in another.

BMI cut-offs

In 2001 Cole et al published a paper establishing a standard definition for child overweight and obesity, with age-and sex-specific BMI-cut-offs corresponding to BMI 25 and 30 in adults (35). The data were obtained from six large national representative cross sectional growth surveys from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the United States, with more than 10 000 subjects aged 6-18 years in each survey. These cut-offs are used independent of ethnicity, though height and shape differ between different races, and have therefore been debated (36;37). However, they are now commonly accepted, and used by International Obesity Task Force (IOTF) as the accepted definition of overweight and obesity. IOTF is a global network of expertise, a research-led think tank and advocacy arm of the International Association for the Study of Obesity (38).

Underweight in children and adolescents was not defined, unless in the definition of anorexia nervosa, until Cole and colleagues in 2007 also established a standard definition with BMI-cut-offs corresponding to BMI 16, 17 and 18,5 in adults (39).

2.2.3 Prevalence

Overweight and obesity

The reported prevalence of overweight and obesity in adolescents has differed during the last 40 years, with a clear variability between countries and within and between decades (table 1). As methods for measurements (self report or measured), definitions of overweight and/or obesity differs, it is difficult to compare result concerning prevalence. The age in the different study-populations may also vary from inclusion of all adolescents 13-18 years, to only selected age groups.

Table 1: Published prevalence of overweight and obesity combined in adolescents 13-18 years in Western Europe, USA and Australia stratified for sex and decade.
(Different definitions have been used.)

Country	Boys					Girls				
	Decade					Decade				
	60-69	70-79	80-89	90-99	2000 →	60-69	70-79	80-89	90-99	2000 →
Norway (40)	8.6			17.4		13.1			17.2	
Finland (41)		7.6		18.0			4.5		11.2	
Denmark (42)		5.1		15.5			6.2		15.6	
Sweden* (43)			7.6		20.0					
Nehterland(44)			10.4	13.9				9.2	15.2	
Netherland(45)			4.1	8.3	15.1			6.2	10.4	17.6
Germany (46)		10.0	11.8	16.3			11.7	13.0	20.5	
England** (47)				28.8					24.0	
Spain ***(48)			14.4	24.9						
USA (49)					38.3					34.5
USA (50)		6.1	4.8	11.2	15.5		6.2	5.3	9.7	15.5
Australia (51)			10.7	19.5				11.8	21.1	

*: Age groups 10,13 and 16. Not stratified for sex
**: Age groups 15-17
***:Age groups 6-15 years. Not stratified for sex

Estimates of overweight and obesity

Using the IOTF-cut-offs, the prevalence of overweight and obesity in European children and adolescents 5-18 years old in 2006 was estimated based on the latest available surveys and published studies, showing gender-and regional differences (52) (Table 2).

If the estimate for Western Europe is applied to Nord-Trøndelag county for 2006, in the age group 13-18 years, we would expect to find more than 1100 boys and 1400 girls with overweight and 250 boys and 350 girls with obesity.

Table 2: Estimates of prevalence overweight and obesity in European children and adolescents (aged 5-18) in 2006 according to the IOTF-cut-offs (52).

European Region	Boys			Girls		
	Overweight	Obesity	O+O	Overweight	Obesity	O+O
Western	25.9	5.5	31.4	31.9	7.7	39.6
Eastern	27.7	5.3	33.0	28.0	6.3	34.3
Southern	38.4	10.0	48.4	34.0	9.1	43.1

Underweight

Prevalence of underweight is seldom reported. The proposed sex-and age specific cut-off values should help to provide internationally comparable prevalence rates of underweight in children and adolescents. When using the corresponding BMI-cut-off of 18.5, the prevalence of underweight in the age group 13-18 years in Young-HUNT 1995-97 was 4.9 % in boys and 6.6 % in girls. In the data from the Norwegian National Health Service (NHS) from Nord-Trøndelag county in 1966-69 (40) underweight was found in 3.4 % of boys and 5.1 % of girls.

Underweight is defined as a BMI below the threshold for normal weight. No estimate of the prevalence of underweight as such has been reported from Europe and USA, only the

prevalence of anorexia nervosa (0, 3%). Anorexia nervosa is a serious psychiatric disorder, including low body weight. The weight criteria in the definition of anorexia nervosa has varied, but according to ICD-10, the weight-criteria for fulfilling the diagnoses is BMI<17.5. Underweight may be a normal phenomenon, and may also result from different diseases, not only anorexia nervosa.

Normal weight

The actual WHO-definition of normal weight is BMI 18.5 – 24.9. Interestingly, the BMI-values defining normal weight have changed during the last decades (table 3). Especially the lower limit has decreased close to the BMI-criteria for anorexia nervosa (BMI 17.5 according to ICD-10).

In Paper I we defined normal weight as having a BMI between the age-and sex specific 5^{th}-75^{th} BMI-percentile. This definition was chosen because of lack of appropriate definitions at that time.

Table 3. Changes in the definitions of normal BMI range (Dietary Guidelines 1980-2000) (53).

Year	Male	Female
1980	20.1 - 25.2	18.6 - 23.7
1985	19.7 - 24.7	18.9 -24.4
1990 (19-34 y)	19.1- 25.0	19.1-25.2
1990 (35 + y)	21.0 -27.1	21.0 -27.0
1995	19.1- 25.0	19.1 -25.1
2000	18.5 - 24.9	18.5 -24.9

Extent of weight problems

While prevalence describes the proportion of a population with a defined weight problem, the extent provides information on the degree of overweight or underweight, expressed as the number of BMI-units above or below the defined limit for weight problems. Dependent on height, 1 BMI unit (e.g. the difference between BMI 20 and BMI 21) corresponds to 2.5-3.5 kg. Using the mean height in Young- HUNT, one BMI-unit corresponds to 3.1 kg in boys and 2.7 kg in girls. If a 18 year boy has BMI 29 (4 BMI-units above the overweight-limit), the extent of overweight is greater than if the BMI was 27 (2 units above the limit). Correspondingly, the extent of underweight is greater at BMI 15 than at BMI 17.

2.2.4 Time trends

Studies from different countries and populations with repeated measures demonstrate a marked increase in overweight and obesity in children and adolescents, independent of chosen definition (41;43;44;46;48;50;54-63). Before 1970 obesity was infrequent in the western adolescent population, the percentual increase in obesity has been even higher than the corresponding increase in overweight. So far the highest reported prevalence has been in USA. The increase, sometimes called the obesity epidemic, seems to have occurred at different times in different populations, and sociocultural changes have been thought to explain the rapid changes (4). However, a Danish study showed that the increase in prevalence of overweight as well as obesity in Denmark had occurred in phases followed by plateau periods, and the phases were not paralleled by trends in economic growth (64). They concluded that macroeconomic growth indicators seem inappropriate as proxies for the environmental exposures that have elicited the obesity epidemic.

2.2.5 BMI-distribution

The distribution of BMI in a population gives important information about weight-problems, indicating the proportion and extent of both underweight and overweight people. The BMI-distribution curve will show a skewed distribution with a long right tale towards higher BMI (overweight/obesity). Changes in the BMI-distribution in a population give valuable information on the changes in both underweight and overweight, changes that not necessarily influence the mean BMI (65). Studying age-specific BMI-distribution chart, the changes found could also give information about at which age the changes occur on a population-level. So far, increase in BMI and prevalence of overweight/obesity has been found in children, from 24 months and upwards (44;55;56).

All studies stratified for age and sex, demonstrate an increasing skewness with a greater shift in the upper part of the distribution (towards obesity), so that, within each group, the heaviest subgroup was heavier than in the prior surveys. This is found both in USA (National Health and Nutrition Examination Survey, NHANES) (66), Sweden (67;68) and Norway(69). In USA, for the youngest children, the lower part of the distribution has shown virtually no change. With increasing age, the whole distribution tended to shift upward slightly, suggesting an increase in BMI across the entire population.

2.2.6 Severity of overweight and obesity in the society

Severity of overweight and obesity is not only related to the number of adolescents fulfilling the criteria for overweight and obesity, but also to the extent. Severity of overweight/obesity can be evaluated using the BMI-range, and changes in the severity is most often assessed using changes in the values of the sex-and age specific BMI-percentiles. When the value of

the 95th percentile increases with e.g. 2 BMI-units, it means that the 5 % of the population with highest BMI has increased their weight with approximately 6 kg (dependent on height). The same is also true for underweight, when the 5th percentile decreases with 2 BMI-units, the 5 % of the population with lowest BMI has decreased their weight with the same amount of kg. The severity of overweight/obesity in the society is not only dependent on the prevalence of overweight/obesity, but also the extent. The same is true for the individual, it is more serious to have an extreme overweight than being just above the BMI-value defining overweight.

3.0 Objectives

Eating problems and weight problems are partly associated, and are both common problems in adolescents. Using data from two population-based surveys, the main objective was to study sex-differences in eating- and weight problems in an adolescent population.
This is addressed through the following:

1) To study the sex differences in prevalence of eating problems in an adolescent population. In addition to study the variation of prevalence according to definitions used.

2) To study changes in the BMI-distribution in adolescents 13-18 years in the same geographical area form 1966-69 to 1995-97.

3) To assess sex-specific change in prevalence and extent of overweight and obesity in an adolescent population during 30 years.

4) To study the association between weight-problems, eating problems and psychological factors, and, in addition, to study predictors of weight change during adolescence.

4.0. Materials and methods

The Nord-Trøndelag Health Study – HUNT

Nord-Trøndelag county has been subject for epidemiological studies for several decades. The Nord-Trøndelag Health Study (HUNT) is one of the largest health studies ever performed. It is a unique database of personal and family medical histories collected during three intensive studies with high participation rates. HUNT 1 was carried out in 1984-1986, while HUNT 2 was carried out in 1995-97. The third study, HUNT 3, was completed in 2008. The HUNT studies are administrated from HUNT Research Centre located in Verdal, Nord-Trøndelag. From the beginning, HUNT Research Centre was a part of the National Institute of Public Health (Oslo), but since 2001 HUNT became part of The Norwegian University of Science and Technology (NTNU), Trondheim.

4.1. The Young -HUNT Study

The Young-HUNT study is the youth part of the Nord-Trøndelag Health Study (HUNT). The first study, Young-HUNT 1 was conducted between August 1995 and June 1997, while Young-HUNT 2 was conducted between January 2000 and June 2001.
Young-HUNT is a school-based study, and all adolescents in grades 8^{th} -13^{th} (13 -19 years of age) were invited to Young-HUNT 1. In Young-HUNT 2, adolescents in grades 12^{th} and 13^{th} in high school or with apprenticeship contracts were invited, including the youngest of those who had participated in Young-HUNT 1. These students were eligible for a longitudinal study, and also for a new cross-sectional study of the age groups 17-19 years.

Associate Professor Turid Lingaas Holmen is the Young-HUNT project manager. She has been responsible for the planning, administration and implementation of the Young- HUNT studies.

4.1.1 Demographics

Nord-Trøndelag county with about 129 000 inhabitants, is one of the 19 counties in Norway, situated in the middle part of the country. Approximately 10 % of the population is between 13 and 19 years old (70). Nord-Trøndelag is a typical rural area, consisting of 24 municipalities with 526 to 20 624 inhabitants. Only two municipalities have more than 20 000 inhabitants, and more than 50 % live in sparsely populated areas.

Nord-Trøndelag has a stable and homogenous population, with an increase in number of inhabitants of only 12000 from 1969 to 2007. The sex and age distribution is similar to Norway as a whole. The same is true for geography, industry, sources of income and economy. The county lacks large cities, and the level of average income is somewhat lower than the average of Norway as a whole. Few immigrants live in the county, in 1970, there was only 40 immigrants from non-western countries, in 1997 1 % of the total population came form countries outside Europe and North America.

4.1.2. Ethics

The Young-HUNT study was approved by the Regional committee for ethics in medical research, and by the Norwegian Data Inspectorate. Also school authorities in the county and principals at all junior high- and high schools approved the Young-HUNT Study in their community and schools. Together with general information of the Young-HUNT Study, the informed consent formula was given to the students before the study, making it possible to discuss the participation with parents or superiors. The consent informed the student about future use of data, voluntariness, and the rights for protection of privacy. Each student signed the informed consent to participate in the study. For all students in junior high school, parents or superiors gave their written consent.

4.1.3 Data collection

In both surveys, the data collection included a questionnaire, a physical examination and an interview.

Questionnaire

A self-administered questionnaire (Appendix 1) was completed during one school hour, in a setting with no opportunity to view answers from other students, and monitored by a teacher. The questionnaire was without name and registration number, only identifiable by a bar code of the unique 11-digit registration number given to all Norwegians at birth. Each student put their completed questionnaire in an empty blank envelope, and sealed it. Teachers collected the envelopes, and handed them over to the field workers.

The questionnaire included a broad range of topics of health and health related behaviour, (Appendix 2), totally 114 questions for grades 8th to 10th. Students in high schools (grades 11th to 13th) answered one page of extra questions not presented for the younger age group.

Clinical examination

Within a month after completing the questionnaire, all participants had a clinical examination performed by especially trained project nurses using standardized procedures.
Anthropometric measures as height, weight, waist and hip circumference and sitting height were collected. In addition blood pressure, pulse and lung function were measured.

Interview

In connection with the physical examination, the nurses conducted two structured interviews, one on headache, and one on allergy and respiratory symptoms.

In this thesis, data from the questionnaire including demographic data, smoking, physical activity, eating problems, anxiety and depression, self-esteem and personality together with measurements of height and weight from the clinical examinations were used. Data from the interviews were not used.

4.1.4. Quality control

All field-workers were specially trained in examination measurement techniques before entering the study. Meetings with all the field workers were held every month in the study period, and practices and experiences were discussed, comparing techniques and interpretations during the study. The project leader and research technician also visited the teams during work and had regular telephone contact.

Weekly, monthly and 6 months working plans were written. Routines were checked and discussed weekly. Quality control routines were followed during data punching and afterwards.

4.1.5 Participation

Young-HUNT 1 1995-97

The target group for the Young-HUNT 1 study was all inhabitants in Nord-Trøndelag county aged 13 to 19 years during the study period. As the study were performed in schools and

followed the school year instead of the calendar year, class lists obtained from each school were the main source for invitation.

Adolescents with apprenticeship contracts and those who had quit school were to some extent registered by superior school authorities, but since they were not registered systematically, these lists were incomplete. In order to reach those who were registered, invitations and questionnaires were sent by mail to private addresses, but only 35 of those participated, and they are not included in this study.

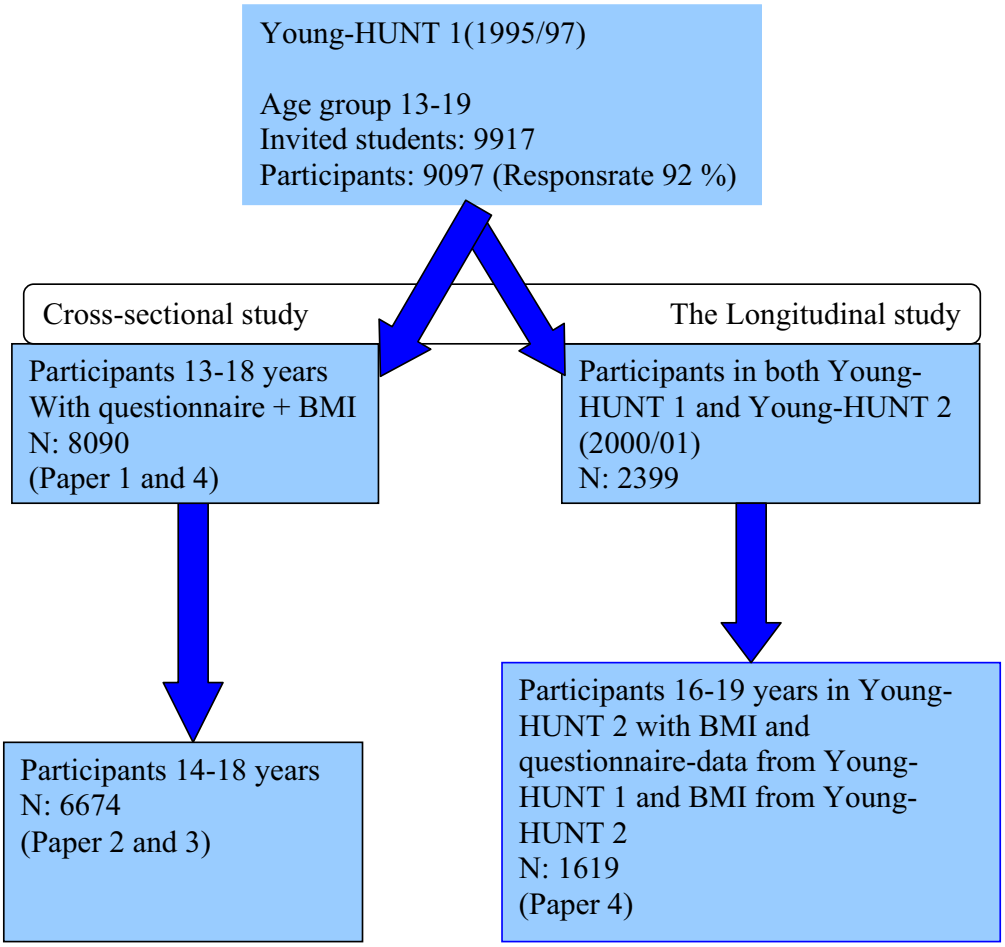
Since adolescents usually graduate from high school the same calendar year they become 19 years, about half of the 19 years old had left school, and were not invited. Some twelve year olds (N: 126) in 8th grade, and a few who had turned 20 years (N: 40), participated. Totally 9917 students attending schools were invited, and 9097 (92 %) completed the questionnaire and/or participated in the physical examination. The target population of this thesis is students in the age group 13 to 18 years who participated and completed both the questionnaire and the physical examination with measurements of height and weight. This includes 8090 adolescents, 4018 boys and 4072 girls.

Young-HUNT 2

The Young-HUNT 2, 2000-01, used the same questionnaire and physical examination as in Young-HUNT 1. In this part of the study, all students in grades 12 and 13 and students in apprenticeships from vocational courses were invited. Of the 4743 students in 8th to 10th grade who had participated in Young- HUNT 1, 2969 students were eligible for participation in the follow up, 2399 (81%) completed the questionnaire, and 1619 students, 747 boys and 872 girls in 12th and 13th grades also had their height and weight measured. Some of the students

in the last two years of high school and those with an apprenticeship were not invited to the clinical examination, thus excluding those from this part of the study.

Figure 6: Participants in Young- HUNT 1 and 2 with data used in s 1-4.



4.2. Data from other sources

The disease protection program 1966-69.

The Norwegian National Health Service (NHS) (later: The National Health Screening Service) established in 1940, has since 1952 regularly collected data from the Norwegian population in a governmental disease prevention program (71) . As part of this program in 1966-69, NHS invited all adolescents 14-19 years in the Nord-Trøndelag county to a health screening, including standardized measurements of height and weight.

4.3 Material used in Paper I-IV

The study cohort described in Paper I (cross-sectional data) included the 8090 adolescents in the age groups 13 to 18, 4018 boys (49.7 %), and 4072 girls (50.3 %) who participated in Young-Hunt 1 with eligible data both on eating problems and measurements of height and weight.

In Paper II and III anthropometric measures from Young- HUNT 1 (95-97) were compared to the anthropometric data collected by NHS in the Disease protection program (66-69). As NHS had measured height and weight in the age group 14-18 years, the same age group was chosen from Young-HUNT 1 for the comparisons. From NHS this included 8378 adolescents 14-18 years old, 4372 boys and 4006 girls, (80 % of the adolescent population), and the same age group in Young-HUNT 1 included 3307 boys and 3367 girls, a total of 6674 adolescents.

In Paper IV the same population described for Paper I was used for cross-sectional associations. In addition, we also used data from those who had participated in both Young-HUNT 1 and Young-HUNT 2 to study predictors of weight changes in a prospective design.

All together 1619 boys and girls had adequate information on anthropometric measures at both baseline and follow up and psychiatric factors at baseline.

In the papers of this thesis, the number of participants varies depending on the age groups and data included in the different studies. (Figure 6).

4.4. Variables used in Paper I-IV

4.4.1 Weight, height and BMI

Measurements

The Young-HUNT study followed the procedures for measuring height and weight made by NHS (National Health Screening Service, The Disease Protection programme). The subjects wore light clothes (T-shirts and trousers) without shoes. Height was read to the nearest cm and weight to the nearest half-kilo or kilo. Height measures and weight scales were adjusted regularly internally and against standards.

