Epidemiology of overweight and obesity in children and adolescents in Oppland county

"The tail belongs to the body, and the deviants are parts of the population"

Geoffrey Rose, 1990.

Abstract

Background:

The burden of disease in children and adolescents has moved from infections to noncommunicable diseases, including overweight and obesity (OWOB). Long-term successful treatment has been limited, and prevention strategies seem to be a more appropriate method. Health-related habits, especially during adolescence, have been found to strongly correspond to habits and health in adulthood. To enable the development of high-quality prevention strategies, a proper start is to become familiar with the prevalence and risk factors for OWOB in a targeted population. The aim of this thesis was to study the prevalence of OWOB in 15–16-year-old adolescents and to examine risk factors for OWOB in children and adolescents in Oppland County.

Material and methods:

The data were collected in Oppland County and consisted of two datasets. One dataset was collected during visits to the local health nurse as routine check-ups. The parental questionnaire was collected at the child`s routine-control performed at six years of age. In the following routine control at eight years of age, the nurse measured height and weight. Thus, we included data from 951 (47%) children born in 2001. The other dataset contained data from a repeated cross-sectional study of all 10th grade students (15–16 years of age) in Oppland County in 2002 and 2017. Questionnaire-data were available from 1675 (80%) adolescents in 2002 and from 1580 (71%) in 2017. It contained questions regarding weight, height, health-related habits, subjective social status (SSS), and mental health problems through the Strength and Difficulties Questionnaire (SDQ). The dataset from 2002 was collected by the Norwegian Institute of Public Health, and the dataset from 2017 was collected by our research team.

In Paper I, we explored the prevalence of OWOB and the association between breastfeeding history in infancy and body mass index (BMI) in eight-year-old children through linear and logistic regression. In Paper II we compared BMI, BMI z-scores, BMI distributions, and prevalence of OWOB in the adolescents in 2002 and 2017 stratified by gender. In Paper III we investigated the association between SDQ scores and both BMI and OWOB through linear and logistic regression analyses. We also analyzed whether the associations between mental health problems and BMI were different for boys and girls. In Paper IV, we built a structural equation model to explore whether the association between Subjective sociodemographic status (SSS) and BMI was mediated by unhealthy behaviors.

Results:

In Paper I, we did not reveal any associations between breastfeeding history in infancy and BMI or OWOB in eight-year-old children when adjusted for relevant confounders. In Paper II, we found that for adolescent girls, the mean BMI and the prevalence of OWOB significantly increased in the dataset from 2017 compared to the dataset from 2002. The mean differences in BMI z-scores were also positive across the 5th to the 95th percentile, indicating that the BMI values increased across the entire distribution. No such changes were found for boys. In Paper III, we found an association between reporting more peer problems and increased BMI and also increased risk of OWOB when analyzing data from boys and girls together. Additionally, we also found gender-related differences in the association between increased SDQ sub-scores and both increased BMI, and risk of OWOB. In Paper IV, we did not find an association between SSS and BMI in the 2002 dataset. In the 2017 dataset, we found that the significant association between increased SSS and lower BMI was mediated by hours of leisure-time exercise and through a latent variable consisting of habits related to cigarette smoking, snuff use and alcohol drinking.

Conclusion and clinical implications:

We did not reveal that breastfeeding history in infancy was associated with OWOB in eight-year-old children. We found gender-related differences regarding prevalence and risk factors for OWOB when assessing the 15–16-year-old adolescent population of Oppland County at two separate time points 15 years apart. We related and interpreted the finding of no association in 2002, but an association between higher SSS and lower BMI in 2017, to societal changes through the epidemiological transition in the years between the surveys. The health-related behaviors that mediated this association in our study were multifaceted and included several risk factors, such as cigarette smoking, snuff use and alcohol drinking, in addition to exercise. No single risk factor can be identified and eliminated to reduce the prevalence of OWOB. The risk factors of adolescent OWOB should therefore be interpreted within the behavioral and sociodemographic context of adolescents.

Norsk sammendrag

Bakgrunn:

Sykdomsbyrden hos barn og unge har endret seg fra infeksjoner til livsstilsykdommer som overvekt og fedme (OVOB). Det har vist seg vanskelig å behandle disse tilstandene, og dermed er det viktig med kunnskap som danner grunnlaget for forebyggende tiltak. Helseatferd og OVOB i barne-, og spesielt ungdomsalder, er relatert til helseatferd og OVOB i voksen alder. Dermed er det viktig å ha oppdatert informasjon om helsevaner og forekomsten av OVOB i barne- og ungdomsbefolkningen. Målet med denne avhandlingen var å sammenligne forekomsten av OVOB hos 15–16 år gamle ungdommer samlet inn med 15 års mellomrom. Vi ønsket også å undersøke risikofaktorer for både økt kroppsmasseindeks (KMI) og OVOB i barne- og ungdomsalder i forhenværende Oppland fylke.

Materiale og metode:

Data ble samlet inn i Oppland fylke og består av to datasett. Det første datasettet inneholder data fra 951 barn (47%) født i 2001. Foreldre fylte ut et spørreskjema ved rutinekontrollen ved års alder, og ved neste rutinekontroll ved åtte års alder målte helse-sykepleieren lengde og vekt av barnet. Det andre datasettet inneholder data fra en gjentatt tverrsnittstudie av 10.klasse-elever i Oppland der vi fikk svar fra 1675 (80%) i 2002 og 1580 (71%) i 2017. Ungdommene svarte på et spørreskjema som handlet om vekt, lengde, helse-relatert atferd, subjektiv sosial status (SSS) og om mental helse. Mental helse ble vurdert via spørreskjemaet «Styrker og svakheter». Datainnsamlingen i 2002 ble utført av Folkehelseinstituttet, og datainnsamlingen i 2017 ble utført av vår forskningsgruppe.

I Artikkel I undersøkte vi om det var en sammenheng mellom varighet av amming i spedbarnsalder og økt KMI, samt OVOB, hos åtte år gamle barn ved bruk av lineære og logistiske regresjonsanalyser. I Artikkel II sammenlignet vi gjennomsnittlig KMI, KMI standard-deviasjons-skår, samt KMI-fordelingen og forekomsten av OVOB for ungdommene i 2002 og 2017, fordelt etter kjønn. I Artikkel III undersøkte vi om det var sammenhenger mellom mental helse og KMI samt OVOB, ved bruk av lineære og logistiske analyser. Vi analyserte også om sammenhengene mellom mental helse og KMI samt OVOB, var ulike for jenter og gutter. I Artikkel IV brukte vi strukturell lignings modellering (Structural Equation Model) for å finne ut om sammenhengen mellom SSS og KMI hos 15–16 år gamle ungdommer ble mediert via usunn atferd. Denne usunne atferden besto av sigarett-røyking, bruk av snus og inntak av alkohol. I tillegg undersøkte vi om sammenhengen var mediert av fysisk aktivitet og inntak av brus.

Resultater:

I Artikkel I fant vi ingen sammenheng mellom varigheten av amming i spedbarns-perioden og økt KMI blant åtte år gamle barn. Resultatet var det samme når vi brukte OVOB som utfallsmål. I Artikkel II fant vi at gjennomsnittlig KMI og forekomst av OVOB blant 15–16 år gamle jenter var signifikant økt i datasettet i 2017 sammenlignet med datasettet fra 2002. Gjennomsnittlig differanse i KMI standard-deviasjonsskår var også økt gjennom hele KMI-fordelingen, altså hadde alle jentene i gjennomsnitt høyere KMI i 2017 enn de hadde i 2002. Vi fant ingen slik sammenheng for guttene. I Artikkel III fant vi at å rapportere mer venneproblemer var en risikofaktor for økt KMI når vi analyserte gutter og jenter som en gruppe. Videre fant vi at det var ulike assosiasjoner for mental helse og økt KMI hos gutter og jenter. Denne sammenhengen var også signifikant for OVOB. Blant jentene fant vi en sammenheng mellom å rapportere mer venneproblemer og økt KMI, og vi fant også en sammenhengen mellom å rapportere mer emosjonelle symptomer og økt KMI. Blant guttene fant vi at å rapportere mer atferdsproblemer var assosiert med økt KMI. Resultatene var sammenlignbare når vi kjørte analysene med OVOB som utfall i logistisk regresjonsanalyse. I Artikkel IV studerte vi sammenhengen mellom SSS og KMI i datasettene fra 2002 og 2017. Sammenhengen var kun signifikant i datasettet fra 2017, hvor vi fant at høyere SSS var assosiert med lavere KMI. Denne assosiasjonen var mediert via antall timer med fysisk aktivitet i fritiden, samt helse-atferd som inkluderte vaner for sigarett-røyking, snus-bruk og inntak av alkohol.

Konklusjon og klinisk betydning:

Vi fant ingen sammenheng mellom amming av spedbarn og risiko for OVOB blant 8 år gamle barn. Vi fant en kjønns-relatert forskjell i forekomst og risikofaktorer for OVOB hos 15–16 år gamle ungdommer fra Oppland på to tidspunkter med 15 års mellomrom. Vi fant at høyere sosiodemografisk tilhørighet og lavere KMI var assosiert i datasettet fra 2017, men ikke i datasettet fra 2002. Vi relaterer funnet til endringer som har skjedd i samfunnet i perioden mellom disse undersøkelsene, og tolker dem gjennom teorien om den epidemiologiske transisjonen. Helseatferden som medierte assosiasjonen mellom sosiodemografisk tilhørighet og KMI virker sammensatt og inkluderer ulike risikofaktorer som røykevaner, bruk av snus og inntak av alkohol, i tillegg til vaner for fysisk aktivitet. Det finnes ingen enkeltstående risikofaktor vi kan identifisere og fjerne for å få bukt med OVOB. Risikofaktorene for OVOB hos barn og ungdom bør derfor tolkes innenfor rammen for deres atferdsmønstre og sosiodemografiske omgivelser.

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Acknowledgements

List of publications

I.   Bjertnæs AA, Grundt JH, Donkor HM, Juliusson PB, Wentzel-Larsen T, Vaktskjold A, Markestad TJ, Holten-Andersen MN. **No significant associations between breastfeeding practices and overweight in 8-year-old children.** Acta Paediatrica. 2019; 0:1-6. https://doi.org/10.1111/apa.14937

II.   Bjertnæs AA, Grundt JH, Juliusson PB, Markestad TJ, Strand TA, Holten-Andersen MN. **Sex-related change in BMI of 15 to 16-year-old Norwegian girls in cross-sectional studies in 2002 and 2017.** BMC Pediatrics. 2019; 19:431. https://doi.org/10.1186/s12887-019-1790-2

III.   Bjertnæs AA, Nesdal Fossum I, Oma I, Bakken KS, Strand TA, Holten-Andersen MN. **A cross-sectional study of the relationship between mental health problems and overweight and obesity in adolescents.** Frontiers in Public Health. 2020; 8(334). https://doi.org/10.3389/fpubh.2020.00334

IV.   Bjertnæs AA, Schwinger C, Juliusson PB, Strand TA, Holten-Andersen MN, Bakken KS. **Health-related behaviors in adolescents mediate the association between perceived family economy and BMI.** Submitted August 30th 2020.

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List of abbreviations

BMI	Body Mass Index
BMIz	BMI standard deviation score
CFA	Confirmatory Factor Analyses
MNAR	Missing not at random
OB	Obesity
OVOB	Overvekt og fedme
OW	Overweight
OWOB	Overweight and obesity
SDQ	Strength and Difficulties Questionnaire
SEM	Structural Equation Modelling
SSS	Social Subjective Status
SCCS	Sugar Containing Carbonated Soda
WHO	World Health Organization

1. Introduction

Overweight and obesity (OWOB) in children and adolescents is a major threat to global public health [1]. The occurrence of OWOB in childhood can pose a challenge to the development of healthy physical, social and psychological traits [2]. Overweight (OW) and obesity (OB) represent a threat with potential adverse effects in every organ system [2-4]. Furthermore, childhood OWOB tends to persist into adulthood yet the association between OWOB in adolescence and in adulthood is even stronger and has been associated with adult morbidity, including cardiovascular disease and cancer [5-10]. In addition, the current and future economic costs related to OWOB are enormous, with potential adverse effects for future populations globally due to high prevalence numbers [11].

1.1. Definition of OWOB in children and adolescents

The World Health Organization (WHO) defines OWOB as "abnormal or excessive fat accumulation that may impair health" [12]. A definition based on the amount of body fat is impractical for epidemiological use, and body mass index (BMI), kg/m^2, is an internationally acknowledged tool for defining OWOB and is applicable for population surveillance [13]. BMI does not distinguish between tissue types and the distribution of fat [14]. Thus, other clinical measures of body composition exist, and include waist circumference, waist to height ratio, and skinfolds [15, 16]. There are gender-related differences in these measurements, as girls have higher mean skinfolds than boys, and boys have higher mean waist circumference than girls [15, 16]. More advanced measures of body composition have been developed, such as dual-energy X-ray absorptiometry and bioelectrical impedance analysis [17]. However, these are less commonly used in clinical settings [17].

The cutoff values for and prevalence of OWOB vary according to the growth charts used. In this thesis, the prevalence of OWOB will be assessed using the International Obesity Task Force (IOTF) cutoff values. Norway has national growth references since 2009 [18], which include IOTF cutoff values for OWOB. OW is defined according to an age- and gender-adjusted BMI of ≥ 25 at age 18, and OB is defined by a cutoff value of ≥ 30 at the same age [19]. Table 1 displays details on the cutoff values for adults ≥18 years of age.

Noncommunicable diseases are familiar to many as lifestyle diseases and include OWOB. Noncommunicable diseases are defined as *"Diseases for which evidence is lacking that transmission from individual to individual is possible by contagion (….) or inheritance"* [20, page 197].

Table 1. Body Mass Index cutoff values for weight classes in adults (25).	
Morbid obesity	≥ 35 kg/m^2
Obesity	≥ 30 kg/m^2
Overweight	≥ 25 kg/m^2
Normal weight	18.51–24.99 kg/m^2
Underweight	≤ 18.5

In general, OW differs from OB regarding both body composition and comorbidities [21, 22]. In this thesis, we will focus on the epidemiological patterns of OWOB, and we do not think that exploring these two subgroups as one will lead to biased associations. We also avoided exploring associations in relatively small groups, as the prevalence of OB in girls and boys was between 2–3% in all studied groups. Furthermore, childhood was defined as including children up to the age of 10 years, and adolescence included individuals between 10–24 years of age.

1.2. An epidemiological approach to OWOB

Epidemiology is defined by the epidemiologist Mervyn Susser (1921-2014) as *"the study of the distribution and the determinants of states of health in populations"* [23].

The epidemiologist Geoffery Rose (1926–1933) stated that an individual´s risk of disease should be interpreted in the context of her population [24]. This can be interpreted as the risk of a certain disease varying by the context in which the individual lives. This thesis describes the prevalence and risk factors of OWOB in children and adolescents in the former county of Oppland, Norway. Thus, the population context is a rural county in a high-income country.

The analyses in this thesis were based on observational data. Difficulties exist in making causal assumptions based on observed relations, as an association does not equal a causation [25, 26]. Checklists, such as the Hill criteria, for whether an observed association can be interpreted as causal exist [27]. Nevertheless, the US epidemiologist Kenneth Rothman (1945–) advises using hypotheses and refutation instead of a checklist approach when debating causality in observed relations [28, page 34].

1.3. Prevalence and trends in OWOB

Between 1980–2013, the global prevalence of OWOB among children and adolescents increased by 47%. However, during the last decade, the increase in mean BMI and the prevalence of OWOB in most northwestern countries in Europe have stabilized, albeit at high levels [29, 30]. Concurrent with the levelling off in OWOB in most children and adolescents, trends have revealed that children who were already OWOB have become heavier [31]. This is evidenced as

an increase in prevalence in the upper percentiles of the BMI growth charts in European countries, including Norway [32-35]. Corresponding developments in OWOB and BMI distributions have been found in the US and China [36-38]. In Europe, a geographical north-south gradient in children has been suggested to exist, with the highest prevalence of OWOB found in the countries of southern Europe [39]. Northern European countries have a prevalence of OWOB of 15–25%, while the UK, Ireland and countries of southern Europe have a prevalence of OWOB comparable to the US of approximately 25–50% [1, 40].

The prevalence of OWOB among Norwegian children has shown a corresponding development, with a tripling in the percentage of children above the 97th percentile in weight for length when comparing prevalence numbers from the 1970s to prevalence numbers from 2003–2006 [31]. This increase was followed by a stable prevalence of OWOB in girls (16 to 17%) and boys (14 to13%) from 2008 to 2015 [41, page 34-35]. There is less knowledge on the prevalence of OWOB in adolescents, and the available regional numbers have revealed opposite gender-related patterns. Numbers from the regional Young-HUNT study between 1995 and 2019 displayed an increase in the prevalence of OWOB in 13–19-year-old girls from 16–25%, with seemingly stable numbers in boys [42, page 9]. Another regional study, the Fit-Futures Study, found that the prevalence of OWOB in boys possibly increased from 23% in 15–17-year-old boys to 28% in 18–20-year-old boys [43]. The numbers in girls were seemingly stable at 21%.

1.4. Critical periods of weight gain

Adipocytes increase in both number (hyperplasia) and size (hypertrophy) during childhood and adolescence, whereas the number of cells remains fairly stable throughout adulthood [44]. Thus, the timespan from childhood through adolescence seems to be a vulnerable period for weight gain.

In childhood, two periods have been found in which the vulnerability to weight gain was especially pronounced. These include the *rapid infant weight gain* and the *adiposity rebound.* A rapid infant weight gain is also known as an accelerated postnatal weight gain and is defined by upward crossing of a centile in weight charts before two years of age [45]. Adiposity rebound represents an increase in BMI in four- to seven-year-old children [46]. An early rebound is associated with an increased risk of later OWOB.

The adolescent age is a critical period for the development of OWOB since there is a high risk that OWOB in adolescence persists into adulthood [5, 6, 8]. Additionally, associations between BMI in adolescence and death in adulthood from both cardiovascular and all-cause mortality have been described [47]. Furthermore, adolescence is a high-risk time for weight gain due to metabolic changes during puberty, which act in concert with the synergistic effects of behavioral risk factors [48].