Classification of height, weight and BMI

In Papers II and III weight problems were assessed using the IOTF-criteria for age- and sex specific BMI-cut-offs for overweight and obesity (35), and in Paper IV recently published age-and sex-specific cut offs corresponding to adult BMI =18.5 (WHO-definition of underweight) were used to define underweight (39). Extent of overweight and obesity is measured using the values of the age- and sex specific 85^{th} and 95^{th} percentile, respectively. In Paper I, underweight and overweight was used as indicators for eating problems. Here extreme underweight was defined as sex-and age specific BMI $<5^{th}$ percentile, while extreme overweight was defined as sex-and age specific BMI$> 95^{th}$ percentile. These definitions had been used in previous papers (72), and were chosen because, at that time, the international

BMI-cut-offs for underweight, overweight and obesity in adolescents used in Paper II-IV not yet were implemented.

4.4.2 Measuring Eating problems

In Young-HUNT, eating problems was measured using a 7-item version of Eating Attitude Test (EAT-7). Further questions used in the HBSC-study (Health Behaviour in School-Aged children) including dieting, meal rhythm and body perception were used (73).

EAT

Using EAT-7, both the sum-score (EAT-S) and the two subscales EAT-A (oral control) and EAT-B (bulimia and food preoccupation) was used in the analyses of prevalence of eating problems.

Unnecessary dieting (UD)

Dieting was assessed by the question**:** "*Are you trying to loose weight?*" with the following alternative answers: "*No, I am comfortable with my weight*"," "*No, but I need to loose weight*", and "*Yes*". Dieting may be an adequate healthy behaviour, but also unhealthy. Unnecessary dieting was defined as "*yes*" to one of the two last alternatives when the weight was considered normal (having a BMI in the range between the age-and sex specific 5^{th}-75^{th} BMI-percentile).

Disturbed meal rhythm (DM)

The meal pattern was assessed asking, **"***How often do you eat this meal***"** (breakfast, lunch and warm dinner) (73), and disturbed meal-rhythm was defined as more than two deviations from normal meal rhythm defined as three daily meals at least four days a week.

Body Dissatisfaction; mild (MBD) and extreme (EBD)

The students were also asked to describe the judgement of their body size. The question *"Do you consider yourself as?* with 5 alternative answers: "*Very large*", "A little chu*bby*" , "*Thin*", " *Very thin*" and "*About the same size as others***",** was compared to the adolescents BMI. Mild body dissatisfaction (MBD) was defined as being normal weight (between the 5th and 75th percentile) and consider one self very large, while extreme body dissatisfaction (EBD) was classified as being underweight (<5th percentile) but considering oneself as very large, a little chubby or about the same as others.

4.4.3 Measuring psychological factors

SCL-5

To assess anxiety and depression, a 5-item version of Symptom Check-List (SCL-5) was used. SCL-5 correlates at r=92 with the global SCL-25 score, and the alpha reliability for the (5-item) short form questionnaire was 0.85 % (74). In our study population a principal component analysis with Eigenvalue >1, gave only one factor. If the Eigenvalue was less than 1, we found two factors, but could only partly differentiate between anxiety and depression. The factors showed low homogeneity, and we therefore chose to use the five questions as one index. (Cronbachs alpha for SCL-5 was .793.) Max score on SCL-5 was 20, the distribution was skewed, range was 5 to 20, median score was seven, and the skewness was 1.54.

Rosenberg Self-Esteem Scale (RSES).

4 items from RSES was chosen after analysing a material collected by Mette Ystgaard (75). Those four questions predicted the result from the whole scale better than any other of the 10 questions in the original scale. The alpha-reliability of those 4 questions was 0.80, and the

questions correlated 0.80 - 0.95 with the total score (Professor Kristian Tambs, The Norwegian institute of Public Health, personal information). The same four items is used in the adult part of HUNT.

Max sum-score on RSES was 12, indicating high self esteem. Cronbachs alpha for the 4-item version of RSES was .741.

Personality

The questions concerning personality is a short form of EPQ (Eysencks Personality Questionnaire).This 18-item version was developed for this study by multivariate analyses of data from the original Norwegian translation of EPQ (76;77). The two subscales extroversion and neuroticism showed good internal consistence (Cronbachs alpha .615 and .646 respectively) while the psychoticism scale had poor internal consistence (.345), and was omitted form the analyses.

Smoking

Daily smoking was adjusted for in the multivariate analyses. Daily smokers were defined as those who answered “yes, I smoke daily” to the question “Do you smoke yourself?” or listed number of cigarettes smoked daily.

Inactivity

The students were asked about their leisure time activity (activity not during the average school day), and were defined as inactive if they less than once a week were physical active to the point where they breathed heavily and/or sweated.

4.5. Statistical methods

In this thesis, descriptive statistics as well as multivariate logistic regression modelling and general linear modelling were applied to study the prevalence, changes in prevalence and association between factors.

Statistics Paper I

The comparison of means on unpaired variables was analyzed by Student t-tests. Multiple group comparisons on metric variables were done with One-way ANOVA. Concerning EAT-7, investigation of factor structure was done with principal component analyses with orthogonal rotation. Analyses of internal consistency were done using Cronbach's alpha. The level of significance was set at 0.05 with two-sided tests.

Spearman's correlation coefficient was used to evaluate relation between age and eating problems in each gender separately. Chi-square tests were used in cross-tabulations to evaluate the consistency between the different definitions of eating problems.

To evaluate the consistency in terms of sensitivity and specificity between EAT-7 and EAT-12, Receiving Operation Curve (ROC-curve) was used, and area-under-curve estimates were reported. SPSS version 10.0 was used for the statistical analyses.

Statistics Paper II

The differences in mean height, weight and BMI were analysed using Student's t-test with unequal variances. Analyses of log transformed BMI values gave similiar results (not reported here). P-values for differences in the BMI-percentiles between the studies were computed using bootstrapping with 1000 replications and the "bias corrected and accelerated" (Bca) method (78). Bootstrapping was used because BMI was not normally distributed, especially in the tails of the distribution. Measurement error in change in BMI percentiles due to rounding off measurements to the nearest kg and cm was computed using Monte Carlo simulations with

m=1000 replications.[1] The potential bias in BMI due to age truncation was calculated by linear interpolation. The statistical programs S-PLUS (Insightful Corporation) and R were used for bootstrapping and Monte Carlo Simulations. SPSS version 12.0 (SPSS Inc., Chicago) was used for the other analyses. Two sided p-values <0.05 were considered significant.

Statistics Paper III

Differences in prevalence of overweight and obesity, both between studies and between girls and boys within each study, were tested by calculating confidence-intervals for differences between proportions using the Agresti-Caffo method (79). This method was used because the low prevalence of obesity in the material. SPSS version 12.0 (SPSS Inc., Chicago) and Excel was used for analyses.

Statistics Paper IV

Differences in mean values were calculated using independent sample t-test. Logistic regression analyses were used to study the association between psychological factors and weight category at baseline and between psychological factors at baseline and weight change during adolescence. The contribution of the psychological factors to weight problems was analyzed in two models, one with eating problems and emotional problems, and one with personality factors. In both models, the data were adjusted for smoking and inactivity. Weight categories were compared to normal weight (OR for normal weight =1). Significance was set to 0.05 with 95 % confidence intervals. Data were analyzed with SPSS version 14.0.

[1] Appendix 2

5. 0 Review of Papers I – IV

Review of Paper I

The influence of definitions on the prevalence of eating problems in an adolescent population.

Bjornelv S, Mykletun A, Dahl, A. A. Eat Weight Discord 2002; 7 (4) 284-292.

Objective: The definitions of eating problems vary widely as they integrate cognitive, behavioural, and physiological components to various degrees. The aim of this study was to show how much these differences affect the prevalence of eating problems in an adolescent population.

Methods: 8090 adolescents 13-18 years old participated in Young- HUNT study. They had their height and weight measured, and filled in a questionnaire including questions on meals and eating habits.

Results: The prevalence of eating problems ranged from 0.3 to 47.0 % depending on the definitions used, and with higher scores in girls compared to boys. The various definitions also gave different gender ratios, although the prevalence increased with age in females only. EAT-A showed no correlation with age, and 5.9 % scored above the chosen cut-off. Bulimia and food preoccupation (EAT-B) increased with age, totally 11 % of girls and 5.6 % of boys had scores above cut-off.

Disturbed meal rhythm was found in 9.7 %, 12 % in girls and 6.9 % in boys, and increased with age in both sexes. Unnecessary dieting also increased with age, totally 12.8 % dieted in spite of normal weight, and with a considerable increase with age in girls. 29.7 % of 18-year-old girls were found in this category. Body dissatisfaction was also highest in the oldest girls; totally 8.8 % had mild body dissatisfaction, while only 1.4 % had extreme body dissatisfaction.

Conclusion: The various definitions of eating problems had a low degree of correlation, and lead to quite variable prevalences. All definitions showed that prevalence of eating problems was higher in females, but their prevalence in males was also considerable.

Review of Paper II

Changes in BMI-distribution from 1966-69 to 1995-97 in adolescents.

The Young-HUNT study, Norway.

Bjørnelv S, Lydersen S, Mykeltun A and Holmen T L. BMC Public Health 2007, 7;

Background:

The aim of this study was to explore changes in the BMI-distribution over time among Norwegian adolescents.

Methods: Height and weight were measured in standardised ways and BMI computed in 6774 adolescents 14-18 years who participated in the Young-HUNT study, the youth part of the Health-study of Nord-Trøndelag county, Norway in 1995-97. The results were compared with data from 8378 adolescents, in the same age group and living in the same geographical region, collected by the National Health Screening Service in 1966-69.

Results: From 1966-69 to 1995-97 there was an increased dispersion and a two-sided change in the BMI-distribution. Mean BMI did not increase in girls aged 14-17, but increased significantly in 18 year old girls and in boys of all ages. In both sexes and all ages there was a significant increase in the upper percentiles, but also a trend towards a decrease in the lowest percentiles. Height and weight increased significantly in both sexes and all ages.

Conclusion: The increased dispersion of the BMI-distribution with a substantial increase in upper BMI-percentiles followed the same pattern seen in other European countries and the United States. The lack of increase in mean BMI among girls, and the decrease in the lowest percentiles has not been acknowledged in previous studies, and may call for attention.

Review of Paper III

Sex-differences in time-trends for overweight and obesity in adolescents. The Young- HUNT Study.

Bjørnelv S, Lydersen S, Holmen J, Nilsen T I L, Holmen T L.

Aims: To investigate sex-differences in time trends of both prevalence and extent of overweight and obesity in adolescents, 14-18 years old.

Methods: Standardized measurements of height and weight were collected from population based surveys of adolescents in the same geographical area in 1966-69 (n=8378) and in 1995-97 (n=6673). Prevalence of overweight and obesity was calculated using criteria approved by the International Obesity Task Force (IOTF). Extent of overweight and obesity was assesses by computing age-and sex specific BMI-percentiles.

Results: In 1995-97, 17.2 % met the criteria for either overweight or obesity, compared to 10.7 % in 1966-69. The prevalence of overweight and obesity combined was higher in girls (13.0 %) compared to boys (8.5 %) in 1966-69 (Diff: 4.5 %, 95 % CI: 3.1, 5.9), while no sex difference was found in 1995-97 (girls 16.9 %, boys 17.5 %, Diff: -0.6, 95 % CI: -2.3, 1.1). The increase in overweight was greater in boys (6.2 %, CI: 4.7, 7.6) compared to girls (1.9 %, CI: 0.4, 3.5), while the sex-difference in increased obesity was smaller (boys 2.8 %, CI; 2.1, 3.4, girls 2.0 %, CI: 1.3, 2.6). The increase in extent of overweight and obesity was highest in boys. The value of the 85^{th} percentile and the 95^{th} percentile in boys increased with 1.3 and 3.0 BMI- units, respectively. The corresponding increases in girls were 0.7 and 1.7 BMI-units.

Conclusion: A marked sex-difference in time-trends for both prevalence and extent of overweight and obesity with a more pronounced increase in boys compared to girls was demonstrated. This might have implications for preventive strategies.

Review of Paper 4

Psychological factors and weight problems in adolescents. The role of eating problems, emotional problems and personality traits. The Young- HUNT study.

Bjornelv S, Nordahl HM, Holmen TL

Background: The associations between psychological factors and weight problems in adolescents are not clear. We studied associations between weight problems and psychological factors including personality in an adolescent population. In addition, we examined the same psychological factors as predictors for change in weight category during adolescence.

Method: In 1995-97, 8090 adolescents 13-18 years participated in the Young- HUNT I study, of those 1619 also participated in a follow up in 2000-01 . They completed a questionnaire including eating problems, self-esteem, personality, anxiety and depression, and had their height and weight measured. Weight problems were defined using the international age-and sex-specific BMI-cut-offs defining underweight, overweight and obesity. Psychological factors at baseline were studied both in relation to weight categories at baseline, and as predictors for weight change between baseline and follow-up.

Results: Significant sex-differences in mean values were found in all psychological factors, with higher scores in girls compared to boys. In the cross-sectional design eating problems were associated with weight problems, the two factors oral control (EAT-A) and food preoccupation (EAT-B) showed an inverse association. Oral control was associated with underweight, while food preoccupation was associated with overweight and obesity in both sexes. Low self-esteem was associated with overweight and obesity in both sexes, but no association was found between emotional problems or personality traits and weight problems. At follow-up oral control was a clear predictor of weight change during adolescence in both

sexes. Oral control protected against unhealthy weight gain but also predicted unhealthy weight reduction in both sexes.

Conclusions: Girls scored higher on all psychological factors compared to boys, but no sex-differences were found with regard to the association between psychological factors and weight problems. Eating problems showed the strongest association with weight problems at baseline, and were also the strongest predictor of weight change during adolescence.

6.0 General Discussion

6.1. Methodological considerations

Epidemiology is concerned with the distributions and determinants of disease frequency in human populations. Studies in epidemiology may be descriptive, analytic or both, and accuracy in estimation is an overall goal (80). The study therefore should be conducted with the aim of reducing random and systematic errors. Precision in measurements and estimates correspond to reduction of random errors, and validity, both internal and external, indicates lack of systemic errors, as chance, bias or confounding (80).

6.1.1 Study design

A typical descriptive study is a study with focus on describing a disease or elucidating its determinants. In a cross-sectional descriptive study, the status of an individual with respect to the presence or absence of a symptom (e.g. obesity) and an exposure (e.g. depression) is assessed at the same point of time. Using this kind of design it is not possible to decide about causality, only associations and strength of associations can be assessed. Time trends can also be studied by comparing data from cross-sectional studies performed at different time periods. The formulation of etiological hypothesis often occurs from descriptive studies, but an analytical design is necessary to test hypothesis (80).

In a prospective study the disease (e.g. obesity) at follow-up is studied in relation to exposure (e.g. anxiety and depression) at baseline, making it possible to see if exposure (eg depression) at baseline predicts obesity at follow-up.

Young-HUNT 1 and Young-HUNT 2 were separately conducted as cross-sectional studies, while the follow-up of 8^{th} -9^{th} graders from Young- HUNT 1 to Young-HUNT 2 had a

prospective cohort study. In this thesis, Paper I had a cross-sectional study using data only from Young-HUNT 1. Papers 2 and 3 presented trend studies using cross- sectional data from Young-HUNT 1 and from NHS collected in the late sixties, while Paper 4 has both a cross-sectional design using data from Young-HUNT 1 and a prospective design using the follow-up data from Young-HUNT 1 to Young-HUNT 2.

6.1.1. Precision

Precision can be increased by increasing the number of subject studied (N) and/or by reducing misclassification. In epidemiological studies, to increase N would not necessarily increase the precision because the occurrence of the key variables may not be common. The degree to which chance or random errors may account for the results can be evaluated by tests of statistical significances.

In Young-HUNT 1, 95 % of the students in junior high and 86 % of students in senior high schools participated. This accounted for 90 % of the total population in the age groups 13-18 years in the county at the time. The large sample sizes and high response rate indicate precise estimates and the role of chance may therefore be less of a concern. However, some of the variables studied, were infrequent (e.g. obesity). This would tend to reduce the possibility to demonstrate significant associations, giving a type II error. Some of the associations and predictors studied in Paper IV might have been significant with a higher number of students in the different weight categories. In all papers (I – IV) the role of chance was tested and statistical significance quantified by p-values or confidence intervals. Participation-rates in the NHS-study were assessed according to birth rates in the county for the years when the participants were born, and 80 % of the adolescent population aged 14 -18 years participated. The large number of participants with high participation rates indicates high precision.

6.1.2 Internal validity

Internal validity is defined as the degree to which the results of an observation are representative for the particular group of people being studied (81). Three general types of biases can reduce internal validity; selection bias, information or misclassification bias and confounding.

Selection Bias

Attendance

The participation rate in the Young-HUNT study was high, and the sample size is large. However, the study did not include all adolescents, and there might be a sampling error. The invitation might not have reached all those who had left school, and adolescents with an apprenticeship contract. This resulted in fewer participants in aged 18 and 19, especially in vocational classes. Adolescents with an apprenticeship contract, more boys than girls, had chosen a more practical education, and they might differ from those with an academic approach.

In the prospective cohort study in Paper IV only students in the two last years of high school at follow-up were invited to the clinical part of the study and had their height and weight measured. Adolescents with an apprenticeship contracts (n= 157) and some last graders in high school the first study year (n=337) were not invited and completed only the questionnaire. This may have resulted in a less representative population in the longitudinal study compared to the cross-sectional studies.

Socioeconomy

Weight and BMI is known to vary with socioeconomic status (4;82), and in Young-HUNT a selection bias concerning socioeconomy can not be entirely excluded. There is no question about socioeconomy in the Young- HUNT 1 questionnaire. However, in senior high-school student choose either academic or vocational classes, and this may to some extent be a proxy for social class. In the two first years of senior high school, students participating in Young-HUNT were distributed between the two types of education, but in the third year, the participants mainly came from academic classes.

In boys, there was a significant higher prevalence of obesity in vocational classes compared to academic classes, and in girls the prevalence of both overweight and obesity was higher in vocational classes (Table 6).

Table 6: Differences in weight-category distribution between academic and vocational classes.

Weight category	Boys		Girls	
	Academic	**Vocational**	**Academic**	**Vocational**
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Underweight	4.6 (3.3-5.9)	5.1 (3.6-6.6)	4.8 (3.6-6.0)	6.2 (4.3-8.1)
Normal weight	80.3 (77.9-87.2)	74.3 (71.3-77.3)*	80.6 (78.4-82.8)	69.2 (65.5-72.9)*
Overweight	13.7 (11.6-15.8)	15.3 (12.9-17.8)	12.1 (10.3-13.9)	19.0 (15.9-22.1)*
Obesity	1.4 (0.7-2.8)	5.3 (3.8-6.8) *	2.5 (1.7-3.4)	5.7 (3.8-7.6)*

* Significant differences, $p<0.05$

As students choosing vocational classes would be in an apprenticeship contract the last year of high school and not invited to Young-HUNT 1, a selection bias in the highest age groups (17-19) may have occurred. The real population mean and the true prevalence of overweight and obesity in these age groups may be somewhat higher than reported in Paper 3. This

would not apply for the youngest students. The attendance rate in the Young- HUNT 1 was high and the total number of adolescents in an apprenticeship contracts or not attending schools were low, making it unlikely that the total results are significantly influenced by this selection bias.

In the follow-up study, no significant difference in weight-categories or mean BMI was found between the total sample of students in the age group 13-15 years in Young- HUNT 1 and the students from this age group who also participated in the follow- up at Young-HUNT 2 (Table 7). Neither was there any differences found between these two groups of students when ages 13, 14 and 15 were tested separately. Therefore, weight and BMI as a proxy for socioeconomy did not influence the associations found.

Table 7. Mean BMI and prevalence of weight categories in the total population of 13-15 years old in Young- HUNT 1, and in the follow-up population.

Weight Category	Boys		Girls	
	Total population	Follow-up population	Total population	Follow-up population
	% (95% CI)	% (95%CI)	% (95% CI)	% (95% CI)
Underweight	5.3 (4.6-6.0)	5.5(4.1-6.9)	6.5 (5.7-7.3)	7.1(5.7-8.5)
Normal weight	77.1(75.8-78.4)	78.5 (76.1-81.0)	76.4 (75.1-77.7)	77.3 (75.0-79.6)
Overweight	14.4 (13.3-15.5)	12.7 (10.7-14.7)	14.2 (13.1-15.3)	13.2 (11.3-15.1)
Obesity	3.2 (2.7-3.7)	3.2 (2.2– 4.3)	2.9 (2.4-3.4)	2.3 (1.5-3.1)
BMI: Mean (SD)	20.32 (3.0)	20.15 (2.9)	20.76 (3.1)	20.59 (3.1)

The NHS-data had only information about age and BMI, making it impossible to compare changes in BMI and weight problems with socioeconomy.

Information- or misclassification bias

Information or observation bias includes any systematic error in the measurement of exposure or outcome (80). Non-random misclassification is classification error that depends on values of other variables (e.g. unnecessary dieting), while random misclassification refers to classification error that does not depend on other variables (e.g. psychometric scales). Random misclassification increases the similarity between groups, and usually underestimates or dilutes the associations studied.

Self-reported information might be under- or overestimated by the participants. Questions and answering may be interpreted differently, and all self-reported information may be influenced by the respondents' attitudes toward the study, and the reliability of their answers. This may also have been the case in Young-HUNT, but as the questionnaires were thoroughly filled in and the questions used to assess psychological factors were validated scales or parts of validated scales, this type of misclassification may have been diminished. If psychological problems were underreported in Young- HUNT, the real association between psychological problems and weight problems could have been stronger than we found in our analyzes. And if eating problems were overestimated, the strength of the associations between weight problems and eating problems could be weaker than reported in Paper 4. Smoking may tend to be underreported, but previous studies has shown that reports of daily smoking, as used in Paper 4, are mostly trustworthy (83). However, we have no reason to believe that there would be a systematic way of misreporting.

In Young-HUNT 1 and 2 the nurses were instructed to measure height to the nearest cm and weight to the nearest kilo or half kilo. The latter was intended to say that they should measure to the nearest half kilo (being a whole or a half kilo), but may have been understood as the nearest kilo, since most measurements are rounded off to the nearest kilo. Since height and

weight were rounded off to the nearest cm and, most often, kg, there will be measurement errors in the tabulated differences.

The Young- HUNT studies were preformed during the school year, from September to June. Time since meal varied throughout the day, clothes have a seasonal variation, and also differ between 1966-69 and 1995-97.

The possible biases concerning the accuracy of anthropometric measurements were thoroughly discussed with the editor in Paper 2 (Appendix 3). Measurement error calculations were also performed. To be on the safe side, the measurement error of weight was treated as rounded off to the nearest kilogram. As discussed in Paper II, with measurement errors of one cm or one kg the results would still be valid. The measurement error calculations were done by Professor in statistic Stian Lydersen. A more detailed description of the calculations is found in Appendix 2. The measurement error found, however, could not explain the differences found.

Self-reported height and weight vs. measured height and weight.

The use of standardized measurements of height and weight is a strength to our study. Studying weight problems in community samples, self-reported height and weight are often used, and not always discussed. The accuracy of self reported height and weight has been studied in adults (84), but also in adolescents (85). Reviews of the studies indicate that people tend to overestimate height and underestimate weight, and that the discrepancy between self-reported data and measurements varies with age, sex and BMI (84). Adolescent girls have been found to underestimated weight with 1-4 kg, while boys underestimated their weight with 1.5-2.6 kg (85). Individuals who were overweight underestimated their weight more than those with normal weight, and prevalence rates of overweight were up to 17,7 % lower when BMI was based on self-reported than on measured values. Self-reported data on height

and weight are therefore considered valuable if this is the only source of data, but measurements are highly recommended to follow the overweight- and obesity status.

Confounding

Confounding occurs when the effect of risk factors has not been separated and it is therefore concluded that the effect is due to one rather than the other risk factor. A confounder must be a risk factor for the outcome, and also associated with the exposure, but should not be an intermediate step in the causal path between exposure and outcome (80).

When multivariable models were used to assess the association between weight category and psychological problems, smoking and inactivity were seen as possible confounders. Inactivity itself is a risk factor for overweight and obesity. Smoking is known to reduce the hunger sensation, and may be used as a weight-reducing method. Both inactivity and smoking is is also related to psychological factors.

Weight problems as well as psychological problems have been found to be related to socioeconomic status (4). Daily smoking has been postulated to be a proxy for socioeconomy (86). Among students in senior high school in Young-HUNT 1, 15.2% of boys and 22.7% of girls in academic classes were daily smokers, compared to 30% of boys and 35 % of girls in vocational classes. Prevalence of overweight and obesity as well as psychological problems increases with decreasing socioeconomic status (59;87;88). Socioeconomy therefore might be a possible confounder when studying the associations between psychological factor and weight problems. We did not have data on socioeconomic status for the adolescents in the Young- HUNT 1 questionnaire. However, daily smoking was adjusted for in the model. Merging data from Young- HUNT 1 with data from parents participating in HUNT 2, we obtained data from fathers' highest education in approximately 60 % of the adolescents in

Young- HUNT 1. Using this as an indicator for socioeconomy and adjusting for this in the analysis, the associations between psychological factors and weight problems remained the same.

Ethnicity is also a possible confounding factor, overweight and obesity as well as low socioeconomic status is related to ethnicity in different studies (89;90). The number of students of other races than Caucasian in Nord-Trøndelag was low, less than 20, and there is no reason to believe that this could influence the results.

6.1.3 External validity

Although good internal validity, external validity, whether the findings are applicable to other populations, must also be questioned. Since populations may differ considerably in socioeconomic conditions, generalizability to other nations and cultures may be difficult.

The large number of participants and high participation rates in Young-HUNT supports a high internal validity of the study population in the county. Nord-Trøndelag county has a sex and age distribution similar to Norway as a whole. The same is true for geography, industry, sources of income and economy. But the county lacks large cities and the level of average education and income were also somewhat lower than the average in Norway as a whole. However, the prevalence rates of overweight and obesity in Young- HUNT are similar to reported prevalence rates form other parts of Norway, except data form Oslo (87;91), where prevalence of overweight and obesity were significantly lower (10.8 % in Oslo, 17.2 % in Young- HUNT). The city of Oslo with larger differences in socio-economy and ethnicity may not be representative for Norway as a whole. In addition, height and weight were self-reported. Prevalence of overweight and obesity in Young- HUNT is in the same range as data from other European countries form the same time period, indicating that our data are generalizabile.

6.2. Importance and implications of main findings

6.2.1. Eating problems in an adolescent population

Paper I illustrates the importance of (considering) differences in definitions of eating problems when discussing the size of such problems or when comparing prevalence between different studies. Generally, low correlations were found between the variables used to define EP. The various definitions of EP seem to catch different eating features, illustrated by the fact that there was only 15-30 % overlap between the different definitions. Independent of chosen definition, eating problems were more common in girls compared to boys, and the proportion of girls with EP increased significantly with age. No such variation with age was found in boys.

6.2.2. Weight problems and psychological factors

Earlier studies, many of them performed in clinical settings, have not been conclusive concerning the association between weight problems and psychological problems including eating problems and personality traits. This may partly be due to different definitions of the psychological factors studied. A high score or a score above a cut off on scales assessing eating problems, anxiety, depression or self-esteem, is not necessarily identical with a clinical disorder. Associations found in population based studies, therefore, may differ from associations a in clinical settings. Our findings with association between overweight/obesity and low self-esteem have also been found in clinical studies, but, contrary to clinical studies, our study showed no association between depression and overweight/obesity. Although depression may be more common in a clinical overweight- and obese population compared to a general population, it can not be ruled out that other instruments more sensitive for depressive mood might have detected an association between depression and overweight/obesity also in the Young-HUNT population.

When eating problems was divided in anorectic and bulimic subtypes, they were associated with underweight as well as overweight/obesity. Few, if any, previous studies had done this. Eating problems includes a variety of different symptoms, and analyses including different kinds of eating problems in one factor, could blur associations between subgroups of symptoms and different kinds of weight problems.

From Young- HUNT 1 to Young-HUNT 2, more than 85.5 % of the normal weight adolescents remained normal weight. Underweight was the least stable weight category, less than 50 % of underweight girls and boys remained underweight, opposed to 81.5 % of boys and 68.6 % of girls still being within the category overweight/obesity after 4 years. Oral control predicted unhealthy weight decrease and protected against unhealthy weight increase. Interestingly, no psychological factor predicted healthy weight reduction (reduction from over-weight or obesity towards normal weight). This may partly be explained by the scales used to measure psychological factors, but another explanation may be that healthy weight reduction occurs in adolescents without emotional problems.

Eating Attitude Test (EAT) is a test developed as a screening instrument for eating disorders, but the factor oral control in this study have properties resembling a psychological trait rather than a symptom of a disease. A psychological trait is defined as a stable part of the personality, while a symptom is more a state, and will change over time. Oral control may be a “restrictive trait”, protecting against overweight and obesity. This is in accordance with findings using TFEQ (The Three Factor Eating Questionnaire, another questionnaire used to assess eating disorders), and EDE (Eating Disorder Examination, a structured diagnostic interview for eating disorders) (92;93). TFEQ has a factor called “dietary restraint”, and EDE

has a subscale called “restraint scale”. Dietary restraint has been found to be a component in a package of genetically determined physiological, sociocultural and psychological processes that regulate energy balance (94), and might predispose for anorexia nervosa (95). The EAT-factor oral control resembles dietary restraint, and high degree of oral control may be a trait like dietary restraint predisposing for underweight and anorexia.

Our study indicates that the two factors oral control and food preoccupation might be important mediators in the development of weight problems.

6.2.3 Time trends in BMI-distribution

Weight problems have emerged since the Second World War. The increase in overweight and obesity is most prominent; while underweight has been a problem in the developing countries. To follow the nutritional status in a population, changes in the BMI-distribution give valuable information about the consequences of different factors including socioeconomy, availability of food and physical activity status on subgroups in the population. From 1966-69 to 1995-97 we found an increased dispersion of the BMI-distribution with a substantial increase in upper BMI-percentiles, but also a decrease in the lowest percentiles. The increase in the highest percentiles were higher in boys compared to girls, and followed the same pattern seen in other European countries and the United States. However, the lack of increase in mean BMI among girls, and the decrease in the lowest percentiles had not been acknowledged in previous studies. This is important in the prevention of weight problems. The whole adolescent population must not bee seen as a homogenous group. The majority of adolescents are still within the normal weight range, and focus must be on the extremes in both ends of the BMI-distribution and on the sex-differences. To explore and understand the different ethological factors resulting in weight problems in different subgroups of adolescents could improve preventive strategies and reduce the problems.

6.2.4 Sex-differences

Eating problems are found both in girls and boys, but studies on the relationship between eating problems and other psychological factors have most often been limited to girls. When studied, the prevalence of eating problems (96-98) has been found to be lower in boys compared to girls. This sex-difference is in accordance with sex-differences found in eating disorders. Social, cultural and genetic factors are possible explanatory factors for this sex-difference, but this is not yet fully understood.

Weight problems are found in both sexes, but the distribution of weight problems has varied with time. In Nord-Trøndelag underweight, overweight and obesity showed no significant sex-difference in 1995/97, but 30 years earlier, overweight was more prevalent in girls compared to boys, and during the 30-year period boys had the most prominent increase in both prevalence and extent of overweight.

Previous studies may demonstrate sex-differences in time-trends of weight problems, but have not discussed underweight or focused on the sex-differences found.

Sex-differences in time trends may be caused by different social, cultural and perhaps also genetic factors. Food availability is the same for both sexes, but focus on the ideal slim body may have had more impact on girls compared to boys, making boys the sex at risk for overweight and obesity, at last for some decades.

6.3 Further research

Eating- and weight problems may have considerable impact on adolescents health, and are predictive for health problems in adulthood. While eating problems may lead to eating disorders and other psychiatric symptoms and somatic complications, overweight and obesity may cause a variety of somatic illnesses as diabetes and cardiovascular diseases in addition to psychiatric disorders.

So far the challenge is not lack of knowledge about the possible health consequenses of eating- and weight problems in adolescents, but the lack of relevant knowledge to identify the adolescent at risk for developing such problems.

6.3.1 Defining at-risk population

Eating problems

Further research in the eating-problem-field should focus on type and seriousness of problems predicting need for treatment. Eating problems are common in young women, but most teenage syndromes are brief and self-limiting (99). Due to inaccurate definitions and variable terminology in this field, there is some uncertainty about the volume of the problems. A consensus on the definition on eating problems and instruments used to screen the prevalence is needed both to define the at-risk population and to follow the development of eating problems.

The most challenging question, however, is to identify who are at risk for developing eating disorders. Dieting is often a triggering factor (100), but most dieting adolescents do not develop eating disorders. Symptoms of anxiety and depression has been found to be higher in young adults who had eating problems in adolescents, and a higher prevalence of substance abuse have also been found (101).

Weight problems

To define the at-risk population is also important in concerning overweight and obesity. Not all adolescents with a BMI above the sex-and age-specific value for overweight are at risk for serious overweight and subsequent somatic and psychiatric complications. The benefit of the actual BMI-cut-offs defining overweight and obesity should also be focused on, perhaps the range for normal weight should include one or two additional BMI-units in the upper range, while the lower border also is elevated.

6.3.2. Prevention

Prevention is the best way to handle the eating- and weight problems, and knowledge about the problems and the at-risk population, including age, sex and sociocultural factors is essential. We need to know more about etiological factors for both eating problems and weight problems, and sex-differences have to be highlighted.

Eating problems includes all kind of weight problems, and therefore the whole range of the BMI-distribution has to be followed. To be able to prevent eating disorders and related psychological problems, we need cohort studies to follow the development and identify psychological and psychosocial factors as well as weight problems that predict eating problems. Simultaneously we need to search for both psychological and psychosocial factors protecting against eating problems.

6.3.3. Treatment

Most people, also children and adolescents should have their treatment for eating and weight problems in primary care; only a minority needs more specialized treatment in hospitals as inpatients or outpatients. This indicates that general practitioners and school-nurses needs effective treatment programs to help both the young girl with an eating problem, and the boy

with a considerable weight problem, and also have knowledge about when to worry and when not to do so. Such programs need to be validated.

Hospitalized medicine is restricted to those with defined disorders not possible to treat in primary care. To rate the prevalence of different disorders, including eating- and weight disorders, is necessary to develop adequate treatment resources both for inpatients and outpatients as well as in primary care. The prevalence of anorexia nervosa in Norway has been estimated to 2760 persons including about 1400 youths in the age-range of 15-19 years. However, according to the reports from the Child-and Adolescents Units (BUP-data) in the years 2001-2004, the number of adolescents referred to treatment was less than 300 each year, only about 25% of the estimates. Although some may be misdiagnosed or not diagnosed in general practise, it is not reasonable to believe that only 25 % of those in need of specialised treatment are referred to clinics for child and adolescent psychiatry (BUP). The epidemiological studies that have been the basis for the national estimates are mostly based on questionnaires, only two studies includes an interview (102). When studies on prevalence do not differentiate between eating disorders and eating problems, the estimates are not suitable in treatment planning. New studies using tools that are more specific should be designed for this purpose.

6.3.4. Health economics

To prevent overweight and obesity is also a health economic concern, the increasing prevalence of overweight and obesity with the somatic consequences will result in an increasd need for medical treatment both in primary care and in hospitals. Eating disorders and serious eating problems also call for treatment, and once the disorder has emerged, the treatment could be extensive both in time and in resources needed.

In further research on prevalence, etiological factors and prevention strategies of eating problems and weight problems, it is necessary to focus on the whole BMI-distribution. Eating problems and other psychological problems is closely related to weight problems, and the association between weight problems and psychological factors should be further evaluated in order to improve preventive strategies and also treatment programs. More research is needed to understand how psychological factors can influence weight change, so that healthy weight change can be promoted and unhealthy weight change reduced. Further research on eating- and weight problems in adolescents will require collaboration between psychiatric and somatic research fellows, just as this collaboration is needed in the treatment of the eating disorders or weight related disorders when they have developed.

7.0 Conclusion

- The prevalence of eating problems in the young-HUNT population varied with the definition chosen. Unnecessary dieting was the most prevalent eating-related problem, while extreme body dissatisfaction was rare. Eating problems were more frequent in girls compared to boys. Opposed to boys, the problems increased with age in girls.
- From 1966-68 to 1995-97 the change in the BMI-distribution in adolescents 14 -18 years showed an increased dispersion and a skewed distribution. In boys there was a significant increase in mean BMI, but in girls, this was found only in age group 18. The value of the lowest BMI-percentiles had decreased, while the value of the highest percentile had increased, more so in boys compared to girls.
- Both prevalence and severity of overweight and obesity had increased in the 30-years period prior to the Young- HUNT-1 study. The prevalence of overweight and obesity in the Nord-Trøndelag adolescent population in 1995-97 was 17 %, independent of age and sex. From 1966-69 to 1995-97, the prevalence and extent of overweight and obesity had increased in both sexes, most prominent in boys.
- Eating problems were associated with weight problems, oral control (EAT-A) was associated with underweight while food preoccupation was associated with overweight and obesity in both sexes. Low self-esteem was associated with overweight and obesity in both sexes, but no associations were found between anxiety and depression or personality and weight problems.
- Low degree of oral control predicted unhealthy weight increase through adolescence, while high degree of oral control predicted unhealthy weight reduction in both sexes.

References

(1) Venus of Willendorf. Wikipedia 2008 Available from: URL: http://en.wikipedia.org/wiki/Venus_of_Willendorf

(2) Haslam D. Obesity: a medical history. Obes Rev 2007 Mar;8 Suppl 1:31-6.

(3) WHO. Diet, nutrition and the prevention of chronic diseases. 2008. Report No.: (Report of the joint WHO/FAO expert consultation **WHO Technical Report Series, No. 916 (TRS 916).**

(4) Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. Obes Rev 2004 May;5 Suppl 1:4-104.

(5) Kjelsaas EBCGK. 2004.

(6) Seip M, Lie SO. [100 years of pediatrics in Norway. The history up to 1950]. Tidsskr Nor Laegeforen 1993 Jan 30;113(3):343-9.

(7) Schiötz C. Physical development of children and young people during the abe of 7 to 18-20 years. An investigation og 38700 pupils at public (elementary)and higher (secondary) schools in Chritiania. 1923.

(8) Brundtland GH, Liestol K, Walloe L. Height and weight of school children and adolescent girls and boys in Oslo 1970. Acta Paediatr Scand 1975 Jul;64(4):565-73.

(9) Sundal A. The norms for height (length) and weight in healthy Norwegian children from birth to 15 years of age. Universitetet i Bergen; 2008.

(10) Veileder SI-1154:Kommunens helsefremmende og forebyggende arbeid i helsestasjons- og skolehelsetjensten. www hdir no 2008 August 4

(11) www.fhi.no. National Institute of Public Health 2008 October 15

(12) Lavik NJ, Clausen SE, Pedersen W. Eating behaviour, drug use, psychopathology and parental bonding in adolescents in Norway. Acta Psychiatr Scand 1991 Oct;84(4):387-90.

(13) Johansson Lars, Solvoll K. Norkost 1997. report 2008Available from: URL: www.shdir.no/publikasjoner/rapporter/norkost_1997_24168

(14) Vandereycken W. History of anorexia nervosa and bulimia nervosa. In: Fairburn CG BK, editor. . Eating disorders and obesity - a comprehensive handbook. 2.ed. New York: Guilford, 2002: 151 - 5.; 2008.

(15) Vedul-Kjelsas E, Gotestam KG. [Eating disorders in a historical perspective]. Tidsskr Nor Laegeforen 2004 Sep 23;124(18):2369-71.

(16) Rosenvinge JH, Vandereycken W. Early descriptions of eating disorders in the Norwegian medical literature. Acta Paedopsychiatr 1994;56(4):279-81.

(17) National Collaborating Centre for Mental Health/ National Institute for Clinical Excellence. Eating Disorders. Core interventions in the treatment and management of anorexia nervosa, bulimia nervosa and related eating disorders. http://www nice org uk 2009Available from: URL: http://www.nice.org.uk/nicemedia/pdf/CG9FullGuideline.pdf

(18) Garner DM, Garfinkel PE. The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. Psychol Med 1979 May;9(2):273-9.

(19) Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. Psychol Med 1982 Nov;12(4):871-8.

(20) Wichstrom L. Social, psychological and physical correlates of eating problems. A study of the general adolescent population in Norway. Psychol Med 1995 May;25(3):567-79.

(21) Bjomelv S, Mykletun A, Dahl AA. The influence of definitions on the prevalence of eating problems in an adolescent population. Eat Weight Disord 2002 Dec;7(4):284-92.