1.5. Risk factors for OWOB

The Foresight report from 2007 was constructed as guidance on how the UK could respond to the increasing prevalence of OWOB (Figure 1) [49]. The report contains a system map displaying the interplay between more than 100 different contributors to OB. In the map, this multitude of contributors has been simplified into seven categories covering social and individual psychology, activity, food and physiology. This approach to describing risk factors for OWOB incorporates both the role of the environment and of the individual and visualizes the concept of a "whole systems approach" when addressing OWOB [49]. In the following, relevant themes for my thesis will be described, but these will not, and possibly could not describe everything.

1.5.1. Sociodemographic inequalities in OWOB

A thematic cluster in the Foresight map is social psychology, covering inequalities in health due to sociodemographic differences. Groups with lower sociodemographic affiliation are generally at greater risk for adverse health outcomes and are traditionally defined by the objective measures income, education or occupation [50-54]. These measures are often not yet accomplished by the adolescent. Subjective Sociodemographic Status (SSS) is another commonly used measure of sociodemographic affiliation. In the study of adolescents, we used the SSS interpreted as "the perception of one's location in the status hierarchy of society" [54].

Several theories have been suggested to explain why inequalities in health exist across groups of differing sociodemographic affiliation [51]. These theories suggest that these differences in health are due to that groups with lower sociodemographic affiliation have a lower standard of e.g., residencies, nutrition and working conditions, or alternatively, that they live more stressful lives associated with more disease in general [51]. A third suggestion is that people with lower sociodemographic affiliation display less healthy habits when examining nutrition, exercise, alcohol consumption, cigarette smoking, and use of drugs [55-58].

Figure 1. The full obesity map with thematic clusters from Foresight (with permission) [59]

1.5.2. Health-related behaviors

Breastfeeding can be interpreted as parental health-related behavior associated with higher sociodemographic affiliation in high-income countries [60]. Norwegian mothers who breastfeed longer tend to smoke less, be older, and have completed higher education compared to mothers who breastfeed for shorter periods [61, 62]. Studies have also shown that formula-fed infants gain more weight in infancy than breastfed infants, and this rapid infant weight gain in infancy has been found to be associated with an increased risk of later OB [45, 63]. The rapid weight gain in bottle-fed children is suggested to be caused by the higher protein content of formula compared to breast milk [64]. A diet high in protein early in life may increase the risk of OB in eight-year-old children [65]. Breastfeeding is endorsed by the WHO for the promotion of optimal growth and limitation of unfavorable weight gain in later life [66].

Adolescent behavior differs from that in childhood and adult life. This period is important for future health, as many health-related habits are established during this age [67]. This phase encompasses both biological growth and major transitions in social roles, and is characterized by the development of autonomy and risk-seeking behavior [68-70]. The adolescent brain is affected by the late maturation of the prefrontal cortex, where planning, organization, risk assessment and delay of pleasure take place. This process of cerebral maturation is not completed until the mid-20s [69]. Additionally, the adolescent brain is hypersensitive to reward through increased release and sensitivity to dopamine [69, 71]. Thus, adolescent behavior can be interpreted as closely related to dopamine-releasing behaviors like risk-taking, but also eating [72, 73]. Furthermore, adolescent behavior is complex and has been suggested to represent a continuum from healthy to unhealthy [74].

1.5.3. Mental health

Individual psychology is another thematic cluster described in the Foresight map (Figure 1) [49]. Both depression, behavioral problems, stigmatization, peer problems, and attention-deficit/hyperactivity disorder are mental health problems related to OWOB [75-80]. Adverse life events such as emotional, physical, or sexual abuse in childhood have also been linked to a higher prevalence of OWOB in adulthood [81]. The association between mental health problems and OWOB is suggested related through established risk factors such as less exercise, poor diet quality, and sedentary behavior [75, 82, 83]. However, the direction of the association between mental health problems and OWOB is unclear (79, 88). This could possibly be due to that OWOB could lead to mental health problems through stigmatization, but as described above, mental health problems can also lead to decreased energy expenditure and/or increased energy intake.

Gender-related differences in the association between mental health problems and OWOB have been suggested, especially in adolescents [84, 85]. In addition to the well-known higher

prevalence of internal mental health problems in women, a higher prevalence of these problems are also found among adolescent girls OWOB [85, 86]. Accordingly, the relations between mental health problems and OWOB should be explored in more detail to gain a better understanding to if and why they exist.

1.5.4. The epidemiologic transition

Both the increases in prevalence and the social inequality of OWOB in children and adolescents can be interpreted through a theory of how Western societies have changed in recent decades [87]. The increasing prevalence has been associated with economic growth. Sufficient wealth is needed to generate a linear relationship between gross domestic product and mean BMI, which eventually flattens out [88]. Thus, following economic growth, a change in predominating patterns of morbidity occurs, with a decrease in the prevalence of infectious diseases and an increase in chronic diseases, including OWOB and mental health problems. This change in predominating diseases is called the epidemiological transition [11, 89, 90].

In high-income countries, a shift has occurred in the social patterning of OWOB during recent decades. Whereas OWOB used to be more prominent in higher income groups, it is now associated with low income [91]. This changed social pattern of OWOB has been interpreted through the fact that population groups with more resources gain access to more food first, and thus OWOB can be a sign of wealth [87]. After a while, changes encompassing higher living standards and a "Western" lifestyle are also achievable for the less economically privileged. Through what is named a nutritional transition, access to unhealthy food increases, enabling a higher intake of calories than strictly needed [92]. A less physically active lifestyle is also frequently included in these habits, and this pattern has been called an activity transition [93]. Hence, a higher prevalence of OWOB will be found in the lower-income groups and possibly also connected to inexpensive energy-dense foods [87, 92].

1.5.5. The intersection between genetics and environment

Physiology is the last theme in the Foresight map (Figure 1) [59]. One of the central themes among the risk factors for OWOB involves the complex interplay between genetics and environmental impact. An intergenerational transmission of OWOB has been found , and maternal OWOB is strongly associated with OWOB in the offspring [94]. It is difficult to fully separate the impact from family behavior and shared environment from that of genetics, and suggestions have been made that the environment plays a more important role in OWOB than genetic factors do [95, 96]. Another view is that the environmental impact comes on top of a genetic vulnerability for OWOB [97]. There is also a possibility that these risk factors can vary

according to age, as environmental influences on BMI have been found to weaken around the adolescent age, whereas the genetic correlation between children and parents tended to influence the BMI also for older age-groups [98].

2. Rationale

In 2013, the white paper "Good health – a common responsibility" stated that the increase in OWOB have profound impacts on public health, with children and adolescents being at special risk and therefore holding a special need for protection [99, page 8]. In chapter 6 of that report, it was stated that sustainable public health management must be based on scientific grounds, and that national, regional, and municipal data on health-related habits and risk factors associated with OWOB are lacking. Furthermore, a need for a broader knowledge of social inequalities in health is paramount. Better data will provide a better premise for goal-oriented enterprises and for the surveillance of effects from these actions. Overall, health promotion is an important achievement in society and a goal for all public policies in Norway [99, page 7-17].

Our observational study was carried out in accordance with these guidelines. We wanted to collect data to create a foundation enabling health professionals and decision makers in our county, and in comparable populations, to address present and future challenges due to OWOB among children and adolescents.

3. Aims of the thesis

The overall aim of this thesis was to describe the prevalence of OWOB among adolescents in a regional community population and to explore associated risk factors. The risk factors included mental health problems and health-related behaviors in children and adolescents.

Specific objectives

a. To examine whether any breastfeeding or whether duration of exclusive and partial breastfeeding was associated with body mass index (BMI) z-scores and a risk of OW or OB at eight years of age in a regional cohort after adjusting for potential confounders.
b. To explore whether an increasing mean BMI and prevalence of OWOB was due to an increasing BMI within a subgroup of adolescents.
c. To investigate if mental health indices covaried with increased BMI in a population-based study of 15 to 16-year old adolescents, and if these associations differed between genders.
d. To investigate the possible relationship between SSS and BMI in adolescents at two different time points and to determine whether the association was mediated by health-related behaviors in cross-sectional samples of 15–16-year-old adolescents.

4. Materials and Methods

4.1. Study area

All participants lived in the county of Oppland, one of 19 counties in Norway (11 counties from 1.1.2020) and had 183,253 inhabitants in 2002 and 189,870 inhabitants in 2017 [100]. The county has 26 municipalities, is predominantly rural and has two larger towns with populations of 25,000–30,000 [101].

4.2. Datasets

We used observational data in our studies. The data used in Paper I was collected by local health nurses as a part of a longitudinal study The Growth and Health of Children in Oppland study [102, 103]. According to the national school health service guidelines, all children pay visits to the school nurse at six and eight years of age [104], and data were collected at these two routine visits: The questionnaire at six years of age, and the anthropometric data at eight years of age. The anthropometric measurements were recorded to the nearest 0.1 kg and 0.1 cm. For those who declined to participate, the local public health nurse registered gender, age, height and weight anonymously and reported the data to the study team. The data-sets are summarized in Table 2.

The Norwegian Institute of Public collected the data used in Paper II–IV in 2002, and we collected the dataset in our research group in 2017. Figure 2 displays the flowchart of the repeated cross-sectional study.

The 2002-study was also performed in Oslo, Hedmark, Troms and Finnmark [105, 106]. The answers were collected on paper in 2002, and electronically in 2017. In 2002, participants not present in school at the day of the study could answer by mail at a later time. A pilot study was conducted among 64 students in 2002 [106]. In 2015–2016, we piloted the questionnaire in 120 students to investigate the practical execution of the study, the distribution of the answers, and if the questions seemed easy to understand.

An overview of which datasets that are used in the papers is found in Figure 3.

Table 2. Summary of datasets used in this thesis

Year of data-collection	Mean age in years	Data collected	N (% boys)	% Participation	Ethical approval (project-number)	Consent
Paper I						
2007	5.7	Parental questionnaire and consent	1119 (47.0)	59	The Regional Committee for Medical Research Ethics (1.2006.3491)	One of the parents signed a consent
2010	8.3	Weight, height, gender, age reported by public health nurses	951 (46.3)	47		
Papers II-IV						
March-June 2002[a]	15.9	Self-reported questionnaire	1675 (50.9)	80	The Regional Committee for Ethics in Medical Research and the Data Inspectorate of Norway[b]	Students > 16 years: Written consent. Students < 16 years: Parental consent
April-June 2017	15.8	As above	1580 (48.5)	71	The Regional Committee for Medical Research Ethics South East (2016/1755)	As described above

[a] *= Data collected by Norwegian Institute of Public Health.*
[b] *=[106]*
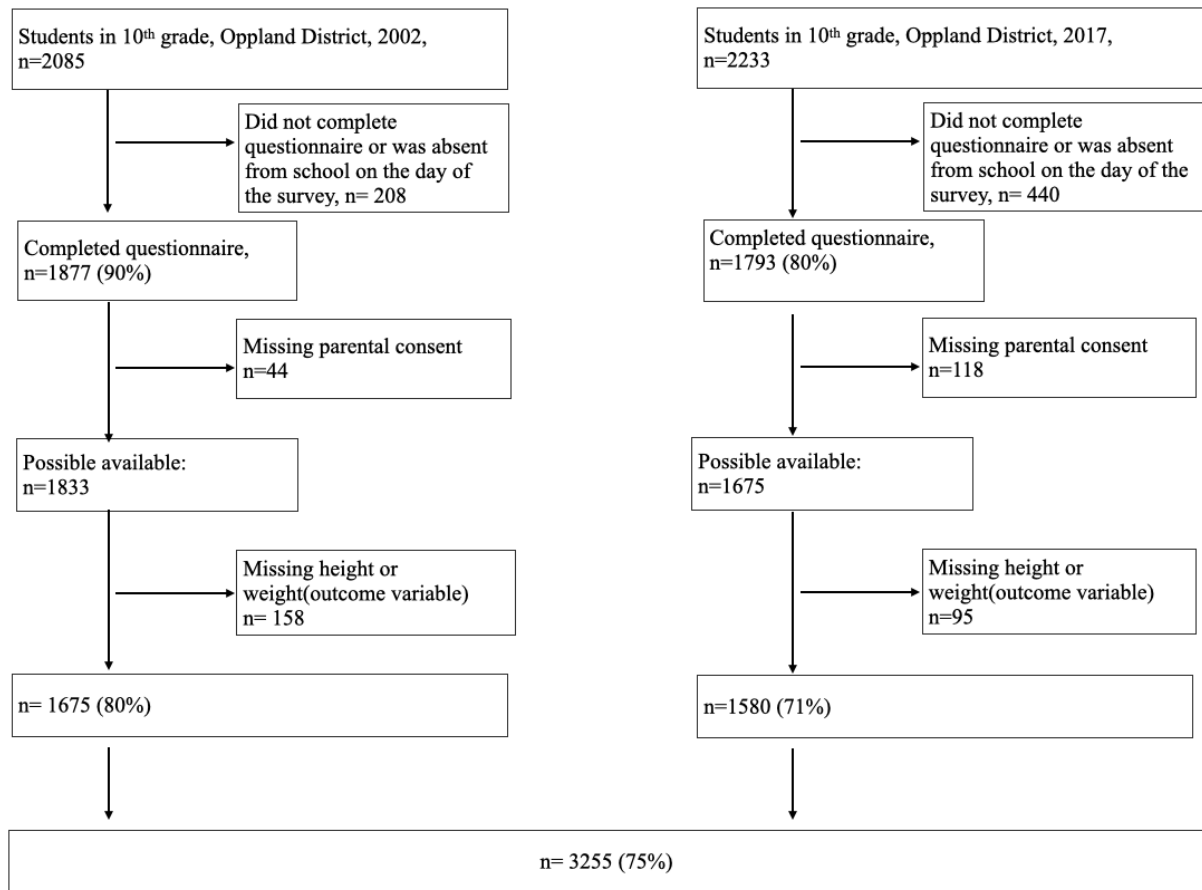
Figure 2. Flowchart of datasets of adolescents used in Paper II–IV.
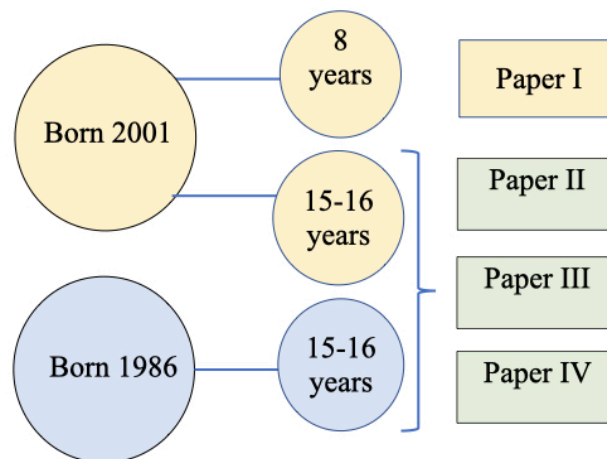
Figure 3. Overview of which datasets used in each paper.

4.3. Outcome variables

The outcome variables were BMI, BMI z-score or OWOB (Table 3). We used the national references for all these variables. For OWOB, we used the international IOTF-cut-offs according to the national reference [18, 19]. The BMI z-score equals the number of age and gender-adjusted standard deviations in our dataset compared to the Norwegian reference.

Table 3. Outcome variables used in the papers					
		Paper			
Dependent variable /outcome		I	II	III	IV
BMI			x	x	x
BMI z-score		x	x		
Overweight or obese (OWOB) (normal weight vs. overweight and obese)		x	x	x	
Yellow color symbolizes that the data are from the survey in 8-year old children in 2007, green color symbolizes data from the surveys in 15–16-year old adolescents in 2002 and 2017.					

4.4. Exposure variables

The exposure variables in Paper I were breastfeeding practices. The parents reported duration of partial breastfeeding and duration of exclusive breastfeeding in months. We dichotomized the variable duration of exclusive breastfeeding into ever breastfed and <4 months of exclusive breastfeeding. A total of four variables were used as exposures: Ever breastfed, <4 months of exclusive breastfeeding, duration of partial breastfeeding, and duration of exclusive breastfeeding. The latter two variables were reported in months.

In Paper II, we used the dichotomous variables gender and year of study (2002 or 2017) as exposure variables. Gender was reported by the participant, and time of study was registered by the research-team.

In Paper III, the Strength and Difficulties Questionnaire (SDQ) was used to assess self-reported mental health. SDQ is a brief behavioral screening questionnaire for 3–16 year old children [107]. The SDQ can be used for mental health screening, as a part of clinical assessment, for treatment outcome, and in research. The SDQ contains 25 questions split into five subscales; 1) emotional symptoms, 2) peer problems, 3) conduct problems, 4) hyperactivity, and 5) prosocial behavior. Each single question is scored on a 3-item Likert scale as 0 for "Not true", 1 for "Somewhat true", or 2 for "Certainly true". Each sub-score can range between 0–10, with higher scores reflecting more problems, except for the prosocial scale, where higher scores reflect fewer

difficulties in prosocial behavior. The SDQ also contains an impact score, reflecting the child´s distress and impairment. We did not use the prosocial behavior, as we defined the four other sub-scores as exposures.

In Paper IV, the exposure variable was SSS measured by the adolescent perceived family economy. The categories were poor, average, good, and very good.

4.5. Other variables

In Paper I, we adjusted the analyses for 15 variables. The three continuous variables were birthweight z-score, maternal BMI and paternal BMI. Gender and dental caries were dichotomous variables. The remaining ten variables, and how they were dichotomized, are shown in Table 4.

In Paper III, we included the following variables in the multivariable analyses; gender, the participant age in months, being a member of a leisure time sports-team or not, eating daily breakfast or not, year of study, and perceived family economy. Two variables were dichotomized: Daily breakfast was categorized from the five categories never/seldom, 1–2 times /weekly, 3–4 times weekly, 5–6 times weekly, and daily into daily or not. Member of leisure-time sports-team was categorized from the 3 categories none, several, and one, into yes/no.

In Paper IV, we built a Structured Equation Model (SEM) including hours of exercise (6 categories: 0, 1–2, 3–4, 5–7, 8–10, ≥11), consumption of sugar containing carbonated soda (SCCS) (5 categories: Seldom/never, 1-6 glasses weekly, 1 glass daily, 2–3 glasses daily, ≥ 4 glasses daily), cigarette smoking (four categories: Never, used to, occasionally, daily), snuff-use (the same four categories) and ever drunk alcohol (yes/no).