(22) Garfinkel PE, Newman A. The eating attitudes test: twenty-five years later. Eat Weight Disord 2001 Mar;6(1):1-24.

(23) Garner DM, Olmstead MP, Polivy J. Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. Int J Eat Disord 1983;2(2):15-34.

(24) Selzer R, Hamill C, Bowes G, Patton G. The branched eating disorders test: validity in a nonclinical population. Int J Eat Disord 1996 Jul;20(1):57-64.

(25) Devaud C, Jeannin A, Narring F, Ferron C, Michaud PA. Eating disorders among female adolescents in Switzerland: prevalence and associations with mental and behavioral disorders. Int J Eat Disord 1998 Sep;24(2):207-16.

(26) Henderson M, Freeman CP. A self-rating scale for bulimia. The 'BITE'. Br J Psychiatry 1987 Jan;150:18-24.

(27) Hoek HW, van HD. Review of the prevalence and incidence of eating disorders. Int J Eat Disord 2003 Dec;34(4):383-96.

(28) Bulik CM, Reba L, Siega-Riz AM, Reichborn-Kjennerud T. Anorexia nervosa: definition, epidemiology, and cycle of risk. Int J Eat Disord 2005;37 Suppl:S2-S9.

(29) Hoek HW, van HD. Review of the prevalence and incidence of eating disorders. Int J Eat Disord 2003 Dec;34(4):383-96.

(30) Machado PP, Machado BC, Goncalves S, Hoek HW. The prevalence of eating disorders not otherwise specified. Int J Eat Disord 2007 Apr;40(3):212-7.

(31) Buddeberg-Fischer B, Bernet R, Sieber M, Schmid J, Buddeberg C. Epidemiology of eating behaviour and weight distribution in 14- to 19-year-old Swiss students. Acta Psychiatr Scand 1996 Apr;93(4):296-304.

(32) Ackard DM, Croll JK, Kearney-Cooke A. Dieting frequency among college females: association with disordered eating, body image, and related psychological problems. J Psychosom Res 2002 Mar;52(3):129-36.

(33) Button EJ, Loan P, Davies J, Sonuga-Barke EJ. Self-esteem, eating problems, and psychological well-being in a cohort of schoolgirls aged 15-16: a questionnaire and interview study. Int J Eat Disord 1997 Jan;21(1):39-47.

(34) Huenemann RL. Consideration of adolescent obesity as a public health problem. Public Health Rep 1968 Jun;83(6):491-5.

(35) Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000 May 6;320(7244):1240-3.

(36) Poskitt EM. Body mass index and child obesity: are we nearing a definition? Acta Paediatr 2000 May;89(5):507-9.

(37) Wang Y, Wang JQ. A comparison of international references for the assessment of child and adolescent overweight and obesity in different populations. Eur J Clin Nutr 2002 Oct;56(10):973-82.

(38) www.iotf.org. http://www iotf org/whatisiotf asp 2008

(39) Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. BMJ 2007 Jul 28;335(7612):194.

(40) Bjomelv S, Lydersen S, Holmen J, Nilsen TJ, Holmen TL. Sex-differences in time-trends for overweight and obesicy in adolescetns. The Young- HUNT study. Scand J Public Health 2009;accepted fro publication.

(41) Kautiainen S, Rimpela A, Vikat A, Virtanen SM. Secular trends in overweight and obesity among Finnish adolescents in 1977-1999. Int J Obes Relat Metab Disord 2002 Apr;26(4):544-52.

(42) Petersen TA, Rasmussen S, Madsen M. [BMI of Danish school children measured during the periods 1986/1987--1996/1997 compared to Danish measurement in 1971/1972]. Ugeskr Laeger 2002 Oct 21;164(43):5006-10.

(43) Ekblom O, Oddsson K, Ekblom B. Prevalence and regional differences in overweight in 2001 and trends in BMI distribution in Swedish children from 1987 to 2001. Scand J Public Health 2004;32(4):257-63.

(44) Fredriks AM, Van Buuren S, Wit JM, Verloove-Vanhorick SP. Body index measurements in 1996-7 compared with 1980. Arch Dis Child 2000 Feb;82(2):107-12.

(45) van den HK, van DP, van BS, Verkerk PH, Hirasing RA. Prevalence of overweight and obesity in the Netherlands in 2003 compared to 1980 and 1997. Arch Dis Child 2007 Nov;92(11):992-5.

(46) Kromeyer-Hauschild K, Zellner K. Trends in overweight and obesity and changes in the distribution of body mass index in schoolchildren of Jena, East Germany. Eur J Clin Nutr 2007 Mar;61(3):404-11.

(47) Jebb SA, Rennie KL, Cole TJ. Prevalence of overweight and obesity among young people in Great Britain. Public Health Nutr 2004 May;7(3):461-5.

(48) Rios M, Fluiters E, Perez Mendez LF, Garcia-Mayor EG, Garcia-Mayor RV. Prevalence of childhood overweight in Northwestern Spain: a comparative study of two periods with a ten year interval. Int J Obes Relat Metab Disord 1999 Oct;23(10):1095-8.

(49) Lobstein T, Jackson-Leach R. Child overweight and obesity in the USA: prevalence rates according to IOTF definitions. Int J Pediatr Obes 2007;2(1):62-4.

(50) Jolliffe D. Extent of overweight among US children and adolescents from 1971 to 2000. Int J Obes Relat Metab Disord 2004 Jan;28(1):4-9.

(51) Magarey AM, Daniels LA, Boulton TJ. Prevalence of overweight and obesity in Australian children and adolescents: reassessment of 1985 and 1995 data against new standard international definitions. Med J Aust 2001 Jun 4;174(11):561-4.

(52) Jackson-Leach R, Lobstein T. Estimated burden of paediatric obesity and co-morbidities in Europe. Part 1. The increase in the prevalence of child obesity in Europe is itself increasing. Int J Pediatr Obes 2006;1(1):26-32.

(53) Flegal KM, Troiano RP, Ballard-Barbash R. Aim for a healthy weight: what is the target? J Nutr 2001 Feb;131(2S-1):440S-50S.

(54) Booth ML, Chey T, Wake M, Norton K, Hesketh K, Dollman J, et al. Change in the prevalence of overweight and obesity among young Australians, 1969-1997. Am J Clin Nutr 2003 Jan;77(1):29-36.

(55) Bundred P, Kitchiner D, Buchan I. Prevalence of overweight and obese children between 1989 and 1998: population based series of cross sectional studies. BMJ 2001 Feb 10;322(7282):326-8.

(56) Chinn S, Rona RJ. Prevalence and trends in overweight and obesity in three cross sectional studies of British Children, 1974-94. BMJ 2001 Jan 6;322(7277):24-6.

(57) Hulens M, Beunen G, Claessens AL, Lefevre J, Thomis M, Philippaerts R, et al. Trends in BMI among Belgian children, adolescents and adults from 1969 to 1996. Int J Obes Relat Metab Disord 2001 Mar;25(3):395-9.

(58) Lissau I, Overpeck MD, Ruan WJ, Due P, Holstein BE, Hediger ML. Body mass index and overweight in adolescents in 13 European countries, Israel, and the United States. Arch Pediatr Adolesc Med 2004 Jan;158(1):27-33.

(59) Lobstein T, Frelut ML. Prevalence of overweight among children in Europe. Obes Rev 2003 Nov;4(4):195-200.

(60) Matthiessen J, Velsing GM, Fagt S, Biltoft-Jensen A, Stockmarr A, Andersen JS, et al. Prevalence and trends in overweight and obesity among children and adolescents in Denmark. Scand J Public Health 2008 Mar;36(2):153-60.

(61) Pearson S, Olsen LW, Hansen B, Sorensen TI. [Increase in overweight and obesity amongst Copenhagen schoolchildren, 1947-2003]. Ugeskr Laeger 2005 Jan 10;167(2):158-62.

(62) Stamatakis E, Primatesta P, Chinn S, Rona R, Falascheti E. Overweight and obesity trends from 1974 to 2003 in English children: what is the role of socioeconomic factors? Arch Dis Child 2005 Oct;90(10):999-1004.

(63) Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. Int J Pediatr Obes 2006;1(1):11-25.

(64) Bua J, Olsen LW, Sorensen TI. Secular trends in childhood obesity in Denmark during 50 years in relation to economic growth. Obesity (Silver Spring) 2007 Apr;15(4):977-85.

(65) Bjornelv S, Lydersen S, Mykletun A, Holmen TL. Changes in BMI-distribution from 1966-69 to 1995-97 in adolescents. The Young-HUNT study, Norway. BMC Public Health 2007;7:279.

(66) Rosner B, Prineas R, Loggie J, Daniels SR. Percentiles for body mass index in U.S. children 5 to 17 years of age. J Pediatr 1998 Feb;132(2):211-22.

(67) Eriksson M, Rasmussen F, Nordqvist T. Changes in shape and location of BMI distributions of Swedish children. Acta Paediatr 2005 Nov;94(11):1558-65.

(68) Rosner B, Prineas R, Loggie J, Daniels SR. Percentiles for body mass index in U.S. children 5 to 17 years of age. J Pediatr 1998 Feb;132(2):211-22.

(69) Bjornelv S, Lydersen S, Mykletun A, Holmen TL. Changes in BMI-distribution from 1966-69 to 1995-97 in adolescents. The Young-HUNT study, Norway. BMC Public Health 2007;7:279.

(70) www.ssb.no. Statistics Norway (SSB) (website) 2007 October 1

(71) Engeland A, Bjorge T, Selmer RM, Tverdal A. Height and body mass index in relation to total mortality. Epidemiology 2003 May;14(3):293-9.

(72) Buddeberg-Fischer B, Bernet R, Sieber M, Schmid J, Buddeberg C. Epidemiology of eating behaviour and weight distribution in 14- to 19-year-old Swiss students. Acta Psychiatr Scand 1996 Apr;93(4):296-304.

(73) HBSC. www nsd 2008Available from: URL: http://www.nsd.uib.no/data/hbsc/

(74) Tambs K, Moum T. How well can a few questionnaire items indicate anxiety and depression? Acta Psychiatr Scand 1993 May;87(5):364-7.

(75) Ystgaard M. Sårbar ungdom og sosial støtte. Senter for sosialt nettverk og helse; 21993. Report No.: 1/93.

(76) Eysenck SB, von Knorring AL, von KL. A cross-cultural study of personality: Swedish and English children. Scand J Psychol 1988;29(3-4):152-61.

(77) Tambs K, Eysenck SB. EPQ-scores in Norway and England. A comparison. Scand J Psychol 1991;31(2):191-7.

(78) Davison AC HD. Bootstrap Methods and their Application. 1997.

(79) Agresti A, Caffo B. Simple and effective confidence intervals for proportions and differences of proportions result from adding two successes and two failures. American Statistician 2000 Nov;54(4):280-8.

(80) Hennekens C, Buring J. Epidemiology in Medicine. Boston/Toronto: Little Brown and Company; 1987.

(81) Rothman KJ, Greenland S. Modern Epidemiology. Philadelphia:Lippincott-Raven Publishers; 1998.

(82) Groholt EK, Stigum H, Nordhagen R. Overweight and obesity among adolescents in Norway: cultural and socio-economic differences. J Public Health (Oxf) 2008 Sep;30(3):258-65.

(83) Foss OP, Haug K, Hesla PE, Lund-Larsen PG, Vasli LR. [Can we rely on self-reported smoking habits?]. Tidsskr Nor Laegeforen 1998 May 30;118(14):2165-8.

(84) Gorber SC, Tremblay M, Moher D, Gorber B. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. Obes Rev 2007 Jul;8(4):307-26.

(85) Sherry B, Jefferds ME, Grummer-Strawn LM. Accuracy of adolescent self-report of height and weight in assessing overweight status: a literature review. Arch Pediatr Adolesc Med 2007 Dec;161(12):1154-61.

(86) Schepis TS, Rao U. Epidemiology and etiology of adolescent smoking. Curr Opin Pediatr 2005 Oct;17(5):607-12.

(87) Groholt EK, Stigum H, Nordhagen R. Overweight and obesity among adolescents in Norway: cultural and socio-economic differences. J Public Health (Oxf) 2008 Sep;30(3):258-65.

(88) Martinez JA. Obesity in young Europeans: genetic and environmental influences. Eur J Clin Nutr 2000 Mar;54 Suppl 1:S56-S60.

(89) Moreno LA, Sarria A, Fleta J, Rodriguez G, Gonzalez JM, Bueno M. Sociodemographic factors and trends on overweight prevalence in children and adolescents in Aragon (Spain) from 1985 to 1995. J Clin Epidemiol 2001 Sep;54(9):921-7.

(90) Rosner B, Prineas R, Loggie J, Daniels SR. Percentiles for body mass index in U.S. children 5 to 17 years of age. J Pediatr 1998 Feb;132(2):211-22.

(91) Andersen LF, Lillegaard IT, Overby N, Lytle L, Klepp KI, Johansson L. Overweight and obesity among Norwegian schoolchildren: changes from 1993 to 2000. Scand J Public Health 2005;33(2):99-106.

(92) Cooper Z, Cooper PJ, Fairburn CG. The validity of the eating disorder examination and its subscales. Br J Psychiatry 1989 Jun;154:807-12.

(93) Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. J Psychosom Res 1985;29(1):71-83.

(94) de Castro JM, Lilenfeld LR. Influence of heredity on dietary restraint, disinhibition, and perceived hunger in humans. Nutrition 2005 Apr;21(4):446-55.

(95) Culbert K SJKK. Genetics of Eating Disorders. In: Wonderlich S, editor. 2 ed. Academy of Eating Disorder; 2008.

(96) Bjomelv S, Mykletun A, Dahl AA. The influence of definitions on the prevalence of eating problems in an adolescent population. Eat Weight Disord 2002 Dec;7(4):284-92.

(97) Lavik NJ, Clausen SE, Pedersen W. Eating behaviour, drug use, psychopathology and parental bonding in adolescents in Norway. Acta Psychiatr Scand 1991 Oct;84(4):387-90.

(98) Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M. Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? J Am Diet Assoc 2006 Apr;106(4):559-68.

(99) Patton GC, Coffey C, Sawyer SM. The outcome of adolescent eating disorders: findings from the Victorian Adolescent Health Cohort Study. Eur Child Adolesc Psychiatry 2003;12 Suppl 1:I25-I29.

(100) Patton GC, Selzer R, Coffey C, Carlin JB, Wolfe R. Onset of adolescent eating disorders: population based cohort study over 3 years. BMJ 1999 Mar 20;318(7186):765-8.

(101) Patton GC, Coffey C, Carlin JB, Sanci L, Sawyer S. Prognosis of adolescent partial syndromes of eating disorder. Br J Psychiatry 2008 Apr;192(4):294-9.

(102) Rosenvinge JH, Gotestam KG. [Eating disorders--how should treatment be organized?]. Tidsskr Nor Laegeforen 2002 Jan 30;122(3):285-8.

Paper I

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Paper II

BMC Public Health

Research article

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Changes in BMI-distribution from 1966–69 to 1995–97 in adolescents. The Young-HUNT study, Norway

Sigrid Bjørnelv*[1,2], Stian Lydersen[3], Arnstein Mykletun[4] and Turid Lingaas Holmen[1]

Address: [1]HUNT Research Centre, Department of Public Health and General Practice, Faculty of Medicine, Norwegian University of Science and Technology, Neptunvn 1, 7650 Verdal, Norway, [2]Department of Psychiatry, Levanger Hospital, Nord-Trøndelag Hospital Trust, 7600 Levanger, Norway, [3]Unit for Applied Clinical Research, Department of Cancer research and Molecular Medicine, Norwegian University of Science and Technology, 7491 Trondheim, Norway and [4]Faculty of Psychology, University of Bergen, 5020 Bergen, Norway

Email: Sigrid Bjørnelv* - sigrid.bjornelv@ntnu.no; Stian Lydersen - stian.lydersen@ntnu.no; Arnstein Mykletun - arnstein.mykletun@psyhp.uib.no; Turid Lingaas Holmen - turid.lingaas.holmen@ntnu.no

* Corresponding author

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Abstract

Background: The aim of this study was to explore changes in the BMI-distribution over time among Norwegian adolescents.

Methods: Height and weight were measured in standardised ways and BMI computed in 6774 adolescents 14–18 years who participated in the Young-HUNT study, the youth part of the Health-study of Nord-Trondelag County, Norway in 1995–97. The results were compared to data from 8378 adolescents, in the same age group and living in the same geographical region, collected by the National Health Screening Service in 1966–69.

Results: From 1966–69 to 1995–97 there was an increased dispersion and a two-sided change in the BMI-distribution. Mean BMI did not increase in girls aged 14–17, but increased significantly in 18 year old girls and in boys of all ages. In both sexes and all ages there was a significant increase in the upper percentiles, but also a trend towards a decrease in the lowest percentiles. Height and weight increased significantly in both sexes and all ages.

Conclusion: The increased dispersion of the BMI-distribution with a substantial increase in upper BMI-percentiles followed the same pattern seen in other European countries and the United States. The lack of increase in mean BMI among girls, and the decrease in the lowest percentiles has not been acknowledged in previous studies, and may call for attention.

Background

Height, weight and Body Mass Index (BMI) have been used extensively as indicators of weight-related health-problems. Changes in these anthropometric characteristics reflect different changes in society as well as in its individuals. Better nutrition increases both height and weight, and reduces health problems connected with malnutrition. Increased weight and BMI might also indicate a non-healthy diet and too little physical activity causing health problems, while low weight and BMI might reflect unhealthy dieting and eating problems. In order to prevent and modify any unwanted changes in weight and

BMI, it is important to observe trends in the BMI-distribution over time, different changes may call for different or new prevention strategies [1].

Studies both from Europe [2-7] and the United States [8,9] have shown increasing BMI-values in adolescents during the last two decades, with a marked increase in the highest BMI-percentiles. However, some studies [10,11] do not support an overall increase in BMI-percentiles, indicating than not all adolescents belong to the population with increasing BMI. At the same time different studies reports high prevalence of dieting and other unhealthy weight control behaviours in this age group [12,13]. One recent study [3] have focused on the increased dispersion of the BMI-distribution, but surveying Medline 1994-May 2007 for the descriptors BMI and change limited to adolescents, we found no study focusing on changes in the lowest BMI-percentiles.

This article aimed to study changes over time in height, weight, BMI and the total BMI-distribution, by comparing measurements 30 years apart from same aged adolescents, living in the same region.

Methods

Study populations

Data are collected from two different study-populations from the county of Nord-Trondelag, Norway in 1966–69 and 1995–97. The county consists of rural and industrial areas with small social differences and sociodemographic changes between the two studies. In 1995 the county had 127,000 inhabitants, 10,000 more than in 1969.

1) The National Health Screening Service (NHS) 1966–69

The Norwegian National Health Screening Service (NHS) was established in 1940, and from 1952 on regularly basis collected population data from the whole country [14]. As part of this program, standardised data on height and weight was collected from the population of Nord-Trøndelag County in 1966–69. Totally 80% (8378) of the adolescent population 14–18 years old participated, 4372 boys and 4006 girls.

2) Young-HUNT, 1995–97

Young-HUNT is the youth part of Nord-Trondelag Health Study (HUNT)[15]. All students in Junior High Schools (13–16 years) and High Schools (16–19 years) in the county were invited to the Young-HUNT study. The response rate was 90%. A self reported questionnaire was completed during one school hour. In the clinical part of the study, specially trained nurses measured weight and height within one month after completion of the questionnaire. In the age group 14–18 years, height and weight were measured in 3307 boys and 3367 girls, totally 6674 adolescents.

Measurements

Age

In both studies age is reported according to truncated age, that is, age 14 ranges from 14.00 – 14.99 years. In both populations and for all ages in both boys and girls, the mean age ranged from 0.47 to 0.52 years higher than the truncated age.

Mainly due to differences in birth rates, the number of participants in each age group differs in and between the two study populations. The number of participants is lower in the highest ages. In the Young- HUNT study students in High-school having a year of apprenticeship outside of school were not invited. In 1966/69, many of the oldest adolescents had ended school and worked outside the county.

Height and weight

The Young-HUNT study followed the procedures for measuring height and weight made by the NHS. Height and weight were measured by trained nurses using internally standardised meter measures and weight scales. The subjects wore light clothes (T-shirts and trousers) without shoes. Height was read to the nearest cm and weight to the nearest half kilo or kilo. In our calculations of measurement error, we have assumed that weight was rounded off to the nearest kg.

Statistical analyses

The differences in mean height, weight and BMI were analysed using Student's t-test with unequal variances. Analyses of log transformed BMI values gave the same results (not reported here). P-values for differences in the BMI-percentiles between the studies were computed using bootstrapping with 1000 replications and the "bias corrected and accelerated" (Bca) method [16]. Bootstrapping was used because BMI was not normally distributed, especially in the tails of the distribution. Measurement error in change in BMI percentiles due to rounding off measurements to the nearest kg and cm was computed using Monte Carlo simulations with m = 1000 replications. The potential bias in BMI due to age truncation was calculated by linear interpolation. The statistical programs S-PLUS (Insightful Corporation) and R were used for bootstrapping and Monte Carlo Simulations. SPSS version 12.0 (SPSS Inc., Chicago) was used for the other analyses. Two sided p-values <0.05 were considered significant.

Results

Height and weight

Mean height and weight increased from 1966–69 to 1995–97. The differences were significant ($p < 0.001$) for all ages and both sexes (Tables 1 and 2).

Table 1: Distribution of height and weight for each sex and age group in the two study- populations NHS and Young-HUNT

Age	N		Height				Weight			
	NHS (66/69)	Young- HUNT (95–97)	NHS (66/69)		Young- HUNT (95–97)		NHS (66/69)		Young- HUNT (95–97)	
Boys			Mean	SD	Mean	SD	Mean	SD	Mean	SD
14	973	755	163.9	8.7	170.6	8.3	53.4	9.8	59.7	11.5
15	960	756	170.5	8.0	175.3	7.2	60.1	9.2	64.7	11.1
16	922	658	174.0	6.6	178.3	6.7	64.0	9.0	68.4	11.3
17	767	639	176.3	6.5	180.1	6.5	67.3	8.2	72.5	12.0
18	750	499	177.0	6.6	180.1	7.0	69.7	8.3	74.4	12.2
Girls										
14	941	773	161.6	5.7	164.6	6.2	53.9	7.6	56.4	9.7
15	932	755	163.4	5.7	166.2	5.9	56.4	8.2	58.9	9.0
16	825	667	164.2	5.6	166.4	5.9	58.4	8.3	60.4	9.5
17	691	610	164.7	5.7	166.7	6.2	59.7	7.9	62.0	9.7
18	617	542	164.9	5.5	167.3	5.7	60.4	8.1	63.7	10.8

Height and weight increased more in boys compared to girls. For boys, height increased most in the youngest and mean height reached maximum in younger age in 1995/97 compared to 1966/69. No significant age dependence was found for height increase in girls or for weight-increase in either sex.

Mean BMI

In girls 14–17 years there was no significant increase in mean BMI from 1966/69 to 1995/97, the increase was significant only in the 18 years old ($p = 0.002$). Among boys, mean BMI increased significantly ($p < 0.001$) in all ages (Tables 1 and 2).

Table 2: Distribution of BMI for each sex and age group in the two study- populations NHS and Young- HUNT

Age	Mean Body Mass Index					
	NHS (66/69)		Young-HUNT (95/97)		Difference	
	Mean	SD	Mean	SD	Diff.	P
Boys						
14	19.7	2.3	20.4	3.1	0.7	<.001
15	20.6	2.2	21.0	2.9	0.4	<.001
16	21.1	2.3	21.5	3.0	0.4	<.001
17	21.6	2.1	22.3	3.3	0.7	<.001
18	22.2	2.2	22.9	3.3	0.7	<.001
Girls						
14	20.6	2.4	20.8	3.1	0.2	.261
15	21.1	2.7	21.3	3.0	0.2	.147
16	21.6	2.7	21.8	3.2	0.2	.261
17	22.0	2.7	22.3	3.1	0.3	.061
18	22.2	2.6	22.8	3.6	0.6	.002

BMI distribution

The change in the BMI-distribution showed an increased dispersion in BMI-values from 1966/69 to 1995/97 (Tables 1 and 2, Figure 1). There was a significant and skewed increase in the upper percentiles, with a shift around the 50th-percentile, but a trend for a decrease in the lower percentiles. Although significant only in girls aged 14 and boys aged 16 and 18, the pattern of decrease was consistent for all the lower percentiles in both sexes and all ages (Table 3). If there was no expected decrease in the lower percentiles, the probability of observing a decrease for all 10 age-sex groups would be $(1/2)^{10} = 0.001$. Hence, the observed reduction in the lower percentiles of BMI as a whole is highly significant.

Changes in the upper percentiles (90th, 95th and 97.5th) were significant for boys in all ages, but for girls there were no significant changes in the 90th percentile for ages 15–17. In absolute values, the changes in the uppermost percentiles were greater in boys than in girls (Table 3).

Discussion

Our study confirmed a substantial increase in the upper BMI-percentiles over time in the adolescent population. However, no significant increases in mean BMI were found for girls 14–17 years, and the study showed an increased dispersion of the BMI-distribution with a consistent pattern of a decrease in the lowest BMI percentiles, a trend for both sexes and all ages. Previous studies have focused primarily on changes in the upper percentiles, missing these changes in the lower percentiles indicating that the increase in BMI does not involve all adolescents.

Strengths and limitations

The strength of our study is that both NHS and Young-HUNT sampled data from the same county, including

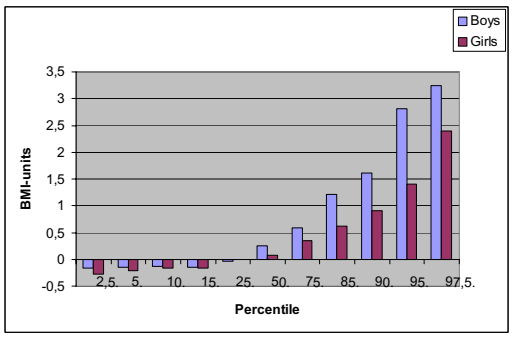

Figure 1
Changes in the BMI-distribution 1966/69 – 1995/97.

more than 80% of the adolescent population, and with the same standardized procedures for measurements of height and weight. Mean ages in all age- and sex groups were similar. We have no data on secular changes in the study periods, but in both studies data were collected over a restricted time period (2–4 years), reducing the probability of major secular changes within each survey period. The population of Nord-Trondelag County has been stable with small sociodemographic and ethnic differences. The large number of participants and high participation rates support a high external validity. Also, Nord-Trondelag County has a sex and age distribution similar to Norway as a whole. The same is true for geography, industry, sources of income and economy.

When comparing results from two cohorts studied 30 years apart, some potential biases need to be addressed. Despite using the same protocols for measurements, differences in measurement-accuracy, time since meal and clothing including seasonal variations could influence the results. No systematic biases are likely in these aspects. We have no reasons to believe that the weight measurements were performed differently in the two studies in respect to weight of light clothes and time since meal. Both studies were conducted during the school-day (08.30 – 14.00), and school-year, with no measurements in June, July and August.

Another issue is the effect of rounding off height and weight to the nearest cm and kg. However, testing this, the resulting uncertainties in BMI percentile differences, given in the footnote for Table 3, is too small to explain the observed differences in BMI-values. The consistent pattern across age-and gender groups, together with the lack of increase of mean BMI in girls 14–17 year, also support the findings of a decrease in the lowest BMI-percentiles.

Potential bias due to age truncation is practically negligible, as stated in the footnote for Table 3.

Although a marked increase in the upper BMI-percentiles is well established, not all studies support the notion of an overall increase in BMI. This may support our findings of a decrease in the lowest BMI-percentiles and no increase in mean BMI in girls 14–17 years. While the prevalence of overweight and obesity in British children increased from 1984 – 1994 [17], a later short report found no significant changes in mean BMI 1986–1996 for girls aged 12–16

Table 3: Differences in values of BMI-percentiles (in BMI-units) between the two study populations NHS (1966/69) and Young-HUNT (1995/97)[1]

	Boys					Girls				
Age	14	15	16	17	18	14	15	16	17	18
Percentiles (a)										
2.5	-0.2	-0.16	-0.43*	-0.55	-0.87*	-0.6*	-0.28	-0.07	-0.04	-0.07
5	-0.11	-0.14	-0.18	-0.14	-0.93*	-0.45*	-0.36	-0.24	-0.12	0
10	0	-0.15	-0.09	-0.10	-0.59*	-0.39*	-0.03	-0.26	-0.09	0.02
15	-0.01	-0.16	-0.11	-0.04	-0.15	-0.37	-0.08	-0.32	0	0.09
25	0.08	-0.10	-0.17	0.15	0.11	-0.28	0.03	-0.1	0.14	0.04
50	0.28*	-0.05	0.21	0.39*	0.35	-0.2	0.26	0.02	-0.09	0.19
75	0.94	0.43	0.49	0.77	0.97	0.36	0.16	0.13	0.54	0.51
85	1.62	1.08	0.83	1.14	1.74	0.89	0.08	0.57	1.79	1.14
90	2.28*	1.89*	1.29*	1.72*	2.26*	0.9*	0.53	0.96	1.03	1.73*
95	2.94*	2.36*	3.04*	2.89*	2.73*	1.53*	1.15	1.4*	1.72*	2.71*
97.5	3.33*	2.78*	3.31*	4.43*	5.08*	2.24*	0.75	2.13*	2.29*	4.38*

* $p < .05$ for mean difference equal to 0.
[1] Since height and weight were rounded off, to the nearest cm and half kg, there is measurement error in the tabulated differences. Its standard deviation has been computed as 0.07, 0.03, and 0.12, BMI-units respectively, for the 2.5, 50, and 97.5 percentiles.

[10]. Also an Australian study among primary school children showed no increase in mean BMI from 1985–1997 among girls 12 years old and boys 7, 8 and 10 years [18]. Two Swedish studies have different conclusions. One article comparing the values of the 50-percentile between two cohort studies in the 1950s and in the 1970s summarised that the Swedish child population had remained at a very similar BMI-level since the Second World War [11], another study concluded that the median BMI was significantly higher in 2001 than in 1987 for boys aged 10, 13 and 16 years, and in girls 16 years old [2]. Also in this latest study, the greatest change in BMI was found in the highest percentiles.

Comparing different studies of changes in BMI- percentile is complicated due to use of different methodology, including measurements, sampling procedures, the decade the study started, and time span between measurements. The fact that other studies conducted within different time frames also reports some decrease in the lower percentiles, can indicate that this not only is a Norwegian phenomenon. Studies from both Europe [2,4-7] and the United States [8,9] have all focused on the changes in upper percentiles. Few studies have evaluated changes in the entire BMI-distribution. A Finnish [5] study in age groups 12, 14, 16 and 18 years found, according to the tables, little or no change in the lower (5^{th} and 15^{th}) and middle (50^{th}) percentile. A Swedish study [3] evaluating the differences in BMI-distribution in children 2–15 years of age born in 1973/75 and 1985/87 found an increase only above the 25^{th} percentile, and more pronounced in the upper parts of the BMI-distribution. Girls 13 and 14 years old had lower values of the 5th percentile in 1985/87 compared to 1973/75. Different other studies [2,7-9] have also presented tables with decrease in the lowest percentile in a few age- and sex groups, but without any comment on these findings. Although statistically significant only in boys 16 and18 years and girls 14 years, the consistency of the pattern in all ages and both sexes in our study, indicates a clear trend of decrease in the lower percentile that should not be ignored.

Existing Norwegian standards for height and weight [19] in children and adolescents were constructed from data sampled in Bergen from 1971–74. No recent official measures of height and weight have been published, making it difficult to predict when and how fast the changes have occurred. British studies in adolescents have shown little change in the prevalence of overweight and obesity between 1974–1984, but a significant increase between 1984 and 1994 [10,17]. A follow-up study of Young-HUNT in 2000–01 with 1613 girls and boys aged 17 and 18 years found no significant changes in height and weight from the Young- HUNT studies 1995–97 (data not shown) indicating that changes mainly occurred before 1995. This assumption is supported by the adult part of the HUNT-study, showing a marked increases in BMI among young adults between HUNT-I (1984–86) and HUNT-II (1995–97) [20].

Changes in the BMI-distribution over 30 years, as shown in this study from Nord- Trondelag Norway, may have multiple different explanations, both biological and socio-cultural, and their clinical relevance should be explored. Better socioeconomic conditions may have led to two different problems among adolescents, on one side obesity on the other side unhealthy weight control behaviour including eating problems. Especially in girls dieting and eating problems was reported quite frequently in the Young-HUNT population [12]. The fact that mean BMI in our study showed no increase in girls 14–17 years supports the need to follow the changes in BMI -distribution, not only the highest percentiles,

Conclusion

The increased dispersion in the BMI distribution from 1966/69 to 1995/97 with an increase in the highest percentile confirms the increased prevalence of obesity in the adolescent population found in other studies. The lack of increase in mean BMI in girls 14–17 years and a decrease in the lowest percentiles also calls for attention. When studying changes in BMI distribution and national differences, it is necessary not only to compare the mean or median, but also, as this study show, to look at the whole BMI-distribution. Focus should be on etiological factors determining the individual BMI as well as the shape of the total BMI-distribution.

Competing interests

The author(s) declare that they have no competing interests.

Authors' contributions

TLH is the Principal Investigator of the Young- HUNT studies, and has contributed to the planning and reporting of this as well to writing the article.

SL contributed to statistical analysis and to writing the article

AM has contributed to the planning and reporting of the work and writing the article.

SB is the guarantor.

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Ethical approval:

The Regional committee for ethics in medical research, and the Norwegian Data Inspectorate has approved the protocol for the study.

References

1. Neumark-Sztainer D: **Can we simultaneously work toward the prevention of obesity and eating disorders in children and adolescents?** *Int J Eat Disord* 2005, **38:**220-227.
2. Ekblom O, Oddsson K, Ekblom B: **Prevalence and regional differences in overweight in 2001 and trends in BMI distribution in Swedish children from 1987 to 2001.** *Scand J Public Health* 2004, **32:**257-263.
3. Eriksson M, Rasmussen F, Nordqvist T: **Changes in shape and location of BMI distributions of Swedish children.** *Acta Paediatr* 2005, **94:**1558-1565.
4. Fredriks AM, van Buuren S, Wit JM, Verloove-Vanhorick SP: **Body index measurements in 1996-7 compared with 1980.** *Arch Dis Child* 2000, **82:**107-112.
5. Kautiainen S, Rimpela A, Vikat A, Virtanen SM: **Secular trends in overweight and obesity among Finnish adolescents in 1977-1999.** *Int J Obes Relat Metab Disord* 2002, **26:**544-552.
6. Petersen TA, Rasmussen S, Madsen M: **[BMI of Danish school children measured during the periods 1986/1987--1996/1997 compared to Danish measurement in 1971/1972].** *Ugeskr Laeger* 2002, **164:**5006-5010.
7. Rios M, Fluiters E, Perez Mendez LF, Garcia-Mayor EG, Garcia-Mayor RV: **Prevalence of childhood overweight in Northwestern Spain: a comparative study of two periods with a ten year interval.** *Int J Obes Relat Metab Disord* 1999, **23:**1095-1098.
8. Flegal KM, Troiano RP: **Changes in the distribution of body mass index of adults and children in the US population.** *Int J Obes Relat Metab Disord* 2000, **24:**807-818.
9. Rosner B, Prineas R, Loggie J, Daniels SR: **Percentiles for body mass index in U.S. children 5 to 17 years of age.** *J Pediatr* 1998, **132:**211-222.
10. Georgiades E, Reilly JJ, Stathopoulou E, Livingston AM, Pitsiladis YP: **BMI distribution changes in adolescent British girls.** *Arch Dis Child* 2003, **88:**978-979.
11. He Q, Albertsson-Wikland K, Karlberg J: **Population-based body mass index reference values from Goteborg, sweden: birth to 18 years of age.** *Acta Paediatr* 2000, **89:**582-592.
12. Bjomelv S, Mykletun A, Dahl AA: **The influence of definitions on the prevalence of eating problems in an adolescent population.** *Eat Weight Disord* 2002, **7:**284-292.
13. Neumark-Sztainer D, Hannan PJ: **Weight-related behaviors among adolescent girls and boys: results from a national survey.** *Arch Pediatr Adolesc Med* 2000, **154:**569-577.
14. Engeland A, Bjorge T, Selmer RM, Tverdal A: **Height and body mass index in relation to total mortality.** *Epidemiology* 2003, **14:**293-299.
15. 2007 [http://www.hunt.ntnu.no].
16. Davison AC HDV: *Bootstrap Methods and their Application* 1997.
17. Chinn S, Rona RJ: **Prevalence and trends in overweight and obesity in three cross sectional studies of British Children, 1974-94.** *BMJ* 2001, **322:**24-26.
18. Lazarus R, Wake M, Hesketh K, Waters E: **Change in body mass index in Australian primary school children, 1985-1997.** *Int J Obes Relat Metab Disord* 2000, **24:**679-684.
19. Waaler PE: **Anthropometric studies in Norwegian children.** *Acta Paediatr Scand Suppl* 1983, **308:**1-41.
20. Midthjell K, Kruger O, Holmen J, Tverdal A, Claudi T, Bjorndal A, Magnus P: **Rapid changes in the prevalence of obesity and known diabetes in an adult Norwegian population. The Nord-Trondelag Health Surveys: 1984-1986 and 1995-1997.** *Diabetes Care* 1999, **22:**1813-1820.

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Appendix

YOUNG HUNT 1 (1995-1997)
The Nord-Trøndelag Health Study
High School/Secondary School Students Aged 16-19

It's your turn to participate in the extensive health study being conducted in Nord-Trøndelag (HUNT)!

We hope that you have read the information sent home with you about Young HUNT and have decided to participate.

Read the informed consent form that is inside the questionnaire and check that your name is on it. Mark it as to whether you will participate or not, sign it and hand it in to the teacher. These will be put in an envelope and sealed.

Your name should NOT be on your questionnaire!

To fill out the questionnaire properly you must put an X in the boxes that you think apply to you. Answer the best you can! If there are questions that you do not want to answer, skip them. When you are finished, put the questionnaire in the envelope, seal it and give the envelope to the teacher. Do this even if you haven't finished the questionnaire.

All your answers will be treated in the strictest of confidence!

No one at school is allowed see your answers.

If you wish to speak to someone about the study, speak to the Young HUNT nurse at your school or ring HUNT Research Centre (see back of questionnaire).

Good Luck and Thank You!

Date: ___ / ___ - ___

1. Are you male or female? <male, female>

2. What grade are you in? <academic, vocational>
5th year Secondary School/10th grade
6th Form at Secondary School or College/11th grade
2nd year of 6th Form at Secondary School or College/12th grade
Folk high school

3. What type of plans do you have regarding continued studies?
(Put an X in one or more boxes)
None
College or university, less than 4 years
College or university for 4 years or more
Vocational school or training
Don't know

WHERE YOU LIVE

4. What type of housing do you live in?
(Put an X in only one box)
Single-family house/villa
Farm
Flat in block or terraced block of flats
Terraced house/2-4 family housing
Other accommodations

5. Who do you currently live with?
(Put an X in one or more boxes)
Mother
Father
1-2 siblings
3 or more siblings
Mother's new husband or partner
Father's new wife or partner
Spouse/partner (boyfriend or girlfriend)/friends
Alone/in a rented room
Foster parents
Other

6. Are there fitted carpets where you live:
In the living room? <yes, no>
In your bedroom? <yes, no>

7. Is there a cat where you live (in your home)? <yes, no>

8. Is there a dog where you live (in your home)? <yes, no>

9. Are there other animals with fur where you live (in your home)? <yes, no>

YOUR HEALTH

10. How is your health at the moment?
(Put an X in the box that best describes your health)
Poor
Not so good
Good
Very good

11. Are you disabled in any of these ways (function impairment)?
(Put an X in one box on each line) <No, A little, Somewhat, Severely>
Motor ability impairment (movement)
Vision impairment
Hearing impairment
Impairment due to physical illness
Impairment due to mental health problems

12. Have you had any of these ailments in the past 12 months?
(Put an X in one box on each line) <Never, Seldom, Sometimes, Often>
A Headache (without known medical cause)
B Neck or shoulder pain
C Joint or muscle pain
D Stomach pain (without known medical cause)
E Nausea
F Constipation
G Diarrhoea
H Heart palpitations
I Bronchitis or pneumonia
J Ear infection
K Sinus infection

13. If you answered "never" to <u>all</u> the above listed ailments, have you had any of these ailments <u>often</u> earlier (meaning before the last 12 months)**?** <yes, no>

If YES, **which ailment was it (see above list)?**
Write the name of the ailment or letter from above
_____

WHEEZING AND ASTHMA

14. Have you ever had wheezing or whistling in the chest? <yes, no>

If you answered NO, please skip to question 19

15. Have you had wheezing or whistling in the chest <u>in the past 12 months</u>? <yes, no>

If you answered NO, please skip to question 19

16. How many attacks of wheezing have you had <u>in the past 12 months</u>?
None
1 to 3
4 to 12
More than 12

17. <u>In the past 12 months, h</u>ow often, on average, has your sleep been disturbed due to wheezing?
Never woken with wheezing
Less than one night per week
One or more nights per week

18. <u>In the past 12 months</u>, has wheezing ever been severe enough to limit your speech to only one or two words at a time between breaths? <yes, no>

19. Have you ever had asthma? <yes, no>

If YES, **has a doctor said that you have had asthma?** <yes, no>

20. <u>In the past 12 months</u>, has your chest sounded wheezy during or after exercise? <yes, no>

21. <u>In the last 12 months</u>, have you had a dry cough at night apart from a cough associated with a cold or chest infection? <yes, no>

ECZEMA

22. Have you ever had an itchy rash which was coming and going for at least 6 months? <yes, no>
If you answered NO, please skip to question 27

23. Have you had this itchy rash at any time during the past 12 months? <yes, no>
If you answered NO, please skip to question 27

24. Have you had this itchy rash in the following places: the folds of your elbow (inside), back of your knees, on the front of your ankles, under your buttocks or around your neck, ears or eyes? <yes, no>

25. Has this rash cleared completely at any time during the past 12 months? <yes, no>

26. In the last 12 months, how often on the average have you been kept awake at night by this itchy rash?
Never in the past 12 months
Less than 1 night per week
1 or more nights per week

27. Have you ever had eczema? <yes, no>

RHINITIS

All these questions are about problems which occur when you DO NOT have a cold or the flu.