Table 4. Dichotomized variables in Paper I	
Original variable with categories	Dichotomized variable (yes/no)
Four separate questions: How often does the child eat breakfast /lunch/ dinner/ supper weekly? *(Eight categories for all questions: Never/seldom, once, twice, three times, four times, five times, six times, daily)*	All four meals <5 times weekly
Weekly participation in exercise generating heavy breathing or sweating? *(Seven categories: Never, < once/month, 1–3 times/ month, once weekly, 2–3 times weekly, 4–6 times weekly, daily)*	< four times weekly
Mean daily screen-time on TV, DVD, video, TV-games or PC registered in hours? *(Six categories: not at all, < 0.5 hours, 0.5–1 hour, 2–3 hours, 3–4 hours, > 4 hours)*	> two hours daily
Smoking parents or other care-givers in the household? *(Five categories: No: Neither mother nor father. Yes: mother, father, maternal or paternal cohabitant, others in the household)*	Maternal smoking
	Paternal smoking
Who does the child live with? *(Eight categories: Mother and father, mother, father, both mother and father but in separate households, mother and new partner, father and new partner, foster-parents, others)*	Single parent
Highest completed maternal education? *(5 categories: 9 years of school, 10–11 years of school, 12 years of school, college, university)*	> 12 years
Highest completed paternal education? *(as described above)*	> 12 years
Place of living? (*Categories: Municipality*)	> 20,000 inhabitants
Number of treatments with antibiotics due to a chest infection? *(4 categories: Zero, treatments < 2 years age, treatments < 2 years age–one year ago, treatments the preceding year)*	Treated with antibiotics
Number of treatments with antibiotics except chest infections? (*Number of treatments*)	

4.6. Statistical analyses

We treated missing observations in variables by listwise deletion, meaning that if a case was missing an observation, we excluded this case from all analyses [108, page 85]. We also assessed data prior to analyses according to the following description:

- To explore if there were outliers in the datasets, we inspected data-plots, and also evaluated observations >3 standard deviations, and ran the analyses with and without these possible

outliers. If the results did not change, the observation was kept in the dataset [109, page 126-130].

- We removed data that were biologically implausible, and set the limits based on a thorough, manual evaluation of the answers.
- If nothing else is stated in particular in the studies below, observations without value for height, weight, age or other exposure data were treated as missing data.
- Further, through inspection of plots, we confirmed linearity between the exposure and outcome variable, and also that the association was homoscedastic.
- Next, we checked that the residuals were normally distributed through inspection of q-q-plots and histograms, and also through checking that skewness was <2 and kurtosis were <7 [110, page 134, 111].
- We evaluated clinically important effect-modifiers.
- For all variables in adjusted analyses, we also explored variance inflating factor [112].

4.6.1   Paper I

In Paper I, we estimated if four different measures of breastfeeding practices in infancy, namely duration of partial or exclusive breastfeeding, any breastfeeding, or less than four months of breastfeeding was associated with BMI or OWOB in eight-year-old-children.

The potential confounding variables were included based on findings from previous research [113, 114]. Ten confounding variables were dichotomized, as shown in Table 4.

Further, we compared the means and differences in proportions of the participants and non-participants, using a t-test or a Pearson´s chi-square-test as appropriate. We performed crude and adjusted linear and logistic regression models separate for the four different breastfeeding exposures, using either BMI or OWOB as outcomes. We performed the multivariable analyses in one step, namely the "enter-procedure" in SPSS [115]. We chose variables for the multivariable analysis based on results from earlier studies, not p-values from the crude analysis. In the dichotomous variable exclusive breastfeeding <4 months or ≥4 months, we investigated the differences in maternal smoking habits and maternal education using Pearson's chi-square test.

In the published paper, the variables that recorded duration of partial and exclusive breastfeeding were registered as "missing" in the 91 children who had never been breastfed. To investigate if this handling of data had implications on the result, the "missing" observations in these 91 participants was recoded to 0, and then the crude and adjusted analyses were re-run in preparation of this thesis. The results showed that the crude estimate for duration of partial breastfeeding changed to a small, but significant association (β -0.01 (95% Confidence Interval (CI) -0.02, -0.001). The other crude and adjusted analyses retrieved insignificant results. Thus, a

small, and probably clinical insignificant crude association was found. We do not consider this result to have implications for the conclusion in Paper I.

For analyses in Paper I, we used the Statistical Package for the Social Sciences (SPSS) for Windows, version 21.0.5 Armonk, NY: IBM Corp.

4.6.1. Paper II

In Paper II, we compared the BMI-distributions in adolescents in 2002 and 2017, stratified by gender. We calculated a percentage of OWOB for each study, and explored the mean difference in BMI and BMI z-score. We also calculated the risk difference of OWOB and OB. We used bootstrap resampling with 1000 replicates to calculate the 95% CI of the difference in various percentiles between the two time points. The distributions were created with Epanechnikov kernel density using R version 3.6.1 (2019-07-05) -- "Action of the Toes" Austria: R Foundation for Statistical Computing, 2019, www.R-project.org). We also analyzed the data using STATA 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017).

4.6.2. Paper III

In Paper III, we studied the association between mental health and BMI in adolescence. We combined the datasets from 2002 and 2017.

To generate the four sub-scores of the SDQ, we used the syntax available on the SDQ website [116]. Accordingly, sub-scores were created if at least three out of five items were answered. Missing values were replaced by mean values. We adjusted the analyses with variables as explained in paragraph 4.5 above.

We performed crude and adjusted linear and logistic regression analyses with BMI and OWOB as outcomes. We also explored if the association between BMI and mental health problems differed by gender using an effect-modification-term for gender and each different subscale. Further, we checked if clustering of schools changed the association by calculating intra class correlations for the 2017 dataset, as the information considering school was not available in the 2002-dataset. The internal consistency was expressed by the McDonald's Omega [117]. We analyzed data using STATA 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017).

4.6.3. Paper IV

In Paper IV, we studied if the association between SSS and BMI was mediated through health-related behaviors in adolescence. We found that the direct effect between SSS and BMI was

insignificant in the 2002-dataset, but significant for the 2017-dataset. Thus, we did not build a model for the 2002-data, and used SEM to build a model for 2017-data.

First, we investigated the bivariate association between SSS and BMI using linear regression with the category average family economy as reference-group. Next, we calculated Spearman's rank correlations including p-values between included variables in the SEM-model for 2017.

We used standardized estimates, and also tested if using BMI z-score as outcome resulted in different associations and estimates. The SEM-model was built in two steps. First, we built the latent variable, also called measurement-model, through confirmatory factor analyses to explore how well the variables co-varied and fitted within the latent variable. We removed variables that were not correlated to the latent variable, had factor loadings <0.4, showed non-possible values, or resulted in a poor model fit when they were included [108, chapters 7-8]. The latent variable had to contain at least three items to be included in the SEM-model [108, chapter 7]. Our a-priori hypothesis was that health-related behaviors in adolescence mediated the association between perceived family-economy and BMI. We started by investigating if the data revealed a pattern of covariation in consuming nutrition high in sugar (cakes and candy, SCCS, sugar-sweetened lemonade or energy-drinks). We also investigated if exercise and inactivity displayed covariation (hours of leisure-time work-out, membership in sport-teams and hours of screen-time). Moreover, we looked into health-related habits (smoking tobacco, using snuff, drinking alcohol, and frequency of brushing teeth). We built the latent variable that included cigarette smoking, snuff use, and alcohol drinking according to the criteria mentioned above.

Second, we built the structural model that included the direct and indirect pathways, and also the latent variable [118]. The direct pathway was defined as linking SSS and BMI. The indirect pathways were defined as linking SSS and BMI through the latent variable health-related behavior, and through hours of leisure time exercise and consumption of SCCS. We calculated the proportion of the indirect effect from indirect effect/direct + indirect effect. The model for 2017 is presented in result-section 5.1.3

As all variables except BMI were ordinal, we used the diagonally least squares estimator (DWLS) [108, page 257-258]. Further, we tested the model's goodness of fit to see if our models reproduced the observed variance-covariance matrix, using Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SMR) as indicators [108] (chapter 12). No post-hoc modification of the model was performed. We compared the included and excluded cases. The path- and SEM-analyses were assessed using the library lavaan [119] and the packages SemPlot and semTools [120] in R version 3.6.1 (2019-07-05) -- "Action of the Toes" Austria: R Foundation for Statistical Computing, 2019, www.R-

project.org). For all other analyses we used STATA 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017).

4.7. Ethical considerations

All participation was voluntary. The studies in this thesis are executed in agreement with the principles of the Declaration of Helsinki and the Health Research Act [121, 122]. The publications followed the recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals (commonly named the Vancouver convention) [123]. All ethical approvals, project-numbers, and an overview of given consents can be found in Table 2.

A disadvantage when exploring health-related behaviors to approach how socio-demographic affiliation influences OWOB, is that OWOB individuals could be perceived as choosing poor behaviors and not as being influenced by tendencies within the society [51]. Nevertheless, we are not neglecting complicated theories describing why these behavioral patterns likely occur [55].

There is also a possibility that comparing normal weight people to OWOB can be interpreted as blaming individuals for their weight, which can initiate stigmatization [78]. Our effort to discuss the risk factors of OWOB as a framework that affects population health, is based on an intention to support the opposite: To obtain an understanding of the risk factors for OWOB within the given context.

Further, screening of height and weight is included in the child and adolescent routine health program in Norway [104]. The purpose of this screening is not restricted to revealing OWOB alone, but if OWOB is uncovered, no effective treatment is established [124]. Thus, the need for more knowledge of OWOB including the risk factors can also be supported due to ethical reasons.

5. Results / Summary of the papers

5.1.1. Paper I

In Paper I, our hypothesis was that there was an association between duration of breastfeeding practices in infancy and BMI in childhood. We included 951 children with mean age of 8.3 years in the study. Of those with parental consent, 47% participated. We did not reveal any differences between the participants and the group without parental consent in age, anthropometric measurements or rates of OWOB, but there was a slightly lower percentage of boys in the group with parental consent.

There was a 21.1% prevalence of OWOB, 22.7% in girls and 19.3% in boys. We also found that 90% had been exposed to some breastfeeding. The mean duration of exclusive and partial breastfeeding were respectively 4.6 months (standard deviation 2.6 months) and 10.7 (standard deviation 6.1) months. There was a crude, positive association between <4 months of exclusive breastfeeding and BMI z-score (beta 0.23 (95% CI 0.08, 0.37)), but the analyses did not reveal any adjusted association in linear or logistic regression for either of the breastfeeding practices.

Thus, we concluded that our study did not support the commonly held notion that breastfeeding reduces the risk of OWOB in eight-year old Norwegian children.

Table 5. Results from adjusted linear and logistic regression analyses in Paper I

	n	Linear regression (dependent variable: BMI z-score)		Logistic regression (dependent variable: OWOB[1])		
		Coefficient[2]	(95% CI[3])	OWOB[1,4,7] (%)	OR[5]	(95% CI[3])
Ever breastfed[6]	708	-0.06	(-0.34, 0.21)	20.1	0.99	(0.48–2.02)
Exclusive breastfeeding(months)[6]	622	0.00	(-0.03, 0.04)	20.3	0.98	(0.90–1.08)
Partial breastfeeding(months)[6]	621	0.00	(-0.01, 0.01)	19.0	1.02	(0.99–1.06)
< 4 months of exclusive breastfeeding[6]	672	0.06	(-0.11, 0.21)	25.8[7]	1.06	(0.67–1.66)

[1]OWOB= Overweight and obesity
[2]Unstandardized regression coefficient
[3]Confidence Interval
[4]Percent OWOB for each exposure
[5]Odds Ratio
[6]Adjusted for not having regular meals, activity < 4 times weekly, daily screen time > 2 hours, maternal smoking, paternal smoking, birth weight z-score, maternal BMI, paternal BMI, gender, single caretaker, maternal education, paternal education, rural living, having had caries, ever been treated by antibiotics.
[7]Table 5 is slightly adapted from Paper I.

5.1.2. Paper II

In Paper II, we hypothesized that we would uncover an increasing mean BMI and an increasing prevalence of OWOB in the upper percentiles of the BMI-distribution. There were 1675 participants in the 2002-dataset and 1580 in the 2017-dataset. We found gender-related changes in BMI when comparing numbers from the 2002 and 2017-datasets. For girls, we found that there were significant increases in the mean BMI from 20.7 to 21.4, the mean BMI standard deviation score (BMIz) from -0.007 to 0.22, and in the prevalence of OWOB from 9 to 14%. We did not reveal any significant changes in boys. For all percentiles in the dataset, BMI in girls were also increased when comparing the two datasets. This result was also visible on inspection of the BMI-distributions; The BMI- distribution for girls revealed a right-shift towards increasing values on the BMI scale. The BMI distribution for boys, on the other hand, was similar in position, shape and dispersion for the two time-points (Figure 4).

We concluded that the increase in OWOB among 15–16-year-old Norwegian girls presented a uniform shift in the entire BMI distribution for girls. There is a possibility that this finding, if replicated by others, may have significant implications on future health in Norwegian women.

Vertical lines: Mean value for the two datasets.
___ = 2017 dataset.   ….= 2002 dataset.

Figure 4. BMI z -score distributions 2002 and 2017 stratified by gender.
Figure 4 is published using BMI as outcome variable in Paper II.
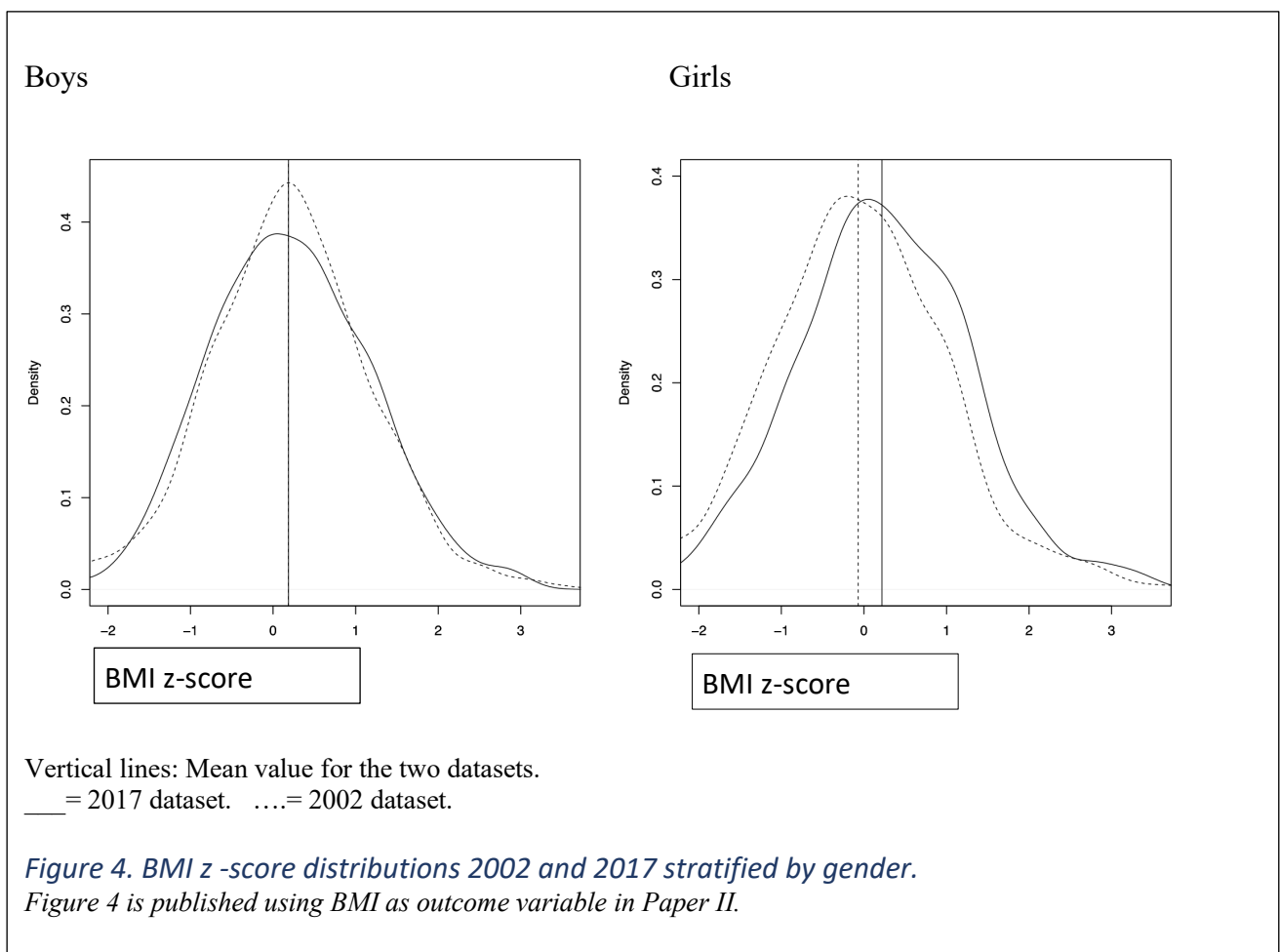
5.1.3. Paper III

In Paper III, we hypothesized that mental health problems were directly associated with BMI and that this association was different in boys and girls. We found that BMI in the total sample of 3256 adolescents was positively associated with peer problems (beta (ß): 0.08, (95% CI 0.01, 0.14)), indicating that for every point increase in peer-problems sub-score, BMI increased by 0.08 kg/m^2.

We found different associations for boys and girls. Girls' BMI significantly increased with peer problems (beta (ß): 0.18 (95% CI 0.08,0.27)) and emotional symptoms (beta (ß): 0.07, (95% CI 0.01, 0.13)), and boys' BMI increased with increasing values of conduct problems (beta (ß) 0.10 (95% CI 0.01,0.19)). The association between emotional symptoms and BMI for boys and girls are demonstrated in Figure 5.

We concluded that higher reported values of peer problems were associated with increased BMI in this adolescent group. Further, that small, but significant associations between mental health problems and higher BMI in adolescence are different for boys and girls.
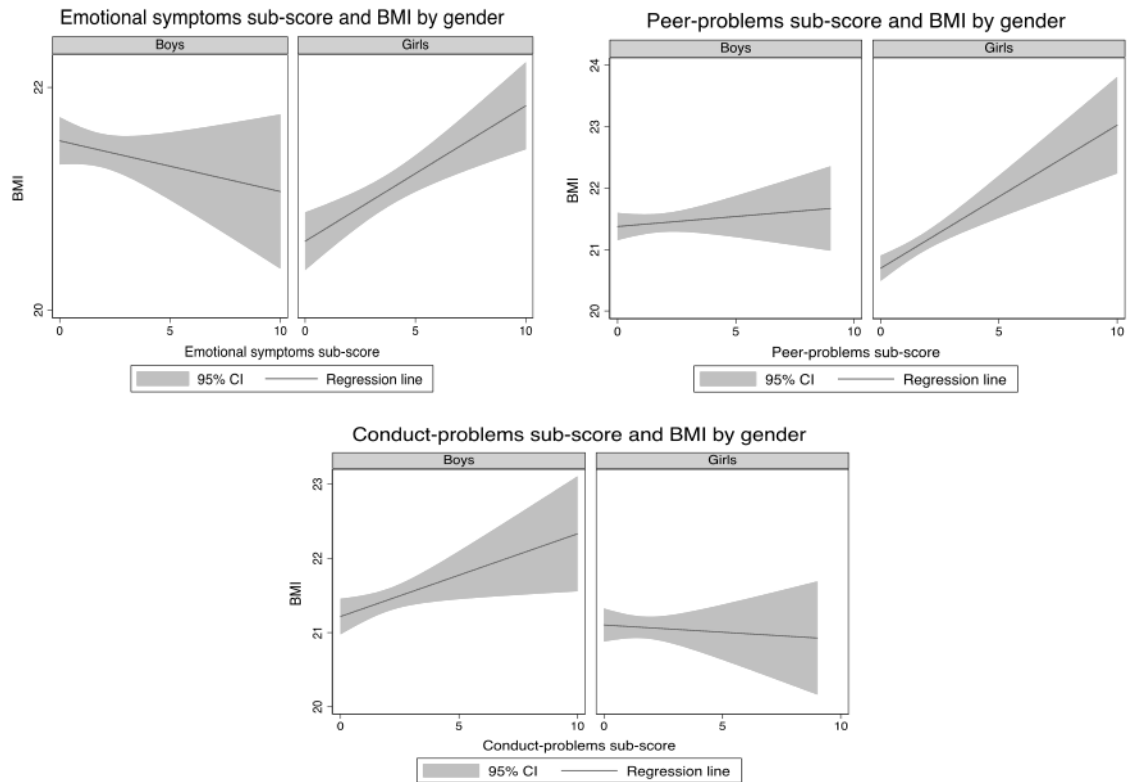
Figure 5. The association between sub-scores of emotional symptoms, peer problems and conduct problems and BMI modified by gender.

The figure depicting the relationship between emotional problems and BMI is published in Paper III.

5.1.4. Paper IV

In Paper IV, our a-priori hypothesis was that health-related behaviors in adolescence mediated the association between SSS and BMI. We studied the association between four categories of SSS and BMI through health-related behaviors using SEM-analysis. We used a mediation-analysis to explore if weekly hours of exercise or frequency of sugar-sweetened carbonated beverages mediated the association between SSS and BMI. We also used a latent variable that included cigarette smoking, snuff use, and alcohol drinking. Data on 1596 adolescents in the 2002-data and 1534 adolescents in the 2017-data were analyzed. Due to no significant direct association between SSS and BMI in 2002, we did not build a SEM-model for this dataset. We built a SEM-model for the 2017-data which is displayed in Figure 6.

We found no direct association between socio-demographic affiliation and BMI for 2002 (standardized β -0.02, (95% CI -0.07,0.03)). However, for 2017, we found a direct association that BMI decreased by increasing SSS (standardized ß -0.05 (95% CI -0.10, -0.001)). Thus, the BMI decreased by 0.05 standard deviations (0.05 x 3.1 = 0.16 BMI units) if the SSS was reported as one higher unit of perceived family economy. We found that the association was mediated through weekly hours of exercise (standardized ß -0.013 (95% CI -0.02, -0.004)) and unhealthy behavior (standardized ß -0.009 (95% CI-0.002, -0.04)).

We concluded that the association between SSS and BMI was mediated through health-related behaviors in the 2017-dataset. The complex pattern of unhealthy behavior in adolescents included observations not directly related to energy consumption.
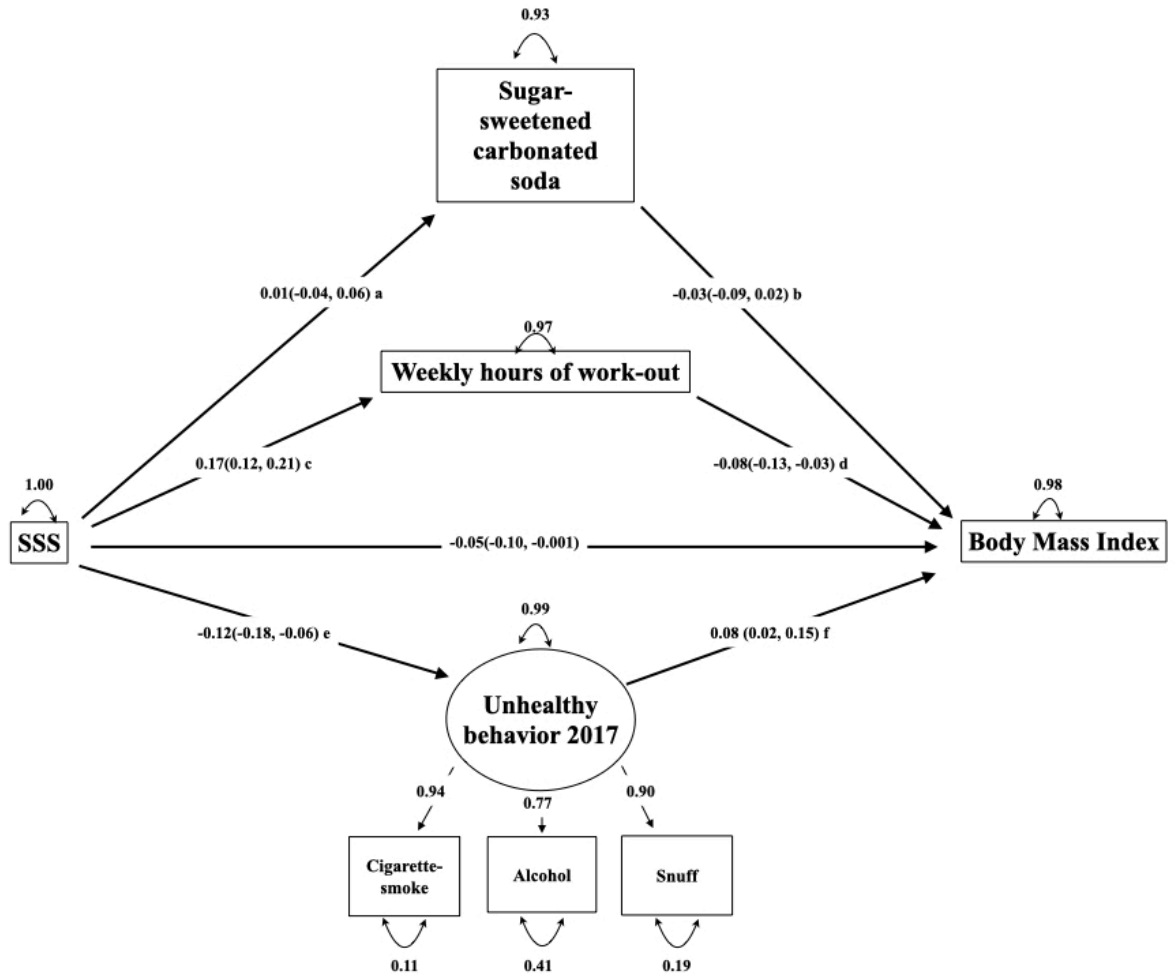
Figure 6. Structural Equation Model for the 2017 dataset.

The rectangles indicate observed variables. The circle indicates a latent variable
Numbers on straight arrows in the structural model indicate standardized β with 95% Confidence Intervals. Numbers on straight arrows in the measurement model indicate standardized regression coefficients between the latent variable and the observed variable. Numbers on top of curved arrows indicate unexplained variance.
Letters a,b,c,d indicate parts of the indirect pathways with standardized β with 95% Confidence Intervals.
The indirect pathways from perceived family economy to Body Mass Index:
*a*b = mediated through consumption of sugar-sweetened carbonated beverages = 0.001 (0.007, -0.001)*
*c*d=mediated through hours of weekly work-out: -0.013 (-0.02, -0.004). Mediated effect: 20.6%*
*e*f= mediated through unhealthy behavior: -0.009 (-0.002, -0.04). Mediated effect 15.3%*
Figure 6 is included in the submitted Paper IV.

6. Discussion

In this thesis, we describe the epidemiology of OWOB in children and adolescents in the county of Oppland. The next part will be a short review of the findings in the papers, followed by a discussion of the methodological aspects of the papers, then a discussion of how our findings can be related to findings from other studies follows.

6.1. Main findings

In adolescents, we found that the prevalence of OWOB increased from 9 to 14% in girls and from 17 to 20% in boys, as measured in repeated cross-sectional studies in 2002 and 2017. These numbers represent significant increases in adolescent girls for both prevalence of OWOB and mean BMI, while the numbers were stable in adolescent boys.

We did not reveal any associations between breastfeeding history in infancy and OWOB in eight-year-old children. For adolescents, we found that peer problems were associated with BMI, and mental health issues differed for boys and girls. For girls, we found an association between increased BMI and both more emotional symptoms and peer problems. For boys, we found that increasing conduct problems were associated with higher BMI. We studied the relationship between SSS and BMI and did not reveal any associations in the dataset collected in 2002. For the dataset collected in 2017, we found both a direct association between increasing SSS and decreasing BMI and this association was mediated through less unhealthy behavior and more exercise.

6.2. Methodological considerations

6.2.1. Study design

This thesis consists of analyses based mostly on cross-sectional data. The data for Paper I were collected as a part of a longitudinal study, and the questionnaire was collected two years prior to the collection of anthropometric data. The data used in Papers II–IV originated from a repeated cross-sectional study.

Cross-sectional data are suitable to determine e.g. the prevalence of a disease [110, page 34], as we did in Paper II. In cross-sectional studies, changes in the same individuals cannot be measured, and causation cannot be addressed. Accordingly, the findings in these studies can be seen as generating hypotheses for further research.

For Paper III, former research has claimed that association between mental health problems and obesity is inconsistent due to that the association is only valid in smaller subgroups

[125]. To prevent that smaller subgroups in the dataset had a larger impact on the result, we chose to analyze the data from 2002 and 2017 as one sample in Paper III.

In Paper IV, we explored whether adolescent behavior mediated the association between sociodemographic affiliation and BMI. The validity of analyzing mediators in cross-sectional data has been debated, and estimates have been found to differ from those found in longitudinal studies [126]. The results from cross-sectional studies should therefore also be further explored through longitudinal studies.

6.2.2. Validity

It is essential to evaluate whether a study is trustworthy through a study's validity. Validity has two overall components, internal and external validity, as shown in Figure 7. The internal validity is a measure of how well the data are collected, analyzed and/or interpreted [20, page 287]. External validity describes whether the study can be generalized to similar groups beyond the study participants [20, page 288]. In other words, validity is a consideration of whether the study measures the characteristic or association it had intended to measure and if the results can also be applied to other groups.
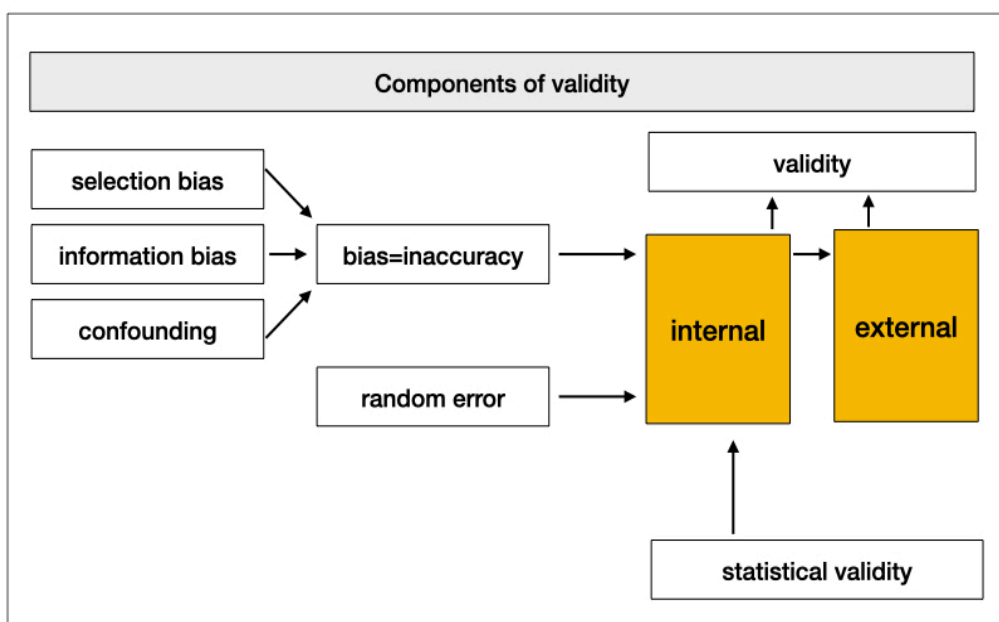

Figure 7. Description of validity assessment.

6.2.3. Bias

Systematic error or bias can introduce inadequate internal validity to a study. Bias can be classified into selection bias, information bias, or confounding [127, chapter 9]. A biased association can result from errors occurring in all of the steps during the study, the design, conduct, analysis, interpretation, or publication. The effects of these types of systematic errors are not predictable, and may lead to both over- and underestimation of effects [127, chapter 9] .

6.2.4. Selection bias

Faulty procedures for selecting participating individuals for study participation can introduce selection bias [20, page 258].

In Paper I, approximately 50% of the eligible children participated. The nonparticipating children lacked parental consent, or they did not have their anthropometric measurements taken in the routine exam in third grade. We explored the possibility of selection bias by comparing the participants and those without parental consent. The groups did not differ in anthropometric measurements, but there were slightly more boys among those who chose to participate. As it is not expected that breastfeeding history in infancy or the association between breastfeeding and the outcomes vary between the genders, we do not consider this difference relevant. Furthermore, overrepresentation of higher educated participants has been found in many observational studies [128]. We cannot address this issue due to the study design, but the inclusion was done by the local health nurse during a routine check-up. Sociodemographic status should thus not be important for who was asked to participate in the study.

In Papers II–IV, all students in 10th grade in the county were invited. Completing 10 years of school is mandatory in Norway, and thus, all adolescents in this age group were invited. As 80% participated in 2002 and 71% participated in 2017, the possibility for selection bias should be considered. First, the use of parental consent in adolescent studies can possibly lead to a decline in participation rate [129]. Higher educated parents have been found to give active consent more often [130]. Second, absence from school on the day of the study might not have been at random. Third, the questionnaire was available only in Norwegian for both time points, possibly leading to an exclusion of minority groups without adequate Norwegian language skills. However, Oppland had a small percentage of immigrants at both time points [131]. Research assistants were also present in every class during the study in order to assist participants if difficulties occurred. We have no specific indication of a selection bias, and our percentage of participation is comparable to another study using self-reported height and weight in adolescents [132]. In future studies, a method to reduce a possible selection bias in this age group is to focus on adolescents above 16 years of age, who do not need consent from a parent or superior. Furthermore, the study should preferably be available in languages other than Norwegian.

6.2.5. Missing data

The amount of missing data can also be used to investigate if there is a selection bias in the data. Three types of missing data exist: missing completely at random, missing at random, and missing not at random (MNAR). It is important to distinguish if the missing data are MNAR, as no standardized method is valid in this situation [110, page 285-286].

All data were analyzed using the listwise missing setting. For Paper I, the number of missing observations in the exposure variables varied between 1–17%. For Papers II–IV, missing data were as follows: Paper II: 8.6% in 2002 and 5.7% in 2017. Paper III: 9% for linear regression. In the logistic regression analyses, we excluded underweight individuals (7%) from the dichotomous OWOB variable, leading to a total of 17% missing. Paper IV: 8.4% was missing in the 2017 dataset.

We have no indications that the missing data were due to MNAR. For Paper I, the amount of missing data was higher than ideal, but we believe this was data missing at random. This assumption is based on the fact that the collected data did not include sensitive questions that particpants would not feel comfortable answering. For Papers II–IV, with both the total number of participants and the percentage of missing data, the numbers were higher in 2002. There is a possibility that the opportunity to respond by mail at a later time for those absent on the day of study in 2002 could have led to a higher number of participants. The electronic study in 2017 may have contributed to a more complete dataset in 2017, as the participants were asked to answer the questions regarding age and gender to be able to continue with the questionnaire.

6.2.6. Information bias

Information bias occurs as variables are measured with error [110, page 45]. The incorrect classification of a value leads to a misclassification [20, page 149]. These misclassifications are split into nondifferential and differential. Nondifferential misclassifications happens when subjects are misclassified on exposure or outcome [127, page 139]. Further, these misclassifications are equally distributed between groups and usually lead to underestimation of the effect [127, page 139]. Differential error is differently distributed between the groups and can lead to bias in either direction [127, page 138]. One specific form of differential misclassification is recall bias [127, page 138]. An example of a recall bias could be if responses to how many portions of vegetable were consumed differed between parental groups of children with and without OWOB.

In Paper I, there is a possibility of recall bias in the exposure variables for breastfeeding history in infancy, as parents answered the questionnaire when the child was between 5–6 years of

age. However, several studies have shown that the duration of breastfeeding tends to be somewhat overestimated but quite accurate after 3, 6, and even 20 years [133-135]. Nevertheless, it has been shown that recall bias is more pronounced in maternal smokers and that it increases with parity [134, 136]. We did not have data on parity, and we cannot rule out that our results have been influenced by recall bias.

Neither of the questionnaires used in the studies were validated, except for the SDQ[137]. Pilot studies were performed for the questionnaires used in Papers II–IV both in 2002 and 2017, but no standardized study of reliability or validity was performed. Considering age and education, the participants should have the same premises to understand and answer the questions. But if the questions were asked in an imprecise manner, this could possibly lead to a measurement error and thus increase the chance of random error in the datasets used in Papers II–IV. The SSS used as an exposure variable in Paper IV shares the same problem, as the use of four categories of perceived family economy has, to the best of our knowledge, not been validated. It should be noted that there are several studies of perceived family economy from the 2002- questionnaire of the adolescent study [138-140].