28. Have you ever had a problem with sneezing, or a runny, or blocked nose when you DID NOT have a cold or the flu? <yes, no>

If you answered NO, please skip to question 33

29. In the past 12 months, have you had a problem with sneezing, or a runny, or blocked nose when you DID NOT have a cold or the flu? <yes, no>

If you answered NO, please skip to question 33

30. In the past 12 months, has this nose problem been accompanied by itchy-watery eyes? <yes, no>

31. In which of the past 12 months did this nose problem occur?
(Put an X in the box for any which apply)
January
February
March
April
May
June
July
August
September
October
November
December

32. In the past 12 months, how much did this nose problem interfere with your daily activities?
<Not at all, A little, A moderate amount, A lot>

33. Have you ever had hay fever? <yes, no>

ALLERGIES

34. Do you have any allergies? <Yes, No, Don't know>

If you answered NO, please skip to question 37

35. What do you think you are allergic to? Put an X in the boxes to describe how you are affected by each item listed in the left column.
(Put an X in one or more boxes for each line.)
<No, Nose, Eyes, Eczema, Stomach reaction, Asthma/problems breathing, Other>
Dogs
Cats
Other animals
Grass/trees
House dust
Food
Smoke
Other

36. Has a doctor given you any allergy tests (blood tests, skin tests)**?** <yes, no>

MEDICINE

37. Do you take/use any of these medicines or dietary supplements?
Think about what you use these for. (Put an X in a box on every line.)
<never, sometimes, almost daily>
Pain relievers
Migraine medicine
Sleep medicine
Nerve medicine
Relaxants
Asthma medicine
Allergy medicine
Eczema cream
Laxatives
Iron tablets
Vitamins
Cod liver oil
Homeopathic medicine, herbal medicine
Other
List Other here: _____

CONCERNING OTHER ILLNESSES

38. Has a doctor diagnosed you with:
Epilepsy <yes, no>
Diabetes <yes, no>
Migraines <yes, no>

39. Have you had any other illness that lasted longer than 3 months? <yes, no>

If YES, which? _____

TOBACCO

40. Does anyone you live with smoke at home?
(Put an X in one or more boxes)
No, nobody
Yes, my mother
Yes, my father
Yes, a sibling
Yes, other people

41. Have you tried smoking? (at least one cigarette) <yes, no>
If you answered NO, go to question 45

42. Do you smoke? (Put an X in the appropriate box and write in the number of cigarettes. A package of loose tobacco equals approx. 50 cigarettes.)
Yes, I smoke about ____ cigarettes daily.
Yes, I smoke occasionally, but not daily.
No, not anymore, but previously I smoked once in a while.
No, not anymore, but previously I smoked about ____ cigarettes daily.
No, I don't smoke.

If you answered NO, I DON'T SMOKE, go to question 45

43. How old were you when you began smoking? _____ years old

44. How many years in total have you smoked daily? _____ years

45. Does the smell of smoke ever bother you?
At school? <Never, Sometimes, Often>
At home? <Never, Sometimes, Often>

---

46. Do you use or have you used snuff, chewing tobacco or similar products?
No, never
Yes, but I have quit
Yes, sometimes
Yes, everyday

If you answered NO, NEVER, go to question 50

47. How old were you when you began using snuff/chewing tobacco? _____ years old

48. How many years in total have you used snuff/chewing tobacco? _____ years

49. How many boxes/bags of snuff/chewing tobacco do you use in a week? ____ (number)

SPORTS AND EXERCISE

50. Not during the average school day: **How many <u>days</u> a week do you play sports or exercise to the point where you breathe heavily and/or sweat?**
Everyday
4-6 days a week
2-3 days a week
1 day a week
Not every week, but at least once every two weeks
Not every 14th day, but at least once a month
Less than once a month
Never

51. Not during the average school day: **How many <u>hours</u> a week do you play sports or exercise to the point where you breathe heavily and/or sweat?**
None
About ½ hour
About 1 hour
About 2-3 hours
About 4-6 hours
7 or more hours

52. Do you use asthma medication before you exercise, work out or compete in sports? <yes, no>

53. Are you actively involved in sports?
Yes
No, but I was before
No

If you answered NO, (never been actively involved in sports), go to question 59

54. If you no longer participate in sports, **how old were you when you stopped?** ____ years old

55. Which sport(s) do/did you participate in?
(Put an X in one or more boxes)
A Skiing (cross country, biathlon)
B Skiing (downhill/slalom, ski jump)
C Football/soccer
D Horse riding
E Skating, ice hockey
F Handball, basketball, volleyball
G Martial arts, boxing
H Body building
I Cycling
J Weight lifting
K Track and field, orienteering
L Swimming
M Gymnastics
N Other, write in here: _____

56. Do you play any competitive sports? (X only one box)
Yes
No, but I did before
No

If you answered NO (never competed in sports), go to question 59

57. At what level do/did you compete in sports?
(Give highest level)
Local level (championships, series, etc.)
Regional or state level
National level

58. In which sports do/did you compete?
(In order of participation level, list 3 sports you are/were active in.)
I am/have been most active in _____ and have/had participated for ____ years.
I am/have been 2nd most active in _____ and have/had participated for ____ years.
I am/have been 3rd most active in _____ and have/had participated for ____ years.

YOUR GENERAL WELLBEING

59. Thinking about your life at the moment, would you say that you by and large are satisfied with life, or are you mostly dissatisfied? (Put an X in only one box)
Very satisfied
Satisfied
Somewhat satisfied
Neither satisfied nor dissatisfied
Somewhat dissatisfied
Dissatisfied
Very dissatisfied

60. Do you feel, for the most part, strong and fit or tired and worn out? (Put an X in only one box)
Very strong and fit
Strong and fit
Somewhat strong and fit
Somewhere in between
Somewhat tired and worn out
Tired and worn out
Very tired and worn out

61. Would you say you are usually cheerful or downhearted? (Put an X in only one box)
Very downhearted
Downhearted
Somewhat downhearted
Some of both
Somewhat cheerful
Cheerful
Very cheerful

62. How do you see yourself?
Put an X in a box for each sentence below indicating whether you agree or disagree in how it relates to you. (Put an X in one box on each line)
<Strongly agree, Agree, Disagree, Strongly Disagree>
I take a positive attitude toward myself.
I certainly feel useless at times.
I feel I do not have much to be proud of.
I feel that I'm a person of worth, at least on an equal plane with others.

63. In the last month have you:
< Almost every night, Often, Sometimes, Never>
Had difficulty falling asleep?
Woken up too early and not been able to get to fall asleep again?

64. The questions below are about how you usually behave, feel and deal with things. Place a cross in the box for Yes or No for each statement depending on whether it describes you or not. <yes, no>
Are you a relatively lively person?
Would you be upset by seeing a child or animal suffer?
Do you like meeting new people?
Are your feelings easily hurt?
Do you often feel that you lose interest?
Do you like to tease people even though it may hurt them?
Are you often worried?
Are good manners and cleanliness important to you?
Do you worry that terrible things might happen?
Do you usually take the first step to make new friends?
Are you mostly quiet when you are around other people?
Do you like to be on time for appointments?
Do you often feel tired and indifferent/unmotivated without reason?
Do many people try to avoid you?
Are you a life-of-the-party type person?
Are you bothered by an embarrassing experience long after it happens?
Do you like to have a lot of life and excitement around you?
Do people tell you a lot of lies?

65. Below is a list of some problems. Have you been bothered by any of these in <u>the last 14 days</u>?
(Put an X in one box on each line)
<Not at all, A little, Quite a bit, Very>
Been constantly afraid and anxious
Felt tense or uneasy
Felt hopelessness when you think of the future
Felt dejected or sad
Worried too much about various things

66. During <u>the last month</u> have you been bothered by nervousness (irritability, uneasiness, tenseness or restlessness)?
Almost always
Often
Sometimes
Never

YOUR LEISURE TIME

67. Think back over the last week, <u>the last 7 days</u>. If you did any of the things listed below, put an X in the box for about how many times you did this. (X an answer for each line)
<Not once, Once, 2 or 3 times, 4 times or more>
Visited someone you know
Were visited
Read a book you liked
Listened to music or played an instrument longer than 15 minutes
Were out for more than 2 hours (in a row) with friends
Were at a meeting or training with a club or team
Were active in a hobby
Watched television or a video
Did homework longer than 1 hour

68. How many teams or clubs are you a part of?
(For example: sports team, girl or boy scouts, band, etc.)
None
One
2 or more

FRIENDS

69. Do you have someone that you have considered your best friend during most of the time you have been at school? <yes, no>

70. Do you feel lonely?
(Put an X in one box)
Very often
Often
Sometimes
Seldom
Very seldom or never

71. Are your parents separated or divorced, or have they lived separately for more than one year?
(Put an X in one box and write in your age where necessary)
No
Yes, they lived separately or were separated when I was _____ years old, but they later moved back together again.
Yes, they were divorced or permanently separated when I was ____ years old.

72. If you have siblings, how good a relationship do you feel you have with your sister or brother? If you have several siblings, think about the one you have the best relationship to.
(Put an X in one box)
Much worse than normal
Worse than normal
Average
Better than normal
Much better than normal
I do not have siblings

73. About how many close friends do you have? Include those with whom you can confidentially talk and who help you when you are in need. Do not include the people you live with, but include other relatives.

(Put an X in one box)
None
One
2 or more
4 or more

74. Do you have a steady boyfriend/girlfriend? <yes, no>

75. Do you feel that you have enough friends? <yes, no>

SCHOOL

76. Do any of the following things happen to you at school/concerning school, or have any of them happened?
(Put an X in one box on each line)
<Never, Sometimes, Often, Very often>
Have difficulties concentrating during class
Think that gym or art is fun
Think other classes are fun
Argue with the teacher
Look forward to going to school
Skip school
Understand what is being taught
Have fun during recess/break time
Are satisfied with your test results
Get in a fist fight
Are teased/harassed by other students
Are reprimanded by the teacher
Cannot manage to be calm/sit still during class
Become bored or dissatisfied

MEALS AND EATING HABITS

77. How often do you usually eat these meals?
(Put an X in one box on each line)
<Everyday, 4-6 days a week, 1-3 days a week, Seldom or never>
Breakfast
Lunch
Warm dinner

78. Are you trying to lose weight?
No, I'm comfortable with my weight
No, but I need to lose weight
Yes

79. How often do you <u>not</u> eat your lunch even though you brought one with you?
(Put an X in one box)
Every school day
4-6 days a week
1-3 days a week
Seldom or never
I never bring a lunch with me

80. How often do you drink or eat the things listed below?
(Put an X in one box on each line)
<More than once a day, Once a day, Every week but not everyday, Seldom, Never>
Cola, soda or still soft drinks
Low fat milk/skim milk
Whole milk
Coffee
Potato chips and such
Candy, chocolate and other sweets
Chips/French fries, hamburgers or hot dogs
Whole grain bread/ Crispbread
Butter
Margarine
Fruit
Vegetables

81. Do you consider yourself:
(Put an X in one box)
Very fat
Chubby
About the same as others
Thin
Very thin

82. Below are listed things that concern your eating habits. Put an X in the boxes according to how they apply to you.
(Put an X in one box for each statement)
<Never, Seldom, Often, Always>

When I first begin eating, it is difficult to stop.
I spend too much time thinking about food.
I feel that food controls my life.
I cut my food into small pieces.
I take longer than others to eat my meals.
Older people think that I am too thin.
I feel that others pressure me to eat.

ALCOHOL

83. Have you ever tried drinking alcohol? (Meaning alcoholic beer, wine, hard liquor or moonshine)
<Yes, No, Don't know>

If you answered NO, go to question 87

84. Have you ever drunk so much alcohol that you felt intoxicated (drunk)?
(Put an X in one box)
No, never
Yes, once
Yes, 2-3 times
Yes, 4-10 times
Yes, more than 10 times

85. About how much beer, wine or hard liquor do you usually drink during <u>two weeks</u>? Don't count alcohol free beer. Write 0 if you do not drink alcohol.

Beer	____	number of 1/2 bottles
Wine	____	number of glasses (approx. 1 dl)
Hard liquor, liqueurs	____	number of glasses (approx. 1/2 dl)
Moonshine	____	number of glasses (approx. 1/2 dl)

86. On which days during the week do you most often drink alcohol?
(Put an X in one or more boxes)
I do not drink
Fridays
Saturdays
Other days

87. Have you ever seen either of your parents intoxicated?
(X one box)
Never
A few times
A few times a year
A few times a month
A few times a week

READING AND WRITING DIFFICULTIES

88. How often do you feel your reading or writing skills are below the level of the tasks you do at school and/or in your spare time?
<Never, Very seldom, Sometimes, Often, Always>
Reading
Writing

89. Have you had any particular reading or writing problems in the last 12 months?
<A lot of problems, Some problems, No problems>
Reading
Writing

90. Do you receive help for reading or writing difficulties at this time? <yes, no>

91. Have you had problems with reading or writing earlier, but not within the last 12 months?
<yes, no>
If YES, **did you receive help at that time?** <yes, no>

92. Do you have any speaking difficulties? <yes, no>
If YES, **which one(s):**
Stuttering
Pronunciation difficulties
Problems with your voice
Difficulties expressing yourself

HEALTH SERVICES

93. During the last 12 months have you been to:
(Put an X in one box for every line) <yes, no>
General practitioner (a doctor outside the hospital)
Doctor at the hospital (not having been admitted)
Psychologist
Physiotherapist
Chiropractor
Homeopath
Other treatment (naturopath, reflexologist, laying on of hands, healer, psychic, etc.)

94. Have you ever been admitted to the hospital (exclude when you were born)?
No, never
Yes, once
Yes, more than once

If YES, **have you been admitted to the hospital during the last 12 months?** <yes, no>

95. How often have you been to the school health centre/nurse's office during the last 12 months?
Not at all
1-3 times
More than 3 times

96. Have you ever contacted the school health centre? <yes, no>

97. Would you like to contact/visit the school health centre more than you have? <yes, no>

98. How often have you been absent from school due to illness during the last 12 months?
Less than 1 week
1-2 weeks
More than 2 weeks

PHYSICAL DEVELOPMENT

You are now at the age when your body has begun to change and become more like an adult's body. Below are some questions about physical changes that occur in young people around your age.

99. During the teenage years there are periods where one grows quickly (growing spurt). Have you noticed that your body has grown quickly (become taller)?
(Put an X in one box)
No, I have not begun to grow
Yes, I have barely begun a growing spurt
Yes, I've clearly begun a growing spurt
Yes, it seems that I'm finished with growing spurts

100. Concerning hair on your body (under your arms and your crotch/groin), would you say that the hair on your body has:
(Put an X in one box)
Not begun to grow yet
Barely begun to grow
Quite clearly begun to grow
It seems that my body hair has grown in

101. When you look at yourself, do you think that you are physically maturing/have physically matured earlier or later than others your own age?
(Put an X in one box)
Much earlier
Earlier
A little bit earlier
The same as others
A little bit later
Later
Much later

QUESTIONS FOR GIRLS ONLY

102. Have you begun to develop breasts?
(Put an X in one box)
No, haven't begun yet
Yes, have barely begun
Yes, have quite clearly begun
It seems my breasts are fully developed

103. Have you begun menstruating (gotten your period)?
<yes, no>
If you answered NO, go to question 106

104. How old were you when you first began menstruating?
I was ____ years and ____ months old.

105. Have you ever missed (not gotten) your period for several months after a regular period (without being pregnant)?
(Put an X in one box)
Yes, for 2-5 months
Yes, for 6-12 months
Yes, for more than a year
No, never

106. Have you ever been treated by a doctor for: <yes, no>
Inflammation/infection of the reproductive system (ovaries, fallopian tubes)
Vaginal discharge
Menstrual pain

107. Have you ever taken birth control pills or the mini pill? <yes, no>

If you answered NO, go to the last page

108. How old were you when you first began taking birth control pills?
____ years old

109. How long in total did you take birth control pills?
____ years

110. Do you take birth control pills now? <yes, no>

QUESTIONS FOR BOYS ONLY

112. Has your voice begun to change?
(Put an X in one box)
No, hasn't begun yet
Yes, has just barely begun
Yes, has clearly begun
It seems my voice has finished changing

113. Has facial hair begun to grow (moustache or beard)?
(Put an X in one box)
No, hasn't begun yet
Yes, has just barely begun
Yes, has clearly begun
Yes, I have quite a lot of facial hair

114. Have you been treated by a doctor for:
(Put an X in one box on every line)
Tight foreskin
Discharge from the penis (urethra)
Inflammation of the foreskin or scrotum (testicles)

FOR STUDENTS IN HIGH SCHOOL

These questions are in this questionnaire for high school students to answer.

115. During the last year, have you often felt that you pressured yourself or continuously pushed yourself? <Yes, No, Don't know>

116. Do you feel that you are constantly short of time, even in your everyday tasks?
Always, or almost always
Sometimes
Never

117. Have you ever had thoughts about taking your own life? <yes, no>

118. Have you ever tried hash, marijuana or related drugs? <yes, no>

119. Have you ever used steroids or other performance enhancing drugs? <yes, no>

120. If YES, **how old were you the first time?** ____ years old

121. Have you ever had sexual intercourse? <yes, no>

122. For GIRLS: Have you ever become pregnant when you didn't want to be? <yes, no>

123. For BOYS: Have you ever gotten a girl pregnant without intending to? <Yes, No, Don't know>

For BOTH boys and girls
If YES:

124. How old were you when this happened? ____ years old

125. Was the result an abortion? <Yes, No, Don't know>

COMMENTS

If you have time, you could write here about what you think is important, but was not asked about in this questionnaire. What are your thoughts about being young these days? What do feel can be improved upon concerning health and wellbeing for youth of today?

Appendix 2

Since height and weight were rounded off to the nearest cm and half kg, there is measurement error in the tabulated differences. Its standard deviation has been computed as 0.07, 0.03, and 0.12, BMI-units respectively, for the 2.5, 50, and 97.5 percentiles.

A close look at the data showed that most (95.5%) of the weight measurements were recorded as an integer number of kilograms. To be on the safe side, we have treated the measurement error as if weight was rounded off to the nearest kilogram in our calculations for measurement error.

The true weight of a person is equal to the recorded weight plus a measurement error. Since weight is rounded off to the nearest kilogram, the measurement error is uniformly distributed between -0.5 kg and +0.5 kg. For height, the measurement error is between -0.5 cm and + 0.5 cm. The standard deviation of a uniform random variable equals its range divided by √12, in our case, σ_w*=0.29 kg and* σ_h*=0.29 cm=0.0029 m, respectively. The standard deviation in the resulting measurement error in BMI can be calculated as shown in Appendix B. For example, the standard deviation for measurement error in BMI for a person 164 cm tall and 53 kg (average girl, 14 years, cohort 1) is 0.110 (kg/m*^{2}*). The standard deviation for the average BMI of n=941 girls is* $\sigma_{\overline{BMI}} = \sigma_{BMI} / \sqrt{n} = 0.110 / \sqrt{941} = 0.0036$.