6.2.7. Confounding

Confounding can be thought of as a mixing of effects [28, page 136]. A confounder is defined as associated with the exposure, associated with the outcome, but not an effect of the outcome or the exposure; confounding occurs when the observed association is totally or partly accounted for by other variables [28, page 136-142].

If the confounder is a part of the effect, it is a mediator that can cause a bias in either direction. Under these circumstances, it should not be adjusted for [28, page 141]. Adjusting for a mediator will underestimate the direct effects and lead to smaller effect sizes [141, page 137]. Furthermore, the inclusion of numerous variables can possibly lead to an inflated explained variance in the outcome variable [141, page 62]. Residual confounding exists when variables are not controlled for or controlled for but are measured inadequately [28, page 181].

In Paper I, there is a possibility that some of the included confounders could be interpreted as mediators, e.g., nutritional habits, thus leading to smaller effect sizes. The inclusion of the numerous confounding variables could have led to an inflated explained variance. Furthermore, some of the included variables might also be perceived as irrelevant, e.g., having had caries, introducing a possible specification error. However, the included variables were chosen on the basis of our clinical knowledge and previous studies.

In Papers II–IV, none of the datasets had information on the stage of puberty, which has an impact on both growth and gender-related patterns of fat mass that are not detectable through BMI [142]. Nevertheless, as the mean age of late entrance to puberty is defined as 13.5 years in girls

and 14.5 years in boys, we believe that most participants had reached puberty due to their mean age of 15.8–15.9 years [143].

6.2.8. Random error and internal consistency

As illustrated in Figure 7, random error affects internal validity. Random error is generally regarded as due to chance and is defined as "the proportion of variation in a measurement that has no apparent connection to any other measurement or variable" [20, page 99].

A main limitation for all papers in this thesis is the possible random measurement errors due to self-reported data. If a measurement error exists in the exposure variable, it shifts the regression coefficient towards the null, and this is also called a regression dilution bias. If the measurement error is present in the outcome variable, it increases the standard error, reducing the precision of the effect measure estimates. Random measurement errors will also decrease the total amount of explained variance in the model [144]. Consequently, random errors in both exposure and the outcome variables result in loss of statistical power.

The parental reported exposure variable of breastfeeding history in infancy in Paper I may possibly have led to a regression dilution bias, and thus small effect sizes were found (Table 5). The self-reported observations in Papers II–IV may have led to a possible regression dilution bias and a loss of precision.

Self-reported measurements of height and weight can also lead to some subgroups reporting deviating values. A study found that girls underreported their weight more than boys, OWOB adolescents underestimated weight more than normal weight participants, and underweight adolescents generally overestimated their weight [145]. Nevertheless, self-reported height and weight have been found to be reliable proxy measures of OWOB in adolescents [146]. In Paper II, this possible bias would have been present for both time points, and we consider the numbers comparable.

In Paper III, we explored whether the subscores of the SDQ measured the same construct by assessing internal consistency. Internal consistency can be defined as "the degree of interrelatedness among the measured items of the instrument" [20, page 56]. Internal consistency was assessed through the use of McDonalds' omega, as we assessed models with possible unequal factor loadings [117, 147]. No universally accepted cutoff exists, but values >0.7 are suggested as acceptable for internal consistency [148]. A higher score on the SDQ mainly reveals more mental health *problems*. A different structure with more mental health *strengths* leading to a higher score is used on five of the 25 items. This is done to minimize the likelihood that the participants answering the questionnaire passively. During the analysis process, recoding ensures that the highest number (two) will be replaced with the lowest number (zero) for these five items. We found that the lowest internal consistency was displayed in the items that included this reversed

wording (Table 6). This has also been found in other studies through the use of both Cronbach's alpha and McDonalds' omega [149-151]. Some studies have also found that the factor structure improved when removing the reversed worded items [152, 153]. Thus, the use of reversed wording can possibly be interpreted as a general weakness of the SDQ. If the reversed wording differentially affected scoring in different groups, it may have led to a differential misclassification and should be sorted under the category information bias.

Table 6. Internal consistency of the sub-scores in the Strengths and Difficulties Questionnaire (SDQ).

Subscore of the SDQ	Internal consistency in Paper III[b]
Emotional symptoms	0.75
Peer problems[a]	0.59
Hyperactivity problems[a]	0.61
Conduct problems[a]	0.52
Total difficulties subscale	0.63
a = reversed coded items included b = internal consistency measured by McDonalds' omega	

6.2.9. External validity

In Paper I, we do not have evidence of any bias affecting the external validity, and the results could be generalized to comparable age groups from other rural communities that share the higher risk of OWOB [154]. Furthermore, this cohort was born at the height of the increased mean birthweight in Norway between 1989/90 and 2001/02 [155]. As birthweight has been found to, at least moderately, correspond to BMI in late adolescence, there is a biological reason that the changes in BMI in these cohorts should be comparable to other cohorts born within this timeframe [43].

In Papers II–IV, we investigated associations regarding OWOB in 10th grade in Oppland at two different time points. As our data are limited to a narrow age span (15–16 years of age) and from a county with few minority groups, the results should be generalized to the same age categories in counties with a similar population.

6.2.10. Other statistical considerations.

Most statistical assumptions are built on testing a null hypothesis of no association between variables. If this null hypothesis is incorrectly confirmed, this is a type II error [127] (chapter 10). In Paper I, only 10% of the mothers reported that they had not breastfed their child at all. The low number of observations of non-breastfed children reduced the statistical power, and it is possible that we did not reveal an association that could have been present in the data, i.e., a type II error [127, chapter 10].

6.3. Discussion of findings

6.3.1. Gender-related trends in the prevalence of OWOB in adolescents.

We found an increasing prevalence of OWOB in adolescent girls but not in boys. Our finding was supported by the finding of adolescent girls` mean waist circumference exceeding that of boys in the last round of the Young-HUNT study [42, page 10-11]. Disregarding the possible uncertainty related to these technically challenging measures, this is a dramatic finding, since girls have lower mean waist circumference in almost all ages according to the national reference [15, 156]. A gender-related difference was also found in European adolescent girls aged 10–19 years. Girls gained more weight compared to boys between 1975–2016, and the mean BMI was equal at 21.1 for both genders in Northwestern Europe in 2016 [29, appendix]. In our neighboring countries Sweden and Denmark, the trends are seemingly more mixed: A Swedish regional study found an increase in OWOB in both 11- and 14-year-old girls and boys from 2004-2015 and an increase from 19-25% in 17-year-old boys [157]. Danish national prevalence numbers for OWOB in 14–15-year-old adolescents from 2011-2019 revealed a stable prevalence in boys at 19%, while the prevalence in girls were reported as 17–19%, but it is not noted if this difference is statistically significant [158]. Thus, the results are mixed and difficult to compare because they represent data from regional and national sources.

We also found that for girls, the entire BMI distribution had shifted upwards from 2002 to 2017, meaning that the entire group of girls had, on average, a higher BMI in 2017. For boys, we did not detect any significant change. Our results differed from another previous, regional study in Norway that compared the BMI distribution in the 1960s to the 1990s [32]. The results revealed that the BMI values from the 1990s were more widely dispersed across the distribution, with an increasing prevalence of OWOB in the upper BMI percentiles, and these changes in the upper percentiles were more pronounced in boys than in girls [32]. The finding that the heavy became heavier has also been seen in studies comparing time periods between the 1970s and the 2000s in Sweden [33, 159], Germany [160] and the USA [36]. These studies did not find distinct gender-

related differences, and little information exists on gender-related BMI distributions among adolescents from this millennium.

Our finding of a general upward shift in BMI for girls may have been preceded by the above mentioned upward shift found in boys [32, 161]. In support of this, data from the Norwegian military muster show that the mean weight in boys increased by 3 kg between 1995 and 2010, while height remained stable [162]. Weight gain in adult men was also found from the early 1970s, while weight gain in women was not seen until the 1980s [163]. Why weight gain in males and females was initiated in different decades cannot be easily explained. A reasonable approach in adolescents could be to explore the influence of parental OWOB, as maternal OWOB has been found to be associated with OWOB in offspring, while paternal OWOB was related to OWOB in boys only [164]. Furthermore, global changes in mean BMI for 5- to 19-year-old children and adolescents were found to be moderately correlated to the changes in adults before the year 2000 but weakly correlated afterwards [29]. This change in correlation can possibly be interpreted through that the mean BMI in children and adolescents has reached a plateau, while there is still an ongoing increase in mean BMI in adults [29].

Another approach could be to explore whether changes have occurred in gender-related behavior, including food consumption and exercise. This assumption is not supported by other studies, as Norwegian adolescent girls have reported eating more fruit and vegetables and drinking less SCCSs compared to boys [165]. Furthermore, no changes in patterns of exercise were found in a Norwegian study of 15–year-old adolescents between 2006 and 2018 for boys or girls [166]. There is a possibility for a gender-related trend of increasing OWOB in adolescent girls, but a possible precursor to this trend should be further explored.

6.4.   The risk factors for OWOB explored in this thesis

We explored sociodemographic affiliation, health-related behaviors and mental health problems as risk factors for OWOB in this thesis and will discuss the findings in this order. Thereafter, the context for health-related behaviors will be discussed, followed by the conclusion.

6.4.1.   Sociodemographic inequalities in OWOB

Affiliation to a lower sociodemographic group has generally been associated with worse health outcomes, including noncommunicable diseases such as OWOB [50, 51, 67]. The association seemingly reflects a gradient, as the risk of disease has also been found to differ within both the upper and lower groups of sociodemographic affiliation [167].

In the study of eight-year-old children, we objectively assessed sociodemographic affiliation as parental education level since the questionnaire was answered by the parents. In the

study of adolescents, we assed sociodemographic affiliation through SSS. SSS has been found to reveal information not captured by objective sociodemographic measures, related to health behaviors, and also mental health [54, 168, 169]. It has also been shown to be more strongly related to health indicators than objective measures of sociodemographic affiliation [170].

Further insight into how SSS is associated with adolescent OWOB could be gained by collecting information considering how the adolescent places herself within the social hierarchy of the school community. This information is included as the second item in the adolescent version of the validated MacArthur Scale of SSS and should be included in future studies [55, 171].

Our finding that a higher level of SSS was associated with a lower BMI in 2017, but not in 2002, can be interpreted through the theory of epidemiologic transition, which includes a change in the social pattern of OWOB over time. The time span of 15 years may seem narrow to uncover a shift in the association between sociodemographic affiliation and OWOB. However, reviews of studies from high-income countries have illustrated this trend, with higher sociodemographic affiliation predicting a higher prevalence of OB in 25% of included studies in a review from1989 through the finding of one study revealing this positive relationship in 2008, to the finding of an association between higher weight status and groups with lower sociodemographic affiliation in 2015 [172-174]. Accordingly, we consider our results realistic.

As mentioned in the introduction, several theories exist of why lower sociodemographic affiliation is a risk factor for OWOB in high-income countries. We chose to address health-related habits, as these are important in the energy surplus associated with OWOB.

6.4.2. Health-related behaviors and OWOB

Breastfeeding

We interpret breastfeeding as parental behavior influenced by sociodemographic affiliation [60, 61]. In our study, we found no association between breastfeeding history in infancy and OWOB in eight-year-old children in a high-income country. This finding was consistent with results from observational studies of the association between overweight infants and later OWOB [175, 176] but inconsistent with most other observational studies[113, 177]. Still, it should also be kept in mind that a publication bias may favor studies with findings of significant associations [178].

A hurdle in approaching previous research to evaluate the possible causal role of breastfeeding in infancy and later OWOB is the possibility of confounded associations. Breastfeeding mothers in high-income countries more often have a higher sociodemographic affiliation, and they also make other healthy lifestyle choices [60, 136, 179]. Randomization is challenging due to ethical aspects. However, a few randomized studies exist. One study conducted

in the early 1980s allocated babies born in gestational week 31 to receive either formula or breast milk [180]. In adolescence, the group that received breast milk had a beneficial profile of lipoproteins, C-reactive protein values and a lower blood pressure compared to those who received formula [180, 181]. However, the generalization of the results may be difficult, as the babies included were born prematurely, and the study had a low number of participants. Another study randomized mother-child pairs into receiving breastfeeding support or not, the PROBIT trial from Belarus, and found little difference in BMI z-scores after the age of 8.5 years [182]. However, the study suffered from a possible underestimation of effects and lower power due to a mixture of breastfeeding practices in both groups of supported and unsupported breastfeeding [178].

The possible causal path between breastfeeding and OWOB is difficult to explore also beyond the confounding factors, as the results differ by study design and populations [183, 184]. Furthermore, a proposed causal link between breastfeeding and later OWOB could be a reflection of findings of higher protein levels in formula [64]. This higher intake of protein can possibly stimulate the secretion of insulin-like growth factor 1, leading to cell proliferation, accelerated growth and increased adipose tissue [65]. Formula feeding has also been associated with rapid weight gain in infancy, which again is linked to child, adolescent and adult OB [45].

Interestingly, differences in intelligence have been studied as another long-term outcome of breastfeeding. Studies have found an association between breastfeeding and higher intelligence in children across several methods and in different populations [178, 183-185]. Taken together, the results from observational studies of breastfeeding on OWOB as well as on intelligence display beneficial health outcomes. We raise the question of what observational studies are actually assessing when they measure breastfeeding. Is it a measure of early-life nutrition, or is it possibly a proxy for imperceptible family traits and healthy family habits [185]? To gain new knowledge on breastfeeding and later OWOB, we need studies that adjust properly for possible residual confounding factors, including comparable groups of breastfed and formula-fed infants.

Adolescent habits of nutrition and exercise

We did not reveal any association between consumption of SCCS and SSS. This result was in contrast to earlier studies that found that children with lower maternal education consumed more sugar-sweetened beverages, and also that sugar-sweetened beverages mediated the association between sociodemographic affiliation and BMI in adolescents [186, 187]. SCCS have been found as an important risk factor for weight gain in adolescents globally [188]. The lack of nutritional value and absent satiety signal leads to that the consumption of SCCS represent consumption of excess energy [186]. It is also seen as a proxy of unhealthy nutrition associated with a higher energy intake and a poorer diet with lower consumption of calcium and other nutrients [189]. A

diet high in sugar has also been found in Norwegian adolescents, as only 19% met the dietary recommendation of limiting sugar-added products in their diet in a relatively recent study [190].

A possible mechanism behind the nonsignificant association between SCCS and BMI in our study, can be that the sales-numbers for SCCS has declined the last decade. Simultaneously, the sales numbers for sugar-free carbonated sodas have inclined and now reveal comparable numbers to the SCCSs [191]. Therefore, SCCS may no longer be a main driver of the obesity epidemic. This trend for decreasing consumption of SCCS is also revealed in our data. Another possible explanation is the challenges in the estimation of energy intake and nutrition in children and adolescents [192]. Finally, the use of a non-validated nutrition questionnaire may also have biased the findings.

We found an association between SSS and weekly hours of leisure-time exercise. This finding is supported by an earlier meta-analysis by Quon and colleagues that encompassed studies of adolescents in the age group 12–19 years [193]. Former studies regarding the possible mediation of the association between sociodemographic affiliation and BMI have revealed both significant and inconclusive results [187, 194].

In Norway, 70% of adolescents participate in organized leisure-time sports at 14–15 years of age, and more adolescents with higher sociodemographic affiliation have been found to participate in leisure-time sport activities [195, page 38]. To maintain a healthy BMI, increasing exercise is inferior to decreasing the intake of nutrition high in calories. Nevertheless, exercise may have a positive influence on indices of adolescent mental health and cognitive function [196]. Exercise in adolescents is also an important arena for developing cognitive, social, emotional and psychomotor skills [197]. Thus, the role of exercise is broader than maintaining healthy weight in adolescence and should also be interpreted within this wider frame.

Unhealthy behaviors in adolescent years

We found that cigarette smoking, snuff-use, and alcohol drinking were correlated, as previously found [72]. Fleary [74] studied a broader set of unhealthy behaviors in adolescence which included cigarette smoking, alcohol drinking, substance use, violent behaviors, consumption of fruits and vegetables, and exercise. The author concluded that unhealthy and problem behaviors coexisted as a combined continuum ranging from healthy behavior at one end to health-risk behavior at the other [74]. Adolescent behavioral patterns also underline the importance of exploring these behaviors as a single group: Their behaviors are unlike those of children and adults, and adult health-related habits are often established in adolescence. Thus, more knowledge on adolescent behavioral patterns seems like a foundation for the prevention of adult OWOB.

We found that lower SSS was associated with the latent variable consisting of cigarette smoking, snuff-use, and alcohol drinking. Patterns of behaviors linked to sociodemographic

affiliation in adolescence are challenging to elucidate fully due to influences from both family and peers. An example is that cigarette smoking in adolescents is under the shared influence of parental sociodemographic affiliation and peers [55]. A systematic review of cigarette smoking, unhealthy nutrition, alcohol consumption, and less exercise in adolescents and adults found a clustering pattern within lower sociodemographic affiliation, and also with younger age [198]. The opposite finding was done in a meta-analysis that did not find SSS related to cigarette smoking, alcohol consumption, or drug use in adolescence [193].

Our finding that the latent variable mediated the association between SSS and BMI can contribute to our understanding of this association in adolescence. We relate the finding to the relative differences in sociodemographic status frequently found in high-income countries with low poverty [50]. In these societies, the sociodemographic affiliation also reflects capabilities or resources that influence health-related outcomes [50]. Cigarette smoking, snuff use, and alcohol drinking are not directly attached to an energy surplus. Still, they can be seen as an indirect measure of how sociodemographic inequalities influence health-related decisions related to outcomes like BMI. This interpretation is further supported by that adolescent health-related behaviors have been suggested as influenced by social capital: Groups with higher sociodemographic affiliation adopt healthy behaviors, thereby promoting health and enhancing differences [55].

6.4.3. Mental health

The found association between peer problems and increasing BMI was supported by earlier studies, as OWOB adolescents have been found to have fewer friends, experience more friendship withdrawals, and to be more likely to make friends with other marginalized OW peers [199, 200]. These friendships can possibly also contribute to the surplus energy balance, as OW adolescents have been found to eat more when they are together with OW peers than when they are with normal weight peers [201]. Lower levels of exercise may also influence OWOB, since having fewer friends can lead to problems in engaging in physical activities typical for adolescents, such as team sports or social play [202].

The association can also be assessed in the opposite direction, as OWOB in children and adolescents is considered stigmatizing [78]. Peer problems can result from stigmatizing, and thereby influence mental health [203]. Moreover, our found association between peer-problems in girls and increased BMI can possibly be related to the finding that stigmatization due to OW is a more common problem in girls than in boys [204]. A review also found that females are more influenced by weight stigma than men, and that this association partly accounts for the gender disparities in mental disorders in persons with OWOB [84].

We found that gender modified the relationship between mental health problems and increased BMI. The gender-related pattern in our study was in line with earlier studies of mental health problems, as conduct problems are more commonly found in boys and depression more commonly in girls [205]. Emotional problems and conduct problems have been linked to increased BMI through food intake as a form of comfort and due to impulsive eating behavior [73, 206].

Our finding of a gender-related pattern can be interpreted through the finding of girls and boys answering the SDQ differently: For several items, girls and boys with equal levels of problems did not reveal these in a similar manner when answering the questions [207]. Accordingly, it is possible that girls and boys answer the SDQ in a gender-related pattern, but we also consider it possible that symptoms of mental health problems associated to OWOB differ between the genders.

Several studies have found both conduct problems and depression in childhood related to OWOB in adult life [208-210]. We thus consider our finding of relevance, and that it also adds additional information to the gender-related associations between mental health and increased BMI in adolescents.

In general, some challenges exist in revealing more of the association between mental health and increased BMI in children and adolescents. First, the prevalence of both OWOB and depression has increased simultaneously over the last decades, and second, both OWOB and mental health problems display a higher prevalence in groups of lower sociodemographic affiliation. [77, 211-213]. Thus, it is challenging to study these disorders independently.

In this context, it is important to keep in mind that most OWOB adolescents do not have mental health problems, but health professionals including school nurses should pay attention to the suggested association between mental health problems and OWOB. Additionally, the symptoms of mental health problems related to OWOB can possibly differ for girls and boys. Furthermore, they should be aware that the connections between mental health problems and OWOB also exist outside the stereotypes of gender-related behavior.

6.4.4. Tracing the epidemiologic transition in our study

The percentage that reported healthy habits was higher in 2017 than in 2002. In 2002, 62% of the sample answered "never smoked", compared to 87% in 2017. Furthermore, 44% participated in organized leisure-time sports in 2002, compared to 57% in 2017. While 38% drank SCCS daily in 2002, only 13% did in 2017. The percentage of adolescents planning a higher education increased from 47% in 2002 to 61% in 2017. In contrast, the number of adolescents that had sought help for mental health problems increased from 5–13% from 2002–2017. The prevalence of OWOB also

increased significantly from 9–14% in girls and insignificantly from 17–20% in boys. These findings can be interpreted in several ways.

Besides the discussed biological possibility that the cohort of adolescents born in 2001 can be affected by being born in a period with increased birthweights [155], another possible understandings include that the observed change may be an illustration of the general unhealthy environment of modern society . The easier access to energy-dense foods and drinks high in sugars, and also increased food intake is discussed in several publications [73, 88, 188]. This change is described by the epidemiological transition [87, 92, 93]. Thorough this view, the reported healthier habits may mirror an attempt to make healthier choices, which is hampered by easy access to unhealthy snacks, eating outside of meals, and larger portions leading to higher food consumption [73]. If the reports by the adolescents are accepted as absolutely true, the frames within which adolescents make their health-related choices are not ideal. It may seem that the environment surrounding adolescents supports weight gain rather than weight loss [214].

A higher prevalence of OWOB and more mental health problems were also reported. This finding was in line with other studies in adolescents, suggesting that mental health problems and OWOB are currently the main contributors to the global disease burden in adolescents [215, 216]. An ongoing debate is considering whether we are experiencing a trend with ambitious, stressed adolescents and a subsequent increasing prevalence of mental health problems or if the adolescents have a larger willingness to report symptoms [217]. Uncovering the contemporary trends in health indices in the adolescent population is important to prioritize the resources within the health system.

6.4.5. Prevention of OWOB in children and adolescents

No effective long-term treatment for OWOB in children and adolescents has been established [124]. Furthermore, it has been stated that the global increase in OWOB is just a "normal reaction to an abnormal environment" [88]. Thus, prevention seems to be a more appropriate approach.

The epidemiologist Rose addressed prevention strategies and indicated that a given prevention should aim to target the whole population [218]. This approach can further be divided into so-called *superficial solutions*, with people being encouraged to act on provided health information, and *radical solutions*, with changes in the context within which the behavior occurs. An example of the latter is fluoridation of drinking water for the prevention of dental caries [219].

Studies have found that groups with proper social and economic resources often adhere more to *superficial solutions* compared to other groups, whereas *radical solutions* are found to have equal results in groups of different sociodemographic affiliations [219-221]. The most familiar example of a radical solution to a public health problem was the act relating to the prevention of the harmful effects of tobacco from 2004 [222]. In Norway, this act has been given

credit for reducing the percentage of adolescent daily smokers from 11 to 0.4% from the mid-1990s to the mid-2010s [42, 223].

An ongoing debate of radical vs. superficial interventions to prevent and reduce OWOB, can be used to illustrate the Norwegian government´s current policy. This summer, there has been a debate in Norway following a UK government initiative to reduce obesity levels. This initiative includes restricting advertising for unhealthy food to prevent children and adolescent OWOB [224]. The debate in Norway included the possibility of introducing a similar restriction. The reply from the Minister of Health was that this suggestion had been looked into in 2013, with potential unwanted consequences like e.g., that a producer of sugar-containing juice could not be the sponsor of a local childrens`s sports-team. The Minister of Health also claimed that the government has used other means than to draft legislations, to reach the goal of obesity reduction [225]. However, it will probably be up for debate in the future, if this goal can be reached without further debating such initiatives.

6.4.6. OWOB in children and adolescents in Norway

Adolescent health is closely related to structural factors of national wealth, inequalities in income, and access to education in a given country [67]. Norway is a high-income country as well as an egalitarian welfare state with free access to education for everyone [226]. Why is lower sociodemographic affiliation a risk factor for OWOB in Norwegian adolescents? A possible interpretation can be made through the discussed epidemiologic transition, which has resulted in an obesity enhancing environment with unhealthy foods and snacks being highly available. It is easy to think that we are all equally exposed, but most likely, this is not true. Those with higher sociodemographic affiliation live in neighborhoods where, e.g., the adolescents cannot choose to eat their school lunch at the local fast-food restaurant, and they have better opportunities to ride their bikes to school and several places to engage in sports activities. Furthermore, their friends probably also participate in physical activities, making these groups attractive to join. Hereby, they become part of networks with attitudes directed towards healthy habits regarding exercise, nutrition, and avoidance of cigarette smoking, snuff use, and alcohol drinking.

A problematic, but unavoidable, question remains: How can we help children and adolescents respond in a healthy way to this obesity enhancing environment? The best advice may be to try to connect to healthy networks based on peers, family, or leisure-time activities, as both attitudes and behaviors are found to spread through these networks [55, 227].

Lower sociodemographic affiliation is an established risk factor for OWOB. Thus, the first principle of conducting public health reforms in Norway, neutralizing class differences, seems an appropriate approach in the holistic picture of how to reduce the sociodemographic inequalities in health [99]. This point is further supported through the view of inequalities in health being a result

of a hierarchical society where the most privileged will always use their resources to gain health [228].

7. Future research

OWOB in children and adolescents is a crisis in public health, which makes a strong argument in favor of more research in the field [2].

An interesting approach could be to do a longitudinal study of the intergenerational inheritance of OWOB. Many health-related habits are established in adolescence, and if more healthy habits and a healthy weight were established prior to pregnancy, this could theoretically lead to fewer risk factors for childhood OWOB in the next generation [67]. Interventions should preferably consist of more than one behavioral change to obtain lasting differences. Most important would be to impart healthy attitudes towards nutrition, exercise, but also towards mental health and education. Such an intervention should target everyone, as it would prevent stigmatization and not increase inequalities in health due to sociodemographic affiliation [219].

Two more far-fetched projects could be suggested: one would be to explore whether there is a biological foundation for gender-related differences in OWOB. Another project could examine how the body guards the highest level of excess weight and if there is a way to "reset" this mechanism.

The data on which we base our knowledge of childhood and adolescent OWOB should also be better. For adolescents, we rely mostly on regional data with a possibility for uncertain external validity. For children, the data were collected through the Child Growth Study of Norway in 127 schools from 10 of the former 19 counties in Norway [229]. The percentage of participation was 72% in the first two rounds [230, 231]. The participants change in each round, but the environments are similar, and it could be intriguing to see if the numbers are comparable to those from other samples with a wider age range and if adolescents are also included. More information could also be gathered if cohort designs were used.

8. Conclusion

We did not reveal any association between breastfeeding in infancy, interpreted as parental health-related behavior, and OWOB in eight-year-old children. For adolescents, we found that health-related behaviors were associated with OWOB as a mediator between subjective sociodemographic status and BMI in adolescents. This health-related behavior included cigarette smoking, snuff use, and alcohol drinking in addition to exercise. We found gender-related patterns, as the BMI distribution in 15–16-year-old adolescent girls in Oppland county had shifted to the right when comparing data from 2002 and 2017. Further, the gender-related pattern was also found in the association between mental health problems and OWOB in adolescents. We conclude that these patterns in adolescent OWOB can enwiden our understanding of the epidemiology of OWOB, if further explored. We also see the association between SSS and OWOB as a result of the epidemiological transition during the last decades. Thus, our results imply that no single risk factor can be identified and eliminated to reduce the prevalence of OWOB, and the risk factors of child and adolescent OWOB therefore, should be interpreted within their behavioral and sociodemographic context.

9. Perspectives

9.1. Clinical implications

- Clinicians should interpret the OWOB child or adolescent in the light of the population they belong to. This will give important information considering risk factors for OWOB.
- Both the complex associations connecting lower sociodemographic affiliation to increased BMI, but also the possibility of altering the modifiable behaviors should be communicated in clinical practice. This information can increase the adolescent awareness regarding health-related choices, but also motivate OWOB adolescents and their caregivers.
- There is a need to be aware that mental health problems associated with OWOB can appear differently in girls and boys.

9.2. Policy implications

- An epidemiological understanding of how an upwards shift in the mean value of BMI in a population influences the values in the upper parts of the BMI-distribution should be communicated to policymakers.
- This information could build a foundation for understanding the importance of the need for more radical prevention solutions in public health.
- Such prevention efforts are important to facilitate healthy choices without increasing the social inequalities in health.

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Appendix

Vekst og Helse blant barn i Oppland
Samarbeid mellom helsestasjonene og barnepoliklinikkene i Gjøvik og Lillehammer

+

Skjemaet fylles ut av pårørende og gis til helsesøster.
NB! Skriv tydelig og pass på at kryssene står inne i avkrysningsboksene!

Barnets navn:_____ Fødselsdato: ☐☐ ☐☐ ☐☐

Mors navn:_____

Adresse:_____   +

Mors fødselsnummer: ☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐☐☐

1. Hvor ble barnet født?
   ☐ Gjøvik sykehus   ☐ Lillehammer sykehus   ☐ Ringerike sykehus   ☐ Annet; Hvor?_____

2. Ble barnet født omtrent til ventet tid (innenfor 3 uker før og 2 uker etter termin)?
   ☐ Ja   ☐ Nei   ☐ Vet ikke

Hvis nei, hvor mange uker for tidlig/for sent? ☐☐ Uker for tidlig   ☐☐ Uker for sent

3. Hva var fødselsvekten? ☐☐☐☐ gram

4. Har barnet noen gang vært innlagt i sykehus?
   ☐ Nei
   ☐ Ja; i så fall: Hvor mange ganger ☐☐ ganger   +

5. Hvis barnet har vært innlagt i sykehus, skriv årsaken til at barnet har vært innlagt og hvor gammelt barnet da var:

Opphold Nummer	Årsak til innleggelse	Alder i hele år	Ikke skriv her ICP
1			
2			
3			
4			

Spørsmål om lungefunksjonen

6. Har barnet noen gang (etter nyfødtperioden) hatt tung pust piping/surkling/tetthet i brystet? *Kryss av for det alternativet du mener passer best.*

☐ Ja; Hvis ja
  ☐ Bare før, men ikke etter 2 års alder
  ☐ Både før og etter 2 års alder
  ☐ Bare etter 2 års alder
☐ Nei, aldri; *hvis nei, gå til spørsmål 11*

7. Har barnet hatt tung pust eller piping/surkling/tetthet i brystet i løpet av de siste 12 månedene?

☐ Ja
☐ Nei; *hvis nei gå til spørsmål 11*

8. Hvor mange anfall med tung pust eller piping/surkling/tetthet i brystet har barnet hatt i løpet av de siste 12 månedene?

☐ Ingen
☐ 1 til 3
☐ 4 til 12
☐ mer enn 12   +
☐ har slike plager hele tiden

9. **Hvor ofte har barnets søvn i gjennomsnitt blitt forstyrret på grunn av piping/surkling/tetthet i brystet de siste 12 månedene?**

☐ aldri våknet
☐ mindre enn 1 natt pr uke
☐ 1 eller flere netter pr uke

10. **Har piping/surkling/tetthet i brystet eller tung pust vært så alvorlig de siste 12 måneder at barnet har hatt problemer med å snakke slik at han/hun bare kunne si ett eller to ord mellom hvert pust?**

☐ Ja
☐ nei

11. **Har barnet noen gang hatt astma?**

☐ Ja
☐ nei

12. **Har barnet i løpet av de siste 12 måneder hatt tung pust eller piping/surkling/tetthet i brystet under eller etter fysisk trening, aktiv lek eller mosjonering?**

☐ Ja
☐ nei

13. Har barnet i løpet av <u>de siste 12 måneder</u> hatt tørr hoste om natten, utenom hoste i forbindelse med forkjølelse eller andre luftveisinfeksjoner?

☐ Nei
☐ Ja, noen ganger   +
☐ Ja, hele tiden

14. Har barnet noen gang brukt astmamedisiner?
Antibiotika/penicillin ved lungebetennelse og bronkitt regnes ikke med.

☐ Nei, barnet har aldri brukt slike medisiner (se nedenfor)
☐ Ja, barnet brukte slike medisiner før 2 års alder, men ikke senere
☐ Ja, barnet brukte slike medisiner etter 2 år, men ikke nå lenger
☐ Ja, barnet bruker fortsatt medisiner, i så fall hvilke:
  ☐ Inhalasjonssteroider (Flutide, Pulmicort, Becotide, Seretide, Symbicort); i så fall brukes disse fast eller i perioder?
    ☐ fast daglig   ☐ bare i perioder med forkjølelse eller tung pust
  ☐ Anfallsmedisiner (Efedrin, Ventolin, Bricanyl, Airomir, Oxis, Serevent, Atrovent)
    ☐ fast daglig   ☐ bare ved tung pust eller før anstrengelse
  ☐ Singulair
  ☐ Andre lungemedisiner, skriv ned hvilke: _____

15. Har barnet noen gang hatt episoder med <u>lungebetennelse</u> eller <u>bronkitt</u> som har blitt behandlet med penicillin eller andre antibiotika?

☐ Nei
☐ Ja. I så fall;
Omtrent hvor mange ganger før 2 års alder *(sett 0 for ingen?)*

☐☐ ganger

Omtrent hvor mange ganger fra 2 års alder til for 12 mndr siden?

☐☐ ganger

Omtrent hvor mange ganger siste 12 måneder

☐☐ ganger

16. Hvor mange ganger har barnet fått penicillin eller andre antibiotika for andre sykdommer enn lungesykdommer? *Skriv 0 dersom ingen*

☐☐ ganger

Spørsmål om andre sykdommer

17. Har, eller har barnet hatt atopisk (kløende) eksem?
  ☐ Nei   ☐ Ja, tidligere   ☐ Ja, fortsatt   +
18. Har, eller har barnet hatt, høysnue?
  ☐ Nei   ☐ Ja, tidligere   ☐ Ja, fortsatt
19. Har, eller har barnet hatt, andre allergiske sykdommer?
  ☐ Nei   ☐ Ja; tidligere   ☐ Ja, fortsatt

Beskriv i så fall:_____
_____
_____

20. Bruker barnet briller? ☐ Nei ☐ Ja; hva er styrken?_____
21. Skjeler barnet? ☐ Nei ☐ Ja; behandling?_____
22. Er barnet nærsynt eller langsynt? ☐ Nei ☐ Ja; hva?_____
23. Har barnet andre synsproblemer? ☐ Nei ☐ Ja; hva?_____
24. Har barnet fått påvist nedsatt hørsel? ☐ Nei ☐ Ja; Årsak?_____
  Hvis ja; bruker barnet høreapparat? ☐ Nei ☐ Ja
25. Har, eller har barnet hatt dren i ørene?
  ☐ Nei ☐ Ja; tidligere ☐ Ja, fortsatt
26. Har barnet fått fjernet falsk mandel (polypp, adenoid) ☐ Nei ☐ Ja
27. Har barnet fått fjernet mandlene? ☐ Nei ☐ Ja
28. Har/har barnet hatt hull i tennene? ☐ Nei ☐ Ja
29. Har barnet en medfødt funksjonshemning (f.eks. Downs syndrom, cerebral parese e.l.)? ☐ Nei ☐ Ja, Hvis ja, beskriv:
_____
_____

30. Har, eller har barnet hatt, andre kroniske sykdommer som ikke er nevnt ovenfor (f.eks. cøliaki, diabetes? ☐ Nei ☐ Ja; tidligere ☐ Ja, fortsatt
Beskriv i så fall:_____
_____

Spørsmål om ernæring

31. Har barnet vegetarisk kosthold?   ☐ Nei ☐ Ja
  Hvis <u>ja;</u> spiser hun/han melkeprodukter eller egg? ☐ Nei ☐ Ja

32. Hvordan vil du beskrive hvor flink barnet er til å spise?
(Fyll ut alle aktuelle rubrikker)
☐ Normalt flink til å spise
☐ Spiser lite, vanskelig å få til å spise (småspist)   +
☐ Vansker med å spise/svelge klumper og fast mat
☐ Liker bare enkelte ting; i så fall: Hva vil han/hun ikke spise? _____

☐ Har for god matlyst, må forsøke å begrense inntak
☐ Vet ikke/ har ingen bestemt mening om dette

33. Hvor ofte pleier barnet å spise følgende måltider i løpet av en uke?

	Aldri/ sjelden	1 gang i uken	2 ganger i uken	3 ganger i uken	4 ganger i uken	5 ganger i uken	6 ganger i uken	7 ganger i uken
Frokost	☐	☐	☐	☐	☐	☐	☐	☐
Formiddags-mat/lunsj	☐	☐	☐	☐	☐	☐	☐	☐
Middag	☐	☐	☐	☐	☐	☐	☐	☐
Kveldsmat	☐	☐	☐	☐	☐	☐	☐	☐

34. Hvor mange ganger i uken spiser eller drikker barnet ditt noe av dette?

	Aldri	Sjeldnere enn 1 gang pr. uke	En gang pr. uke	2-4 dager i uken	5-6 dager i uken	En gang hver dag	Flere ganger hver dag
a) frukt	☐	☐	☐	☐	☐	☐	☐
b) grønnsaker	☐	☐	☐	☐	☐	☐	☐
c) godterier med sukker (drops, sjokolade, smågodt o.l)	☐	☐	☐	☐	☐	☐	☐
d) Cola, brus eller andre leskedrikker med sukker	☐	☐	☐	☐	☐	☐	☐
e) fast food (hamburger, pølser og lignende)	☐	☐	☐	☐	☐	☐	☐

35. Ble barnet ammet som spedbarn/småbarn?
☐ Ja   ☐ Nei   ☐ Vet ikke

I tilfelle ja, hvor lenge fikk barnet <u>bare</u> morsmelk uten annet tillegg enn tran/vitaminer?