The standard deviations for measurement error for differences between BMI percentiles for the cohorts (studies), are larger than for the average. We computed these using Monte Carlo simulations with m=1000 replications. The results, corresponding to Table 2, are as shown below. The main results from these calculations are included in the manuscript, as a footnote to Table 2.

Table 4: Standard deviation for differences in BMI percentiles between the cohorts, due to measurement error

	Boys					Girls				
Age	14	15	16	17	18	14	15	16	17	18
Percen-tiles(a)										
2.5	0.066	0.074	0.071	0.078	0.060	0.061	0.062	0.068	0.074	0.075
5	0.053	0.046	0.052	0.050	0.080	0.051	0.058	0.052	0.061	0.069
10	0.039	0.038	0.039	0.047	0.046	0.040	0.040	0.046	0.047	0.051
15	0.033	0.034	0.035	0.037	0.041	0.038	0.036	0.038	0.039	0.048

25	0.032	0.029	0.031	0.032	0.033	0.034	0.033	0.034	0.038	0.046
50	0.029	0.029	0.030	0.035	0.036	0.033	0.033	0.033	0.035	0.042
75	0.036	0.037	0.033	0.040	0.042	0.041	0.042	0.042	0.044	0.061
85	0.052	0.047	0.049	0.048	0.053	0.047	0.048	0.060	0.057	0.062
90	0.058	0.055	0.055	0.056	0.065	0.063	0.059	0.074	0.078	0.089
95	0.084	0.078	0.101	0.096	0.102	0.079	0.081	0.102	0.108	0.104
97.5	0.098	0.106	0.108	0.131	0.103	0.098	0.135	0.120	0.139	0.142

Appendix B

Body mass index is the following function of weight in kg (w) and height in meters (h):

$$BMI = g(w,h) = \frac{w}{h^2}$$

A first order Taylor expansion of the function g(w,h) around $g(\mu_h, \mu_w)$, where $\mu_w = E(w)$ and $\mu_h = E(h)$, gives the approximation

$$\sigma_{BMI}{}^2 \approx \left(\frac{\partial g(\mu_h, \mu_w)}{\partial \mu_h} \right)^2 \sigma_h{}^2 + \left(\frac{\partial g(\mu_h, \mu_w)}{\partial \mu_w} \right)^2 \sigma_w{}^2$$

$$= \left(\frac{-2\mu_w}{\mu_h{}^3} \right)^2 \sigma_h{}^2 + \left(\frac{1}{\mu_h{}^2} \right)^2 \sigma_w{}^2$$

$$= \left(\frac{2 \cdot 53}{1.64^3} \right)^2 0.0029^2 + \left(\frac{1}{1.64^2} \right)^2 0.29^2 = 0.00020 + 0.0119 = 0.0121 = 0.110^2$$

The above approximation makes the reasonable assumption that the measurement error in height and weight are independent. The above formula is found, for example, as equation 5.20, page 162, in Armitage, P. Barry, G., and Matthews, J: Statistical Methods in Medical Research". 4th Edition. Blackwell Scientific Publications, 2002. ISBN 0-632-05257-2.

Appendix 3

There could be a systematic bias in the first (or second) measurement, so that the comparisons are nor valid. All BMI's of the first (second) could be higher (lower) than the actual ones, from witch it follows the data shows a also diminish of the lower BMI-percentiles, in the higher ones this is of course not visible.

Answer:

The possibilities for a systematic over-measuring of weight in the earlier study compared to the later study. The observed changes in 2, 5 percentiles of BMI correspond to the following weight changes:

Sex	age	change in percentile	avg height at 2,5 percentile	weight change, kg
boys	14	-0.2	159	-0.5
	15	-0.16	163.5	-0.4
	16	-0.43	168	-1.2
	17	-0.55	172.5	-1.6
	18	-0.87	177	-2.7
Girls	14	-0.6	158	-1.5
	15	-0.28	159.5	-0.7
	16	-0.07	161	-0.2
	17	-0.04	162.5	-0.1
	18	-0.07	164	-0.2

c) What instructions the participants were given about eating before the measurements in the 1960's and in the 1990's, and at what time of the day the measurements were made, these have effect on weight.

Answer:

The participants were not given any instructions about eating before the measurements. Both the NHS-study and the Young- HUNT study was done during the school-day, that means that some had had breakfast, some had had both breakfast and lunch before the measurements. Of course this has effect on weight, but as the school-class was measured at the same time, the influence of the weight-differences should be minimal.

In young HUNT 83, 9 % of the adolescents had eaten during the last 4 hours, 46 % during the last two hours. We have no information about the time of the day the measurements were done.

d) At what time of the year the measurements were made considering what light clothes meant in the 60s and in the 90s.

Answer

The measurements were made in the school-year, indicating no measurements in the summer-holiday (June, July, August) Clothing differs in both studies, but we have no reason to believe any systematic difference between the two studies.

e) And most important: The measurements accuracy (half kilo) may not be good enough to small changes in BMI.

Answer

In fact, a close look at the data showed that most (95.5%) of the weight measurements were recorded as an integer number of kilograms. To be on the safe side, we have treated the measurement error as if weight was rounded off to the nearest kilogram in our calculations for measurement error.

The true weight of a person is equal the recorded weight plus a measurement error. Since weight is rounded off to the nearest kilogram, the measurement error is uniformly distributed between -0.5 kg and +0.5 kg. For height, the measurement error is between -0.5 cm and + 0.5 cm. The standard deviation of a uniform random variable equals its range divided by √12, in our case, σ_w=0.29 kg and σ_h=0.29 cm=0.0029 m, respectively. The standard deviation in the resulting measurement error in BMI can be calculated as shown in Appendix B. For example, the standard deviation for measurement error in BMI for a person 164 cm tall and 53 kg (average girl, 14 years, cohort 1) is 0.110 (kg/m^2). The standard deviation for the average BMI of n=941 girls is $\sigma_{\bar{BMI}} = \sigma_{BMI} / \sqrt{n} = 0.110 / \sqrt{941} = 0.0036$.

The standard deviations for measurement error for differences between BMI percentiles for the cohorts (studies), are larger than for the average. We computed these using Monte Carlo simulations with m=1000 replications. The results, corresponding to Table 2, are as shown below. The main results from these calculations are included in the manuscript, as a footnote to Table 2

Footnote:
Since height and weight were rounded off, to the nearest cm and half kg, there is measurement error in the tabulated differences. Its standard deviation has been computed as 0.07, 0.03, and 0.12, BMI-units respectively, for the 2.5, 50, and 97.5 percentiles.

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Dissertations at the Faculty of Medicine, NTNU

1977

1. Knut Joachim Berg: EFFECT OF ACETYLSALICYLIC ACID ON RENAL FUNCTION
2. Karl Erik Viken and Arne Ødegaard: STUDIES ON HUMAN MONOCYTES CULTURED *IN VITRO*

1978

3. Karel Bjørn Cyvin: CONGENITAL DISLOCATION OF THE HIP JOINT.
4. Alf O. Brubakk: METHODS FOR STUDYING FLOW DYNAMICS IN THE LEFT VENTRICLE AND THE AORTA IN MAN.

1979

5. Geirmund Unsgaard: CYTOSTATIC AND IMMUNOREGULATORY ABILITIES OF HUMAN BLOOD MONOCYTES CULTURED IN VITRO

1980

6. Størker Jørstad: URAEMIC TOXINS
7. Arne Olav Jenssen: SOME RHEOLOGICAL, CHEMICAL AND STRUCTURAL PROPERTIES OF MUCOID SPUTUM FROM PATIENTS WITH CHRONIC OBSTRUCTIVE BRONCHITIS

1981

8. Jens Hammerstrøm: CYTOSTATIC AND CYTOLYTIC ACTIVITY OF HUMAN MONOCYTES AND EFFUSION MACROPHAGES AGAINST TUMOR CELLS *IN VITRO*

1983

9. Tore Syversen: EFFECTS OF METHYLMERCURY ON RAT BRAIN PROTEIN.
10. Torbjørn Iversen: SQUAMOUS CELL CARCINOMA OF THE VULVA.

1984

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12. Anton Hole: ALTERATIONS OF MONOCYTE AND LYMPHOCYTE FUNCTIONS IN REALTION TO SURGERY UNDER EPIDURAL OR GENERAL ANAESTHESIA.
13. Terje Terjesen: FRACTURE HEALING AND STRESS-PROTECTION AFTER METAL PLATE FIXATION AND EXTERNAL FIXATION.
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55. Eva Hofsli: TUMOR NECROSIS FACTOR AND MULTIDRUG RESISTANCE.
56. Helge S. Haarstad: TROPHIC EFFECTS OF CHOLECYSTOKININ AND SECRETIN ON THE RAT PANCREAS.
57. Lars Engebretsen: TREATMENT OF ACUTE ANTERIOR CRUCIATE LIGAMENT INJURIES.
58. Tarjei Rygnestad: DELIBERATE SELF-POISONING IN TRONDHEIM.
59. Arne Z. Henriksen: STUDIES ON CONSERVED ANTIGENIC DOMAINS ON MAJOR OUTER MEMBRANE PROTEINS FROM ENTEROBACTERIA.
60. Steinar Westin: UNEMPLOYMENT AND HEALTH: Medical and social consequences of a factory closure in a ten-year controlled follow-up study.
61. Ylva Sahlin: INJURY REGISTRATION, a tool for accident preventive work.
62. Helge Bjørnstad Pettersen: BIOSYNTHESIS OF COMPLEMENT BY HUMAN ALVEOLAR MACROPHAGES WITH SPECIAL REFERENCE TO SARCOIDOSIS.
63. Berit Schei: TRAPPED IN PAINFUL LOVE.
64. Lars J. Vatten: PROSPECTIVE STUDIES OF THE RISK OF BREAST CANCER IN A COHORT OF NORWEGIAN WOMAN.

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65. Kåre Bergh: APPLICATIONS OF ANTI-C5a SPECIFIC MONOCLONAL ANTIBODIES FOR THE ASSESSMENT OF COMPLEMENT ACTIVATION.
66. Svein Svenningsen: THE CLINICAL SIGNIFICANCE OF INCREASED FEMORAL ANTEVERSION.
67. Olbjørn Klepp: NONSEMINOMATOUS GERM CELL TESTIS CANCER: THERAPEUTIC OUTCOME AND PROGNOSTIC FACTORS.
68. Trond Sand: THE EFFECTS OF CLICK POLARITY ON BRAINSTEM AUDITORY EVOKED POTENTIALS AMPLITUDE, DISPERSION, AND LATENCY VARIABLES.
69. Kjetil B. Åsbakk: STUDIES OF A PROTEIN FROM PSORIATIC SCALE, PSO P27, WITH RESPECT TO ITS POTENTIAL ROLE IN IMMUNE REACTIONS IN PSORIASIS.
70. Arnulf Hestnes: STUDIES ON DOWN´S SYNDROME.
71. Randi Nygaard: LONG-TERM SURVIVAL IN CHILDHOOD LEUKEMIA.
72. Bjørn Hagen: THIO-TEPA.
73. Svein Anda: EVALUATION OF THE HIP JOINT BY COMPUTED TOMOGRAMPHY AND ULTRASONOGRAPHY.

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74. Martin Svartberg: AN INVESTIGATION OF PROCESS AND OUTCOME OF SHORT-TERM PSYCHODYNAMIC PSYCHOTHERAPY.
75. Stig Arild Slørdahl: AORTIC REGURGITATION.
76. Harold C Sexton: STUDIES RELATING TO THE TREATMENT OF SYMPTOMATIC NON-PSYCHOTIC PATIENTS.
77. Maurice B. Vincent: VASOACTIVE PEPTIDES IN THE OCULAR/FOREHEAD AREA.
78. Terje Johannessen: CONTROLLED TRIALS IN SINGLE SUBJECTS.
79. Turid Nilsen: PYROPHOSPHATE IN HEPATOCYTE IRON METABOLISM.
80. Olav Haraldseth: NMR SPECTROSCOPY OF CEREBRAL ISCHEMIA AND REPERFUSION IN RAT.
81. Eiliv Brenna: REGULATION OF FUNCTION AND GROWTH OF THE OXYNTIC MUCOSA.

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82. Gunnar Bovim: CERVICOGENIC HEADACHE.
83. Jarl Arne Kahn: ASSISTED PROCREATION.
84. Bjørn Naume: IMMUNOREGULATORY EFFECTS OF CYTOKINES ON NK CELLS.
85. Rune Wiseth: AORTIC VALVE REPLACEMENT.
86. Jie Ming Shen: BLOOD FLOW VELOCITY AND RESPIRATORY STUDIES.
87. Piotr Kruszewski: SUNCT SYNDROME WITH SPECIAL REFERENCE TO THE AUTONOMIC NERVOUS SYSTEM.
88. Mette Haase Moen: ENDOMETRIOSIS.
89. Anne Vik: VASCULAR GAS EMBOLISM DURING AIR INFUSION AND AFTER DECOMPRESSION IN PIGS.
90. Lars Jacob Stovner: THE CHIARI TYPE I MALFORMATION.
91. Kjell Å. Salvesen: ROUTINE ULTRASONOGRAPHY IN UTERO AND DEVELOPMENT IN CHILDHOOD.

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92. Nina-Beate Liabakk: DEVELOPMENT OF IMMUNOASSAYS FOR TNF AND ITS SOLUBLE RECEPTORS.
93. Sverre Helge Torp: *erb*B ONCOGENES IN HUMAN GLIOMAS AND MENINGIOMAS.
94. Olav M. Linaker: MENTAL RETARDATION AND PSYCHIATRY. Past and present.
95. Per Oscar Feet: INCREASED ANTIDEPRESSANT AND ANTIPANIC EFFECT IN COMBINED TREATMENT WITH DIXYRAZINE AND TRICYCLIC ANTIDEPRESSANTS.
96. Stein Olav Samstad: CROSS SECTIONAL FLOW VELOCITY PROFILES FROM TWO-DIMENSIONAL DOPPLER ULTRASOUND: Studies on early mitral blood flow.
97. Bjørn Backe: STUDIES IN ANTENATAL CARE.
98. Gerd Inger Ringdal: QUALITY OF LIFE IN CANCER PATIENTS.
99. Torvid Kiserud: THE DUCTUS VENOSUS IN THE HUMAN FETUS.
100. Hans E. Fjøsne: HORMONAL REGULATION OF PROSTATIC METABOLISM.
101. Eylert Brodtkorb: CLINICAL ASPECTS OF EPILEPSY IN THE MENTALLY RETARDED.
102. Roar Juul: PEPTIDERGIC MECHANISMS IN HUMAN SUBARACHNOID HEMORRHAGE.
103. Unni Syversen: CHROMOGRANIN A. Phsysiological and Clinical Role.

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104. Odd Gunnar Brakstad: THERMOSTABLE NUCLEASE AND THE *nuc* GENE IN THE DIAGNOSIS OF *Staphylococcus aureus* INFECTIONS.
105. Terje Engan: NUCLEAR MAGNETIC RESONANCE (NMR) SPECTROSCOPY OF PLASMA IN MALIGNANT DISEASE.
106. Kirsten Rasmussen: VIOLENCE IN THE MENTALLY DISORDERED.
107. Finn Egil Skjeldestad: INDUCED ABORTION: Timetrends and Determinants.
108. Roar Stenseth: THORACIC EPIDURAL ANALGESIA IN AORTOCORONARY BYPASS SURGERY.
109. Arild Faxvaag: STUDIES OF IMMUNE CELL FUNCTION *in mice infected with* MURINE RETROVIRUS.

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110. Svend Aakhus: NONINVASIVE COMPUTERIZED ASSESSMENT OF LEFT VENTRICULAR FUNCTION AND SYSTEMIC ARTERIAL PROPERTIES. Methodology and some clinical applications.
111. Klaus-Dieter Bolz: INTRAVASCULAR ULTRASONOGRAPHY.
112. Petter Aadahl: CARDIOVASCULAR EFFECTS OF THORACIC AORTIC CROSS-CLAMPING.
113. Sigurd Steinshamn: CYTOKINE MEDIATORS DURING GRANULOCYTOPENIC INFECTIONS.
114. Hans Stifoss-Hanssen: SEEKING MEANING OR HAPPINESS?
115. Anne Kvikstad: LIFE CHANGE EVENTS AND MARITAL STATUS IN RELATION TO RISK AND PROGNOSIS OF CANCER.
116. Torbjørn Grøntvedt: TREATMENT OF ACUTE AND CHRONIC ANTERIOR CRUCIATE LIGAMENT INJURIES. A clinical and biomechanical study.
117. Sigrid Hørven Wigers: CLINICAL STUDIES OF FIBROMYALGIA WITH FOCUS ON ETIOLOGY, TREATMENT AND OUTCOME.
118. Jan Schjøtt: MYOCARDIAL PROTECTION: Functional and Metabolic Characteristics of Two Endogenous Protective Principles.
119. Marit Martinussen: STUDIES OF INTESTINAL BLOOD FLOW AND ITS RELATION TO TRANSITIONAL CIRCULATORY ADAPATION IN NEWBORN INFANTS.
120. Tomm B. Müller: MAGNETIC RESONANCE IMAGING IN FOCAL CEREBRAL ISCHEMIA.
121. Rune Haaverstad: OEDEMA FORMATION OF THE LOWER EXTREMITIES.
122. Magne Børset: THE ROLE OF CYTOKINES IN MULTIPLE MYELOMA, WITH SPECIAL REFERENCE TO HEPATOCYTE GROWTH FACTOR.
123. Geir Smedslund: A THEORETICAL AND EMPIRICAL INVESTIGATION OF SMOKING, STRESS AND DISEASE: RESULTS FROM A POPULATION SURVEY.

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124. Torstein Vik: GROWTH, MORBIDITY, AND PSYCHOMOTOR DEVELOPMENT IN INFANTS WHO WERE GROWTH RETARDED *IN UTERO*.
125. Siri Forsmo: ASPECTS AND CONSEQUENCES OF OPPORTUNISTIC SCREENING FOR CERVICAL CANCER. Results based on data from three Norwegian counties.
126. Jon S. Skranes: CEREBRAL MRI AND NEURODEVELOPMENTAL OUTCOME IN VERY LOW BIRTH WEIGHT (VLBW) CHILDREN. A follow-up study of a geographically based year cohort of VLBW children at ages one and six years.
127. Knut Bjørnstad: COMPUTERIZED ECHOCARDIOGRAPHY FOR EVALUTION OF CORONARY ARTERY DISEASE.
128. Grethe Elisabeth Borchgrevink: DIAGNOSIS AND TREATMENT OF WHIPLASH/NECK SPRAIN INJURIES CAUSED BY CAR ACCIDENTS.
129. Tor Elsås: NEUROPEPTIDES AND NITRIC OXIDE SYNTHASE IN OCULAR AUTONOMIC AND SENSORY NERVES.
130. Rolf W. Gråwe: EPIDEMIOLOGICAL AND NEUROPSYCHOLOGICAL PERSPECTIVES ON SCHIZOPHRENIA.
131. Tonje Strømholm: CEREBRAL HAEMODYNAMICS DURING THORACIC AORTIC CROSSCLAMPING. An experimental study in pigs.

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132. Martinus Bråten: STUDIES ON SOME PROBLEMS REALTED TO INTRAMEDULLARY NAILING OF FEMORAL FRACTURES.
133. Ståle Nordgård: PROLIFERATIVE ACTIVITY AND DNA CONTENT AS PROGNOSTIC INDICATORS IN ADENOID CYSTIC CARCINOMA OF THE HEAD AND NECK.

134. Egil Lien: SOLUBLE RECEPTORS FOR **TNF** AND **LPS**: RELEASE PATTERN AND POSSIBLE SIGNIFICANCE IN DISEASE.
135. Marit Bjørgaas: HYPOGLYCAEMIA IN CHILDREN WITH DIABETES MELLITUS
136. Frank Skorpen: GENETIC AND FUNCTIONAL ANALYSES OF DNA REPAIR IN HUMAN CELLS.
137. Juan A. Pareja: SUNCT SYNDROME. ON THE CLINICAL PICTURE. ITS DISTINCTION FROM OTHER, SIMILAR HEADACHES.
138. Anders Angelsen: NEUROENDOCRINE CELLS IN HUMAN PROSTATIC CARCINOMAS AND THE PROSTATIC COMPLEX OF RAT, GUINEA PIG, CAT AND DOG.
139. Fabio Antonaci: CHRONIC PAROXYSMAL HEMICRANIA AND HEMICRANIA CONTINUA: TWO DIFFERENT ENTITIES?
140. Sven M. Carlsen: ENDOCRINE AND METABOLIC EFFECTS OF METFORMIN WITH SPECIAL EMPHASIS ON CARDIOVASCULAR RISK FACTORES.