☐☐ uker *eller*   ☐☐ måneder   ☐ vet ikke

Hvis du ga morsmelk, hvor gammelt var barnet da du <u>*helt sluttet*</u> å amme som tillegg til annen mat?

☐☐ uker *eller*   ☐☐ måneder   ☐ vet ikke

36. Hva synes du om barnets kropp?
☐ Altfor tynn
☐ Litt for tynn
☐ Omtrent passe   +
☐ Litt for tykk
☐ Altfor tykk

Spørsmål om aktivitet, ferdigheter og utvikling

37. Hvor utholdende er barnet i lek og aktivitet?
☐ Holder følge med jevnaldrende barn i lek og aktivitet
☐ Litt mindre utholdende enn jevnaldrende barn
☐ Mye mindre utholdende enn jevnaldrende barn

38. Hvordan oppfatter du barnets fysiske ferdigheter (grovmotorikk)?
(F.eks. løpe, hoppe, sparke ball, sykle o.s.v.?)
☐ Mer "klønete" eller umoden i sine ferdigheter
☐ Lik jevnaldrende
☐ Flinkere enn de fleste jevnaldrende

39. Hvor aktiv synes du barnet er i lek, sport o.l?
☐ Meget aktiv, mer enn gjennomsnitt for andre av samme kjønn og alder
☐ Vanlig aktiv, omtrent som gjennomsnitt for andre av samme kjønn og alder
☐ Lite aktiv, mindre enn gjennomsnitt for andre av samme kjønn og alder

40. Hvor ofte driver barnet med sport eller leker så aktivt at han/hun blir andpusten og /eller svett?
☐ aldri   ☐ mindre enn en gang i måneden   ☐ 1-3 ganger i måneden
☐ en gang i uka   ☐ 2-3 ganger i uken   ☐ 4-6 ganger i uka   ☐ hver dag

41. Hvor mange timer i uka driver barnet med sport eller leker så mye at han/hun blir andpusten og/eller svett?

☐ ingen   ☐ omtrent ½ time   ☐ omtrent 1 time
☐ omtrent 2-3 timer   ☐ omtrent 4-6 timer   ☐ 7 timer eller mer

42. Hvor mange timer gjennomsnittlig sitter barnet daglig foran TV (TV, DVD, video, TV-spill) og/eller foran PC'en?

☐ ikke i det hele tatt   ☐ mindre enn en ½ time om dagen
☐ 1/2-1 time   ☐ 2-3 timer   ☐ 3-4 timer   ☐ mer enn 4 timer

43. Har barnet TV inne på soverommet?

☐ ja   ☐ nei

44. Hvordan oppfatter du barnets ferdigheter med hendene?
(F.eks. tegne, klippe, bygge med Lego o.s.v.?)

☐ Mer "klønete" eller umoden i sine ferdigheter enn jevnaldrene
☐ Lik jevnaldrende
☐ Flinkere enn de fleste jevnaldrende

45. Hvordan vil du beskrive barnets språk i dag?
(Velg det alternativet du synes passer best).

☐ Barnet snakker bedre enn vanlig for jevnaldrende barn
☐ Barnet snakker like godt som andre jevnaldrende barn
☐ Barnet har samme ordforråd som andre, men dårligere uttale
☐ Barnet har mindre ordforråd, men god uttale
☐ Barnet har både mindre ordforråd og dårligere uttale
☐ Barnet har ikke, eller svært lite, språk

46. Har barnet etter 2 års alder hatt behov for spesielle hjelpetiltak som kontakt med:
(Kryss av for alle aktuelle faggrupper).

Fysioterapeut	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
Logoped	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
Ekstra støttetiltak i barnehagen	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
PPT (Pedagogisk psykologisk tjeneste)	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
Psykolog/psykiater	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
Barne- og ungdoms-Psykiatrisk (BUP)	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag
Fylkets habiliteringstjeneste	☐ Nei	☐ ja, tidligere	☐ ja, fortsatt i dag

47. Har barnet gått i barnehage siden 2 års alder?

☐ Nei
☐ I barnehage tidligere, men ikke nå;
Hvor lenge i barnehagen? ☐ år og ☐ mndr

☐ Går fortsatt i barnehage, og har gått hvor lenge? ☐ år og ☐ mndr

48. Hvordan fungerer barnet sammen med andre barn, for eksempel i barnehagen?

☐ Barnet skiller seg ikke fra andre jevnaldrende barn
☐ Barnet har samspillvansker med andre barn
Hvis samspillvansker, angi hvordan *(flere rubrikker kan krysses av):*
☐ Barnet plages av andre barn, føler seg utenfor, sky og isolert
☐ Barnet er aggressivt, urolig og plager andre barn
☐ Barnet mistrives, føler seg utenfor og isolert, uten å plage andre
☐ Andre vansker i samspill med andre; vennligst beskriv disse:_____

Spørsmål om søvn

49. Har barnet noen ganger hatt søvnvansker (flere rubrikker kan fylles ut)?

☐ Aldri hatt søvnvansker av betydning
☐ Søvnvansker før 2 års alder
☐ Søvnvansker etter 2 år, men ikke siste 1 år
☐ Fortsatt søvnvansker

50. Hvis barnet har hatt søvnvansker etter 2 års alder eller fortsatt har søvnvansker, hvordan vil du beskrive disse *(flere rubrikker kan merkes):*

☐ Vansker med å legge seg til å sove om kvelden
☐ Våkner i løpet av natten
☐ Våkner uvanlig tidlig
☐ Våkner uvanlig sent
☐ Andre søvnvansker; beskriv: _____

Avføring og vannlatning

51. Tisser barnet på seg om dagen?

☐ Nei   ☐ Sjeldnere enn 1 g/uke   ☐ Ca 1-3 ggr/uke   ☐ Oftere

52. Tisser barnet på seg om natten?

☐ Nei   ☐ Sjeldnere enn 1 g/uke   ☐ Ca 1-3 ggr/uke   ☐ Oftere

53. Får barnet avføring i bukse/bleie om dagen?

☐ Nei   ☐ Sjeldnere enn 1 g/uke   ☐ Ca 1-3 ggr/uke   ☐ Oftere

54. Får barnet avføring i bukse/bleie om natten?

☐ Nei   ☐ Sjeldnere enn 1 g/uke   ☐ Ca 1-3 ggr/uke   ☐ Oftere

55. Hvor ofte har barnet avføring?

☐ Mer enn 1-2 ggr/dag   ☐ 1-2 ggr/dag   ☐ Ca 1-2 ggr/uke   ☐ Sjeldnere

56. Hvordan er avføringen?

☐ Normalt formet   ☐ Løs   ☐ Hard

Litt om familien

57. Hvor mange søsken eller halvsøsken har barnet?

☐ søsken/halvsøsken

For helsøsken: Oppgi alder, kjønn, høyde og vekt:

Søsken nr. 1: ☐ år og ☐ mndr: ☐ gutt ☐ jente
Høyde ☐ cm   Vekt ☐ kg

Søsken nr. 2: ☐ år og ☐ mndr: ☐ gutt ☐ jente
Høyde ☐ cm   Vekt ☐ kg

Søsken nr. 3: ☐ år og ☐ mndr: ☐ gutt ☐ jente
Høyde ☐ cm   Vekt ☐ kg

Søsken nr. 4: ☐ år og ☐ mndr: ☐ gutt ☐ jente
Høyde ☐ cm   Vekt ☐ kg

58. Hva er foreldrenes høyde og vekt:

Mors høyde ☐ cm   Mors vekt ☐ kg
Fars høyde ☐ cm   Fars vekt ☐ kg

59. Hvem bor barnet sammen med til daglig?

☐ Mor og far
☐ Bare mor
☐ Bare far
☐ Både mor og far, men hver for seg (for eksempel en uke hos hver)
☐ Mor og ny partner (stefar)
☐ Far og ny partner (stemor)
☐ Fosterforeldre
☐ Andre, hvem:_____

60. Spørsmål om spesielle sykdommer i familien

Har, eller har noen hatt, astma?
     ☐ Ingen ☐ Ja, mor ☐ Ja, far ☐ Ja, søsken
Har, eller har noen hatt, høysnue?
     ☐ Ingen ☐ Ja, mor ☐ Ja, far ☐ Ja, søsken
Har, eller har noen hatt, atopisk eksem?
     ☐ Ingen ☐ Ja, mor ☐ Ja, far ☐ Ja, søsken
Har, eller har noen hatt atferdsvansker vansker med konsentrasjon, lærevansker (ADHD o.l)
     ☐ Ingen ☐ Ja, mor ☐ Ja, far ☐ Ja, søsken

61. Røyker foreldre eller omsorgspersoner *(fyll ut alle aktuelle)?*

☐ Nei, verken mor eller far eller andre omsorgspersoner
☐ Ja, mor
☐ Ja, far
☐ Ja, samboer av mor eller far
☐ Ja, andre som bor i huset

62. Røykes det inne i huset?

☐ Nei   ☐ Ja

63. Hva er høyeste fullførte utdanning for mor og far?
(Hvis dere for tiden holder på med en utdannelse, så kryss av denne)

MOR:
☐ 9-årig skole (ungdomsskole)
☐ 9-årig skole + 1-2 års videregående skole
☐ 9-årig skole + 3 år videregående skole (inkl. gymnas)
☐ Høyere utdanning, for eksempel distriktshøgskole, sykepleierhøgskole, lærerhøgskole
☐ Høyere utdanning på universitetsnivå

Mors etniske bakgrunn: ☐ Opprinnelig norsk
☐ Utenlandsk, hvilken nasjon?_____

FAR:
☐ 9-årig skole (ungdomsskole)
☐ 9-årig skole + 1-2 års videregående skole
☐ 9-årig skole + 3 år videregående skole (inkl. gymnas)
☐ Høyere utdanning, for eksempel distriktshøgskole, sykepleierhøgskole, lærerhøgskole
☐ Høyere utdanning på universitetsnivå

Fars etniske bakgrunn: ☐ Opprinnelig norsk
☐ Utenlandsk, hvilken nasjon?_____

64. Hva er mors og fars yrkesmessige situasjon?
MOR:
☐ Fulltidsarbeidende (minst 30 t/u)
☐ Deltidsarbeidende (under 30 t/u)
☐ Arbeidsledig/på tiltak/arbeidssøkende
☐ Student/elev
☐ Hjemmearbeidende
☐ Trygdet/under attføring
☐ Annet

Mors yrke: _____

FAR:
☐ Fulltidsarbeidende (minst 30 t/u)
☐ Deltidsarbeidende (under 30 t/u)
☐ Arbeidsledig/på tiltak/arbeidssøkende
☐ Student/elev
☐ Hjemmearbeidende
☐ Trygdet/under attføring
☐ Annet

Fars yrke: _____

FYLLES UT AV HELSESØSTER
Vennligst før på barnets mål

+

Dato for undersøkelsen: ☐☐ ☐☐ ☐☐

Høyde : ☐☐ , ☐ cm

Vekt : ☐☐ , ☐ kg (veid med truse og eventuelt T-skjorte)

Hodeomkr : ☐☐ , ☐ cm

Helsestasjon: _____

Helsesøster: _____

+

+

+

Etikett

U **Helse–**
undersøkelsen

Dato for utfylling:

Dag	Måned	År

U1.   EGEN HELSE

1.1   Hvordan er helsen din nå? *(Sett bare ett kryss)*

Dårlig	Ikke helt god	God	Svært god
☐ 1	☐ 2	☐ 3	☐ 4

1.2   Har du, eller har du hatt? *(Sett ett kryss for hver linje)*

	JA	NEI
Astma	☐	☐
Høysnue (pollenallergi, allergisk reaksjon, rennende nese, svie i øynene)	☐	☐
Eksem	☐	☐
Diabetes (sukkersyke)	☐	☐

1.3   Har du de siste 12 mnd hatt? *(Sett ett kryss for hver linje)*

	JA	NEI
Ørebetennelse	☐	☐
Halsbetennelse *(minst 3 ganger)*	☐	☐
Bronkitt eller lungebetennelse	☐	☐
Psykisk plage som det er søkt hjelp for	☐	☐
Alvorlig skade eller sykdom	☐	☐

Hvis du svarte «JA»; hva slags alvorlig skade eller sykdom var dette:

_____

1.4   Har du følgende funksjonshemming?
(Sett ett kryss for hver linje)

	Nei	Ja, litt	Ja, mye
Bevegelseshemming	☐	☐	☐
Nedsatt syn	☐	☐	☐
Nedsatt hørsel	☐	☐	☐

1.5   Har du i løpet av de siste 12 mnd flere ganger vært plaget med smerter i? *(Sett ett kryss for hver linje)*

	JA	NEI
Hode (hodepine, migrene e.l.)	☐	☐
Nakke/skuldre	☐	☐
Armer/ben/knær	☐	☐
Mage	☐	☐
Rygg	☐	☐

Hvis du svarte «NEI» på alle spørsmålene under 1.5: Hopp til U2

1.6   Har disse smertene ført til at du har vært hjemme fra skolen?

Oppgi også ca. antall skoledager de siste 12 mnd:
(Sett bare ett kryss)

Nei	Ja, 1-2 dager	Ja, 3-5 dager	Ja, 6-10 dager	Ja, mer enn 10 dager
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

1.7   Har smertene ført til redusert aktivitet i fritida? ..... JA ☐   NEI ☐

U2.   TANNHELSE

2.1   Mener du at du har bedre eller dårligere tenner enn andre ungdommer på din alder? *(Sett bare ett kryss)*

Bedre	Som de fleste	Dårligere	Vet ikke
☐ 1	☐ 2	☐ 3	☐ 4

2.2   Bryr du deg om at du har fine tenner? *(Sett bare ett kryss)*

Ja, mye ☐ 1   Ja, litt ☐ 2   Nei ☐ 3

2.3   Hvor ofte pusser du tennene dine? *(Sett bare ett kryss)*

Flere ganger om dagen	En gang om dagen	Annenhver dag	Sjeldnere enn annenhver dag
☐ 1	☐ 2	☐ 3	☐ 4

2.4   Har du hatt tannverk på grunn av hull? *(Sett eventuelt flere kryss)*

Ja, men før jeg begynte på skolen	Ja, etter at jeg begynte på skolen	Nei, aldri	Vet ikke
☐	☐	☐	☐

U3.   MOSJON OG FYSISK AKTIVITET

3.1   Utenom skoletid: Hvor mange ganger i uka driver du idrett/mosjon slik at du blir andpusten eller svett? ☐☐ *ganger pr. uke*

3.2   Omtrent hvor mange timer pr. uke bruker du på dette?

0 timer	1-2 timer	3-4 timer	5-7 timer	8-10 timer	11 timer eller mer
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

3.3   Driver du med konkurranseidrett? ....   JA ☐   NEI ☐
(Individuelt eller på lag)

3.4   Bruker du naturen (skog og mark) til turer?

	Aldri	Ja, mindre enn 1 gang i måneden	Ja, 1 gang i måneden eller mer
Sommer:	☐ 1	☐ 2	☐ 3
Vinter:	☐ 1	☐ 2	☐ 3

3.5   Utenom skoletid: Hvor mange timer pr. skoledag (mandag til fredag) sitter du i gjennomsnitt foran TV, video og/eller PC (spill og internett)?