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141. Terje A. Murberg: DEPRESSIVE SYMPTOMS AND COPING AMONG PATIENTS WITH CONGESTIVE HEART FAILURE.
142. Harm-Gerd Karl Blaas: THE EMBRYONIC EXAMINATION. Ultrasound studies on the development of the human embryo.
143. Noèmi Becser Andersen:THE CEPHALIC SENSORY NERVES IN UNILATERAL HEADACHES. Anatomical background and neurophysiological evaluation.
144. Eli-Janne Fiskerstrand: LASER TREATMENT OF PORT WINE STAINS. A study of the efficacy and limitations of the pulsed dye laser. Clinical and morfological analyses aimed at improving the therapeutic outcome.
145. Bård Kulseng: A STUDY OF ALGINATE CAPSULE PROPERTIES AND CYTOKINES IN RELATION TO INSULIN DEPENDENT DIABETES MELLITUS.
146. Terje Haug: STRUCTURE AND REGULATION OF THE HUMAN UNG GENE ENCODING URACIL-DNA GLYCOSYLASE.
147. Heidi Brurok: MANGANESE AND THE HEART. A Magic Metal with Diagnostic and Therapeutic Possibilites.
148. Agnes Kathrine Lie: DIAGNOSIS AND PREVALENCE OF HUMAN PAPILLOMAVIRUS INFECTION IN CERVICAL INTRAEPITELIAL NEOPLASIA. Relationship to Cell Cycle Regulatory Proteins and HLA DQBI Genes.
149. Ronald Mårvik: PHARMACOLOGICAL, PHYSIOLOGICAL AND PATHOPHYSIOLOGICAL STUDIES ON ISOLATED STOMACS.
150. Ketil Jarl Holen: THE ROLE OF ULTRASONOGRAPHY IN THE DIAGNOSIS AND TREATMENT OF HIP DYSPLASIA IN NEWBORNS.
151. Irene Hetlevik: THE ROLE OF CLINICAL GUIDELINES IN CARDIOVASCULAR RISK INTERVENTION IN GENERAL PRACTICE.
152. Katarina Tunòn: ULTRASOUND AND PREDICTION OF GESTATIONAL AGE.
153. Johannes Soma: INTERACTION BETWEEN THE LEFT VENTRICLE AND THE SYSTEMIC ARTERIES.
154. Arild Aamodt: DEVELOPMENT AND PRE-CLINICAL EVALUATION OF A CUSTOM-MADE FEMORAL STEM.
155. Agnar Tegnander: DIAGNOSIS AND FOLLOW-UP OF CHILDREN WITH SUSPECTED OR KNOWN HIP DYSPLASIA.
156. Bent Indredavik: STROKE UNIT TREATMENT: SHORT AND LONG-TERM EFFECTS
157. Jolanta Vanagaite Vingen: PHOTOPHOBIA AND PHONOPHOBIA IN PRIMARY HEADACHES

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158. Ola Dalsegg Sæther: PATHOPHYSIOLOGY DURING PROXIMAL AORTIC CROSS-CLAMPING CLINICAL AND EXPERIMENTAL STUDIES
159. xxxxxxxxx (blind number)
160. Christina Vogt Isaksen: PRENATAL ULTRASOUND AND POSTMORTEM FINDINGS – A TEN YEAR CORRELATIVE STUDY OF FETUSES AND INFANTS WITH DEVELOPMENTAL ANOMALIES.
161. Holger Seidel: HIGH-DOSE METHOTREXATE THERAPY IN CHILDREN WITH ACUTE LYMPHOCYTIC LEUKEMIA: DOSE, CONCENTRATION, AND EFFECT CONSIDERATIONS.
162. Stein Hallan: IMPLEMENTATION OF MODERN MEDICAL DECISION ANALYSIS INTO CLINICAL DIAGNOSIS AND TREATMENT.

163. Malcolm Sue-Chu: INVASIVE AND NON-INVASIVE STUDIES IN CROSS-COUNTRY SKIERS WITH ASTHMA-LIKE SYMPTOMS.
164. Ole-Lars Brekke: EFFECTS OF ANTIOXIDANTS AND FATTY ACIDS ON TUMOR NECROSIS FACTOR-INDUCED CYTOTOXICITY.
165. Jan Lundbom: AORTOCORONARY BYPASS SURGERY: CLINICAL ASPECTS, COST CONSIDERATIONS AND WORKING ABILITY.
166. John-Anker Zwart: LUMBAR NERVE ROOT COMPRESSION, BIOCHEMICAL AND NEUROPHYSIOLOGICAL ASPECTS.
167. Geir Falck: HYPEROSMOLALITY AND THE HEART.
168. Eirik Skogvoll: CARDIAC ARREST Incidence, Intervention and Outcome.
169. Dalius Bansevicius: SHOULDER-NECK REGION IN CERTAIN HEADACHES AND CHRONIC PAIN SYNDROMES.
170. Bettina Kinge: REFRACTIVE ERRORS AND BIOMETRIC CHANGES AMONG UNIVERSITY STUDENTS IN NORWAY.
171. Gunnar Qvigstad: CONSEQUENCES OF HYPERGASTRINEMIA IN MAN
172. Hanne Ellekjær: EPIDEMIOLOGICAL STUDIES OF STROKE IN A NORWEGIAN POPULATION. INCIDENCE, RISK FACTORS AND PROGNOSIS
173. Hilde Grimstad: VIOLENCE AGAINST WOMEN AND PREGNANCY OUTCOME.
174. Astrid Hjelde: SURFACE TENSION AND COMPLEMENT ACTIVATION: Factors influencing bubble formation and bubble effects after decompression.
175. Kjell A. Kvistad: MR IN BREAST CANCER – A CLINICAL STUDY.
176. Ivar Rossvoll: ELECTIVE ORTHOPAEDIC SURGERY IN A DEFINED POPULATION. Studies on demand, waiting time for treatment and incapacity for work.
177. Carina Seidel: PROGNOSTIC VALUE AND BIOLOGICAL EFFECTS OF HEPATOCYTE GROWTH FACTOR AND SYNDECAN-1 IN MULTIPLE MYELOMA.

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178. Alexander Wahba: THE INFLUENCE OF CARDIOPULMONARY BYPASS ON PLATELET FUNCTION AND BLOOD COAGULATION – DETERMINANTS AND CLINICAL CONSEQUENSES
179. Marcus Schmitt-Egenolf: THE RELEVANCE OF THE MAJOR hISTOCOMPATIBILITY COMPLEX FOR THE GENETICS OF PSORIASIS
180. Odrun Arna Gederaas: BIOLOGICAL MECHANISMS INVOLVED IN 5-AMINOLEVULINIC ACID BASED PHOTODYNAMIC THERAPY
181. Pål Richard Romundstad: CANCER INCIDENCE AMONG NORWEGIAN ALUMINIUM WORKERS
182. Henrik Hjorth-Hansen: NOVEL CYTOKINES IN GROWTH CONTROL AND BONE DISEASE OF MULTIPLE MYELOMA
183. Gunnar Morken: SEASONAL VARIATION OF HUMAN MOOD AND BEHAVIOUR
184. Bjørn Olav Haugen: MEASUREMENT OF CARDIAC OUTPUT AND STUDIES OF VELOCITY PROFILES IN AORTIC AND MITRAL FLOW USING TWO- AND THREE-DIMENSIONAL COLOUR FLOW IMAGING
185. Geir Bråthen: THE CLASSIFICATION AND CLINICAL DIAGNOSIS OF ALCOHOL-RELATED SEIZURES
186. Knut Ivar Aasarød: RENAL INVOLVEMENT IN INFLAMMATORY RHEUMATIC DISEASE. A Study of Renal Disease in Wegener's Granulomatosis and in Primary Sjögren's Syndrome
187. Trude Helen Flo: RESEPTORS INVOLVED IN CELL ACTIVATION BY DEFINED URONIC ACID POLYMERS AND BACTERIAL COMPONENTS
188. Bodil Kavli: HUMAN URACIL-DNA GLYCOSYLASES FROM THE UNG GENE: STRUCTRUAL BASIS FOR SUBSTRATE SPECIFICITY AND REPAIR
189. Liv Thommesen: MOLECULAR MECHANISMS INVOLVED IN TNF- AND GASTRIN-MEDIATED GENE REGULATION
190. Turid Lingaas Holmen: SMOKING AND HEALTH IN ADOLESCENCE; THE NORD-TRØNDELAG HEALTH STUDY, 1995-97
191. Øyvind Hjertner: MULTIPLE MYELOMA: INTERACTIONS BETWEEN MALIGNANT PLASMA CELLS AND THE BONE MICROENVIRONMENT
192. Asbjørn Støylen: STRAIN RATE IMAGING OF THE LEFT VENTRICLE BY ULTRASOUND. FEASIBILITY, CLINICAL VALIDATION AND PHYSIOLOGICAL ASPECTS

193. Kristian Midthjell: DIABETES IN ADULTS IN NORD-TRØNDELAG. PUBLIC HEALTH ASPECTS OF DIABETES MELLITUS IN A LARGE, NON-SELECTED NORWEGIAN POPULATION.
194. Guanglin Cui: FUNCTIONAL ASPECTS OF THE ECL CELL IN RODENTS
195. Ulrik Wisløff: CARDIAC EFFECTS OF AEROBIC ENDURANCE TRAINING: HYPERTROPHY, CONTRACTILITY AND CALCUIM HANDLING IN NORMAL AND FAILING HEART
196. Øyvind Halaas: MECHANISMS OF IMMUNOMODULATION AND CELL-MEDIATED CYTOTOXICITY INDUCED BY BACTERIAL PRODUCTS
197. Tore Amundsen: PERFUSION MR IMAGING IN THE DIAGNOSIS OF PULMONARY EMBOLISM
198. Nanna Kurtze: THE SIGNIFICANCE OF ANXIETY AND DEPRESSION IN FATIQUE AND PATTERNS OF PAIN AMONG INDIVIDUALS DIAGNOSED WITH FIBROMYALGIA: RELATIONS WITH QUALITY OF LIFE, FUNCTIONAL DISABILITY, LIFESTYLE, EMPLOYMENT STATUS, CO-MORBIDITY AND GENDER
199. Tom Ivar Lund Nilsen: PROSPECTIVE STUDIES OF CANCER RISK IN NORD-TRØNDELAG: THE HUNT STUDY. Associations with anthropometric, socioeconomic, and lifestyle risk factors
200. Asta Kristine Håberg: A NEW APPROACH TO THE STUDY OF MIDDLE CEREBRAL ARTERY OCCLUSION IN THE RAT USING MAGNETIC RESONANCE TECHNIQUES

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201. Knut Jørgen Arntzen: PREGNANCY AND CYTOKINES
202. Henrik Døllner: INFLAMMATORY MEDIATORS IN PERINATAL INFECTIONS
203. Asta Bye: LOW FAT, LOW LACTOSE DIET USED AS PROPHYLACTIC TREATMENT OF ACUTE INTESTINAL REACTIONS DURING PELVIC RADIOTHERAPY. A PROSPECTIVE RANDOMISED STUDY.
204. Sylvester Moyo: STUDIES ON STREPTOCOCCUS AGALACTIAE (GROUP B STREPTOCOCCUS) SURFACE-ANCHORED MARKERS WITH EMPHASIS ON STRAINS AND HUMAN SERA FROM ZIMBABWE.
205. Knut Hagen: HEAD-HUNT: THE EPIDEMIOLOGY OF HEADACHE IN NORD-TRØNDELAG
206. Li Lixin: ON THE REGULATION AND ROLE OF UNCOUPLING PROTEIN-2 IN INSULIN PRODUCING ß-CELLS
207. Anne Hildur Henriksen: SYMPTOMS OF ALLERGY AND ASTHMA VERSUS MARKERS OF LOWER AIRWAY INFLAMMATION AMONG ADOLESCENTS
208. Egil Andreas Fors: NON-MALIGNANT PAIN IN RELATION TO PSYCHOLOGICAL AND ENVIRONTENTAL FACTORS. EXPERIENTAL AND CLINICAL STUDES OF PAIN WITH FOCUS ON FIBROMYALGIA
209. Pål Klepstad: MORPHINE FOR CANCER PAIN
210. Ingunn Bakke: MECHANISMS AND CONSEQUENCES OF PEROXISOME PROLIFERATOR-INDUCED HYPERFUNCTION OF THE RAT GASTRIN PRODUCING CELL
211. Ingrid Susann Gribbestad: MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY OF BREAST CANCER
212. Rønnaug Astri Ødegård: PREECLAMPSIA – MATERNAL RISK FACTORS AND FETAL GROWTH
213. Johan Haux: STUDIES ON CYTOTOXICITY INDUCED BY HUMAN NATURAL KILLER CELLS AND DIGITOXIN
214. Turid Suzanne Berg-Nielsen: PARENTING PRACTICES AND MENTALLY DISORDERED ADOLESCENTS
215. Astrid Rydning: BLOOD FLOW AS A PROTECTIVE FACTOR FOR THE STOMACH MUCOSA. AN EXPERIMENTAL STUDY ON THE ROLE OF MAST CELLS AND SENSORY AFFERENT NEURONS

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216. Jan Pål Loennechen: HEART FAILURE AFTER MYOCARDIAL INFARCTION. Regional Differences, Myocyte Function, Gene Expression, and Response to Cariporide, Losartan, and Exercise Training.
217. Elisabeth Qvigstad: EFFECTS OF FATTY ACIDS AND OVER-STIMULATION ON INSULIN SECRETION IN MAN

218. Arne Åsberg: EPIDEMIOLOGICAL STUDIES IN HEREDITARY HEMOCHROMATOSIS: PREVALENCE, MORBIDITY AND BENEFIT OF SCREENING.
219. Johan Fredrik Skomsvoll: REPRODUCTIVE OUTCOME IN WOMEN WITH RHEUMATIC DISEASE. A population registry based study of the effects of inflammatory rheumatic disease and connective tissue disease on reproductive outcome in Norwegian women in 1967-1995.
220. Siv Mørkved: URINARY INCONTINENCE DURING PREGNANCY AND AFTER DELIVERY: EFFECT OF PELVIC FLOOR MUSCLE TRAINING IN PREVENTION AND TREATMENT
221. Marit S. Jordhøy: THE IMPACT OF COMPREHENSIVE PALLIATIVE CARE
222. Tom Christian Martinsen: HYPERGASTRINEMIA AND HYPOACIDITY IN RODENTS – CAUSES AND CONSEQUENCES
223. Solveig Tingulstad: CENTRALIZATION OF PRIMARY SURGERY FOR OVARAIN CANCER. FEASIBILITY AND IMPACT ON SURVIVAL
224. Haytham Eloqayli: METABOLIC CHANGES IN THE BRAIN CAUSED BY EPILEPTIC SEIZURES
225. Torunn Bruland: STUDIES OF EARLY RETROVIRUS-HOST INTERACTIONS – VIRAL DETERMINANTS FOR PATHOGENESIS AND THE INFLUENCE OF SEX ON THE SUSCEPTIBILITY TO FRIEND MURINE LEUKAEMIA VIRUS INFECTION
226. Torstein Hole: DOPPLER ECHOCARDIOGRAPHIC EVALUATION OF LEFT VENTRICULAR FUNCTION IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION
227. Vibeke Nossum: THE EFFECT OF VASCULAR BUBBLES ON ENDOTHELIAL FUNCTION
228. Sigurd Fasting: ROUTINE BASED RECORDING OF ADVERSE EVENTS DURING ANAESTHESIA – APPLICATION IN QUALITY IMPROVEMENT AND SAFETY
229. Solfrid Romundstad: EPIDEMIOLOGICAL STUDIES OF MICROALBUMINURIA. THE NORD-TRØNDELAG HEALTH STUDY 1995-97 (HUNT 2)
230. Geir Torheim: PROCESSING OF DYNAMIC DATA SETS IN MAGNETIC RESONANCE IMAGING
231. Catrine Ahlén: SKIN INFECTIONS IN OCCUPATIONAL SATURATION DIVERS IN THE NORTH SEA AND THE IMPACT OF THE ENVIRONMENT
232. Arnulf Langhammer: RESPIRATORY SYMPTOMS, LUNG FUNCTION AND BONE MINERAL DENSITY IN A COMPREHENSIVE POPULATION SURVEY. THE NORD-TRØNDELAG HEALTH STUDY 1995-97. THE BRONCHIAL OBSTRUCTION IN NORD-TRØNDELAG STUDY
233. Einar Kjelsås: EATING DISORDERS AND PHYSICAL ACTIVITY IN NON-CLINICAL SAMPLES
234. Arne Wibe: RECTAL CANCER TREATMENT IN NORWAY – STANDARDISATION OF SURGERY AND QUALITY ASSURANCE

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235. Eivind Witsø: BONE GRAFT AS AN ANTIBIOTIC CARRIER
236. Anne Mari Sund: DEVELOPMENT OF DEPRESSIVE SYMPTOMS IN EARLY ADOLESCENCE
237. Hallvard Lærum: EVALUATION OF ELECTRONIC MEDICAL RECORDS – A CLINICAL TASK PERSPECTIVE
238. Gustav Mikkelsen: ACCESSIBILITY OF INFORMATION IN ELECTRONIC PATIENT RECORDS; AN EVALUATION OF THE ROLE OF DATA QUALITY
239. Steinar Krokstad: SOCIOECONOMIC INEQUALITIES IN HEALTH AND DISABILITY. SOCIAL EPIDEMIOLOGY IN THE NORD-TRØNDELAG HEALTH STUDY (HUNT), NORWAY
240. Arne Kristian Myhre: NORMAL VARIATION IN ANOGENITAL ANATOMY AND MICROBIOLOGY IN NON-ABUSED PRESCHOOL CHILDREN
241. Ingunn Dybedal: NEGATIVE REGULATORS OF HEMATOPOIETEC STEM AND PROGENITOR CELLS
242. Beate Sitter: TISSUE CHARACTERIZATION BY HIGH RESOLUTION MAGIC ANGLE SPINNING MR SPECTROSCOPY
243. Per Arne Aas: MACROMOLECULAR MAINTENANCE IN HUMAN CELLS – REPAIR OF URACIL IN DNA AND METHYLATIONS IN DNA AND RNA
244. Anna Bofin: FINE NEEDLE ASPIRATION CYTOLOGY IN THE PRIMARY INVESTIGATION OF BREAST TUMOURS AND IN THE DETERMINATION OF TREATMENT STRATEGIES

245. Jim Aage Nøttestad: DEINSTITUTIONALIZATION AND MENTAL HEALTH CHANGES AMONG PEOPLE WITH MENTAL RETARDATION
246. Reidar Fossmark: GASTRIC CANCER IN JAPANESE COTTON RATS
247. Wibeke Nordhøy: MANGANESE AND THE HEART, INTRACELLULAR MR RELAXATION AND WATER EXCHANGE ACROSS THE CARDIAC CELL MEMBRANE

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248. Sturla Molden: QUANTITATIVE ANALYSES OF SINGLE UNITS RECORDED FROM THE HIPPOCAMPUS AND ENTORHINAL CORTEX OF BEHAVING RATS
249. Wenche Brenne Drøyvold: EPIDEMIOLOGICAL STUDIES ON WEIGHT CHANGE AND HEALTH IN A LARGE POPULATION. THE NORD-TRØNDELAG HEALTH STUDY (HUNT)
250. Ragnhild Støen: ENDOTHELIUM-DEPENDENT VASODILATION IN THE FEMORAL ARTERY OF DEVELOPING PIGLETS
251. Aslak Steinsbekk: HOMEOPATHY IN THE PREVENTION OF UPPER RESPIRATORY TRACT INFECTIONS IN CHILDREN
252. Hill-Aina Steffenach: MEMORY IN HIPPOCAMPAL AND CORTICO-HIPPOCAMPAL CIRCUITS
253. Eystein Stordal: ASPECTS OF THE EPIDEMIOLOGY OF DEPRESSIONS BASED ON SELF-RATING IN A LARGE GENERAL HEALTH STUDY (THE HUNT-2 STUDY)
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