Inntil 1 time	1-2 timer	3-5 timer	Mer enn 5 timer
☐ 1	☐ 2	☐ 3	☐ 4

3.6   Hvordan kommer du deg normalt til skolen i sommerhalvåret? *(Sett bare ett kryss)*

Med buss/tog e.l. *(offentlig transport)*	☐ 1
Med bil/moped	☐ 2
På sykkel	☐ 3
Til fots	☐ 4

3.7   Hvor lang skolevei har du?

Mindre enn 2 km	2-4 km	Over 4 km
☐ 1	☐ 2	☐ 3

U4. RØYKING, RUSMIDLER OG DOP

4.1 Røyker du, eller har du røykt? *(Sett bare ett kryss)*

Nei, aldri	Ja, men jeg har sluttet	Ja, av og til	Ja, hver dag
☐ 1	☐ 2	☐ 3	☐ 4

Hvis du har svart «NEI, ALDRI»; hopp til pkt. 4.3

4.2 Hvor gammel var du da du begynte å røyke? ☐☐ år

4.3 Bruker du eller har du brukt snus, skrå eller lignende? *(Sett bare ett kryss)*

Nei, aldri	Ja, men jeg har sluttet	Ja, av og til	Ja, hver dag
☐ 1	☐ 2	☐ 3	☐ 4

4.4 Røyker noen av de du bor sammen med?
(Sett ett eller flere kryss)

Ja, mor	Ja, far	Ja, søsken	Ja, andre	Nei
☐	☐	☐	☐	☐

4.5 Har du noen gang drukket alkohol? ...... JA ☐ NEI ☐
(f.eks. alkoholholdig øl, rusbrus, vin, brennevin eller hjemmebrent)

Hvis du svarte «NEI»; hopp til pkt. 4.8

4.6 Har du noen gang drukket så mye alkohol at du har vært beruset (full)? *(Sett bare ett kryss)*

Nei, aldri	Ja, en gang	Ja, 2-3 ganger	Ja, 4-10 ganger	Ja, mer enn 10 ganger
☐	☐	☐	☐	☐

4.7 Omtrent hvor ofte har du i løpet av det siste året drukket alkohol? *(Sett bare ett kryss)*
(Lettøl og alkoholfritt øl regnes ikke med)

4-7 ganger i uka	2-3 ganger i uka	ca. 1 gang i uka	2-3 ganger pr. måned
☐ 1	☐ 2	☐ 3	☐ 4

Omtrent 1 gang i måneden	Noen få ganger siste år	Har ikke drukket alkohol siste år	Har aldri drukket alkohol
☐ 5	☐ 6	☐ 7	☐ 8

4.8 Har du noen gang prøvd dopingmidler? *(Sett bare ett kryss)*

Nei, aldri	Ja, en gang	Ja, flere ganger	Ja, jeg bruker det regelmessig
☐ 1	☐ 2	☐ 3	☐ 4

U5. MAT, DRIKKE OG SPISEVANER

5.1 Hvor ofte spiser du vanligvis disse matvarene?
(Sett ett kryss for hver linje)

	Sjelden /aldri	1-3 g. pr.mnd	1-3 g. pr.uke	4-6 g. pr.uke	1-2 g. pr.dag	3 g. el. mer pr.dag
Frukt, bær	☐	☐	☐	☐	☐	☐
Ost *(alle typer)*	☐	☐	☐	☐	☐	☐
Poteter	☐	☐	☐	☐	☐	☐
Kokte grønnsaker	☐	☐	☐	☐	☐	☐
Rå grønnsaker/salat	☐	☐	☐	☐	☐	☐
Feit fisk *(f.eks. laks, ørret, makrell, sild)*	☐	☐	☐	☐	☐	☐
Sjokolade/smågodt	☐	☐	☐	☐	☐	☐
Chips, potetgull	☐	☐	☐	☐	☐	☐
	1	2	3	4	5	6

U5. Mat, drikke og spisevaner (fortsettelse)

5.2 Hvor mye drikker du vanligvis av følgende?
(Sett ett kryss pr. linje)
(1/2 liter = 3 glass)

	Sjelden /aldri	1-6 glass pr.uke	1 glass pr.dag	2-3 glass pr.dag	4 glass el. mer pr.dag
Helmelk, kefir, yoghurt	☐	☐	☐	☐	☐
Lettmelk, cultura, lettyoghurt	☐	☐	☐	☐	☐
Skummet melk (sur/søt)	☐	☐	☐	☐	☐
Cola/brus med sukker	☐	☐	☐	☐	☐
Cola/brus «light»	☐	☐	☐	☐	☐
Fruktjuice	☐	☐	☐	☐	☐
Saft	☐	☐	☐	☐	☐
Vann	☐	☐	☐	☐	☐
	1	2	3	4	5

5.3 Hva slags fett bruker du oftest på brødet?
(Sett bare ett kryss)

Smør/hard margarin	Myk/lett margarin	Oljer	Bruker ikke
☐ 1	☐ 2	☐ 3	☐ 4

5.4 Hvor ofte spiser du disse måltidene en vanlig uke?
(Sett ett kryss for hver linje)

	Sjelden /aldri	1-2 ganger pr.uke	3-4 ganger pr.uke	5-6 ganger pr.uke	Hver dag
Frokost	☐	☐	☐	☐	☐
Formiddagsmat/matpakke	☐	☐	☐	☐	☐
Middag	☐	☐	☐	☐	☐
	1	2	3	4	5

5.5 Hvor mye penger bruker du i uka på snop, snacks, cola/brus og gatekjøkkenmat? *(Sett bare ett kryss)*

0-25 kr	26-50 kr	51-100 kr	101-150 kr	151-200 kr	over 200 kr
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

5.6 Bruker du følgende kosttilskudd:

	Ja, daglig	Iblant	Nei
Tran, trankapsler, fiskeoljekapsler?	☐	☐	☐
Vitamin- og/eller mineraltilskudd?	☐	☐	☐

5.7 Har du noen gang prøvd å slanke deg? *(Sett bare ett kryss)*

Nei, aldri	Ja, tidligere	Ja, nå	Ja, hele tiden
☐ 1	☐ 2	☐ 3	☐ 4

Hvis du svarte «NEI, ALDRI»; hopp til pkt. 5.9:

5.8 Hva har du gjort for å slanke deg?
(Sett ett kryss for hver linje)

	Aldri	Sjelden	Ofte	Alltid
Jeg spiser mindre	☐	☐	☐	☐
Jeg faster	☐	☐	☐	☐
Jeg trener mer	☐	☐	☐	☐
Jeg kaster opp	☐	☐	☐	☐
Jeg bruker avføringspiller eller vanndrivende midler	☐	☐	☐	☐
Jeg tar mettende eller sult-dempende piller	☐	☐	☐	☐

5.9 Hva veide du sist du veide deg? ☐☐☐ hele kg

5.10 Hvor høy var du sist du målte deg? ☐☐☐ hele cm

5.11 Hva synes du om vekta di? *(Sett bare ett kryss)*

Vekta er OK	Veier litt for mye	Veier alt for mye	Veier litt for lite	Veier alt for lite
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5.12 Jeg bryr meg mye om vekta mi. *(Sett bare ett kryss)*

Enig ☐   Litt enig ☐   Ikke enig ☐

5.13 Hvilken vekt ville du vært tilfreds med nå (din «trivselsvekt»)? ☐☐☐ hele kg

5.14 Har du noen gang vært til behandling for spiseforstyrrelser?

Nei	Nei, men jeg burde vært	Ja
☐ 1	☐ 2	☐ 3

U6. PÅKJENNINGER OG MESTRING

6.1 Under finner du en liste over ulike plager. Har du opplevd noe av dette den siste uken (til og med i dag)?
(Sett ett kryss for hver linje)

	Ikke plaget	Litt plaget	Ganske mye	Veldig mye
Plutselig frykt uten grunn	☐	☐	☐	☐
Føler deg redd eller engstelig	☐	☐	☐	☐
Matthet eller svimmelhet	☐	☐	☐	☐
Føler deg anspent eller oppjaget	☐	☐	☐	☐
Lett for å klandre deg selv	☐	☐	☐	☐
Søvnproblemer	☐	☐	☐	☐
Nedtrykt, tungsindig (trist)	☐	☐	☐	☐
Følelse av å være unyttig, lite verd	☐	☐	☐	☐
Følelse av at alt er et slit	☐	☐	☐	☐
Følelse av håpløshet mht. framtida	☐	☐	☐	☐
	1	2	3	4

6.2 Under finner du noen påstander.
(Sett ett kryss for hver linje)

	Helt galt	Nokså galt	Nokså riktig	Helt riktig
Jeg klarer alltid å løse vanskelige problemer hvis jeg prøver hardt nok	☐	☐	☐	☐
Hvis noen motarbeider meg, så kan jeg finne måter og veier for å få det som jeg vil	☐	☐	☐	☐
Hvis jeg har et problem og står helt fast, så finner jeg vanligvis en vei ut	☐	☐	☐	☐
Jeg føler meg trygg på at jeg ville kunne takle uventede hendelser på en effektiv måte	☐	☐	☐	☐
Jeg beholder roen når jeg møter vanskeligheter, fordi jeg stoler på mine evner til å mestre/få til ting	☐	☐	☐	☐
	1	2	3	4

6.3 Har du i løpet av de siste 12 mnd selv opplevd noe av følgende?
(Sett ett kryss for hver linje)

	JA	NEI
Foreldre (foresatte) har blitt arbeidsløse eller uføretrygdet	☐	☐
Alvorlig sykdom eller skade hos deg selv	☐	☐
Alvorlig sykdom eller skade hos noen som står deg nær	☐	☐
Dødsfall hos noen som sto deg nær	☐	☐
Seksuelle overgrep (f.eks. blotting, beføling, ufrivillig samleie m.m.)	☐	☐

6.4 Har du opplevd noe av følgende?
(Sett ett kryss for hver linje)

	Nei	Ja, av og til	Ja, ofte
Stort arbeidspress på skolen	☐	☐	☐
Stort press fra andre for å lykkes/gjøre det bra på skolen	☐	☐	☐
Store vansker med å konsentrere deg i timen	☐	☐	☐
Store vansker med å forstå læreren når hun/han underviser	☐	☐	☐

6.5 Har fagpersonell sagt at du har eller har hatt lese- og skrivevansker. *(Sett bare ett kryss)*

Ja, store	Ja, middels	Ja, lette	Nei
☐ 1	☐ 2	☐ 3	☐ 4

6.6 Har du i løpet av de siste 12 mnd. opplevd problemer med mobbing på skolen/skoleveien?
(Sett bare ett kryss)

Aldri	Av og til	Omtrent en gang i uka	Flere ganger i uka
☐ 1	☐ 2	☐ 3	☐ 4

U7. BRUK AV HELSETJENESTER

7.1 Har du de siste 12 mnd. selv brukt?:
(Sett ett kryss for hver linje)

	Ingen ganger	1-3 ganger	4 ganger eller mer
Skolehelsetjenesten	☐	☐	☐
Helsestasjon for ungdom	☐	☐	☐
Vanlig lege (Allmennpraktiserende lege)	☐	☐	☐
PP-tjenesten	☐	☐	☐
Psykolog eller psykiater (privat eller på poliklinikk)	☐	☐	☐
Familierådgivning	☐	☐	☐
Annen spesialist (privat eller på poliklinikk)	☐	☐	☐
Legevakt (privat eller offentlig)	☐	☐	☐
Sykehusinnleggelse	☐	☐	☐
Sosialtjenesten i kommunen	☐	☐	☐
Fysioterapeut	☐	☐	☐
Tannlege/skoletannlege	☐	☐	☐
Alternativ behandler	☐	☐	☐

U8. UTDANNING OG UTDANNINGSPLANER

8.1 Hva er den høyeste utdanning du har tenkt å ta?
(Sett bare ett kryss)

Universitet eller høyskoleutdanning av høyere grad ☐ 1
(F.eks. lektor, advokat, sivilingeniør, tannlege, lege, psykolog, siviløkonom)

Universitet eller høyskoleutdanning på mellomnivå ☐ 2
(F.eks. cand.mag., lærer, sosionom, sykepleier, politi, ingeniør, journalist)

Videregående allmennfaglig/økonomisk administrative fag ☐ 3

Yrkesfaglig utdanning på videregående skole ☐ 4
(kokk, frisør, byggfag, elektrofag, helse- og sosialfag o.l.)

Ett år på videregående skole ☐ 5

Annet: _____ ☐ 6

Har ikke bestemt meg ☐ 7

8.2 Hvor mye egne penger brukte du siste uke? kr ☐☐☐☐
(Småinnkjøp pluss større gjenstander som f.eks. musikkanlegg o.l.)

8.3 Har du lønnet arbeid i løpet av skoleåret? JA ☐ NEI ☐

Hvis du svarte «JA»:

Hvor mange timer i uka arbeider du? ca. ☐☐ hele timer

Hvor mye tjener du i gjennomsnitt pr. måned på dette arbeidet? kr ☐☐☐☐☐

8.4 Hvilken karakter fikk du siste gangen i karakterboken? *(Sett bare inn hele tallkarakterer)*

Matte	Norsk skriftlig	Engelsk	Samfunnsfag
☐	☐	☐	☐

U9. OPPVEKST OG TILHØRIGHET

9.1 Hvor lenge har du bodd i Norge? ☐☐ hele år

9.2 Hvor lenge har du bodd der du bor nå? ☐☐ hele år

9.3 Har du flyttet i løpet av de siste 5 årene? *(Sett bare ett kryss)*

Nei	Ja, en gang	Ja, 2-4 ganger	Ja, 5 ganger eller flere
☐ 1	☐ 2	☐ 3	☐ 4

9.4 Mine foreldre er: *(Sett bare ett kryss)*

Gift/samboere	Ugift	Skilt/separert	En eller begge er døde	Annet
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

9.5 Hvor er dine foreldre født?

	Norge	Annet land	Hvilket land:
Far:	☐	☐	Far: _____
Mor:	☐	☐	Mor: _____

U9. Oppvekst og tilhørighet (fortsettelse)

9.6 Jeg tror vår familie, sett i forhold til andre i Norge, har:
(Sett bare ett kryss)

Dårlig råd	Middels råd	God råd	Svært god råd
☐ 1	☐ 2	☐ 3	☐ 4

9.7 Er far og/eller mor i arbeid nå?

	Ja, heltid	Ja, deltid	Arbeidsløs/ trygdet	Hjemme-værende	Går på skole/ studerer	Død
Far:	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
Mor:	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

Hvis far og/eller mor er i arbeid, hvilket yrke har de?

Far:_____
Skriv kort hva han gjør på jobben:

_____

Mor:_____
Skriv kort hva hun gjør på jobben:

_____

U10. FAMILIE OG VENNER

10.1 Hvem bor du sammen med nå? *(Sett bare ett kryss)*
(Ta ikke med søsken og halvsøsken.)

Mor og far	Bare mor	Bare far	Omtrent like mye hos mor og far
☐ 1	☐ 2	☐ 3	☐ 4

Mor el. far og ny samboer el. ektefelle	Fosterforeldre	Andre
☐ 5	☐ 6	☐ 7

10.2 Hvor mange søsken eller halvsøsken bor du sammen med? *Antall søsken* ☐☐

10.3 Hvor mange av disse er like gamle eller eldre enn deg? *Antall søsken* ☐☐

10.4 Når du tenker på familien din, vil du si at:
(Sett ett kryss for hver linje)

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
Jeg føler meg knyttet til familien min	☐	☐	☐	☐
Jeg blir tatt på alvor i familien min	☐	☐	☐	☐
Familien legger vekt på mine meninger	☐	☐	☐	☐
Jeg betyr mye for familien min..............	☐	☐	☐	☐
Jeg kan regne med familien min når jeg trenger hjelp	☐	☐	☐	☐
	1	2	3	4

10.5 Hvilket forhold har du til dine foreldre?
(Sett ett kryss for hver linje)

	Stemmer meget godt	Stemmer ganske godt	Stemmer ikke særlig godt	Stemmer ikke i det hele tatt
Foreldrene mine vet hvor jeg er og hva jeg gjør i helgene..........	☐	☐	☐	☐
Foreldrene mine vet hvor jeg er og hva jeg gjør på hverdagene.....	☐	☐	☐	☐
Foreldrene mine vet hvem jeg er sammen med i fritida	☐	☐	☐	☐
Foreldrene mine liker vennene jeg er sammen med på fritida	☐	☐	☐	☐
	1	2	3	4

10.6 Når du tenker på vennene dine, vil du si at: *(Sett ett kryss for hver linje)*

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
Jeg føler meg nært knyttet til vennene mine.	☐	☐	☐	☐
Vennene mine legger vekt på mine meninger.	☐	☐	☐	☐
Jeg kan bidra/være til støtte for vennene mine.	☐	☐	☐	☐
Jeg kan regne med vennene mine når jeg trenger hjelp.	☐	☐	☐	☐
	1	2	3	4

10.7 Hvor mange personer utenfor din nære familie står deg så nær at du kan regne med å få hjelp hvis du:

Har personlige problemer *Antall personer* ☐☐

Har praktiske problemer *(f.eks. m/ skolearbeidet) Antall personer* ☐☐

10.8 Har du selv vært utsatt for vold (blitt slått, sparket e.l.) de siste 12 mnd.? *(Sett bare ett kryss)*

Aldri	Ja, bare av ungdom	Ja, bare av voksne	Ja, av både ungdom og voksne
☐ 1	☐ 2	☐ 3	☐ 4

U11. SEKSUELL ADFERD OG PREVENSJON

	Ja, med en partner	Ja, med flere partnere	Nei
11.1 Har du noen gang hatt samleie?	☐	☐	☐

Hvis du svarte «NEI»; hopp til U12

11.2 Alder første gang? .... Jeg var ☐☐ år

11.3 Brukte du/dere prevensjon ved siste samleie?

Nei	Ja, kondom	Ja, p-pille/p-sprøyte	Ja, annet	Vet ikke
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

	JA	NEI	Vet ikke
11.4 Har du noen gang blitt gravid/gjort ei jente gravid?	☐	☐	☐

Hvis du svarte «JA»;

Hvor gammel var du da dette skjedde? Jeg var ☐☐ år

	JA	NEI	Vet ikke
Ble det utført abort?	☐	☐	☐

U12. BRUK AV MEDISINER M.M

12.1 Hvor ofte har du i løpet av de 4 siste ukene brukt følgende medisiner? *(Sett ett kryss for hver linje)*
Med medisiner mener vi her medisiner kjøpt på apotek. Kosttilskudd og vitaminer regnes ikke med her.

	Aldri	Daglig	Hver uke, men ikke daglig	Sjeldnere enn hver uke	Ikke brukt siste 4 uker
Smertestillende uten resept	☐	☐	☐	☐	☐
Smertestillende på resept ...	☐	☐	☐	☐	☐
Allergi-medisin....................	☐	☐	☐	☐	☐
Astma-medisin	☐	☐	☐	☐	☐
Sovemedisin........................	☐	☐	☐	☐	☐
Beroligende medisin............	☐	☐	☐	☐	☐
Medisin mot depresjon........	☐	☐	☐	☐	☐
Annen medisin på resept	☐	☐	☐	☐	☐
	1	2	3	4	5

12.2 Skriv navnet på medisinene som du har krysset av for ovenfor, og hva grunnen var til at du tok medisinene (sykdom eller symptom):
(Kryss av for hvor lenge du har brukt medisinen)

Navn på medisinen: (ett navn pr. linje):	Grunn til bruk av medisinen:	Inntil 1 år	Ett år eller mer
		☐	☐
		☐	☐
		☐	☐

Dersom det ikke er nok plass her, kan du fortsette på eget ark som du legger ved.

SPØRSMÅL TIL JENTENE

	JA	NEI
12.3 Har du fått menstruasjon («mensen»)?................	☐	☐

Hvis du svarte «NEI»; hopp til 12.5

12.4 Hvor gammel var du da du fikk din første menstruasjon?

Jeg var ☐☐ år

12.5 Bruker du, eller har du brukt:
(Sett ett kryss for hver linje)

	Nå	Før, men ikke nå	Aldri
P-pille/minipille/ p-sprøyte	☐	☐	☐
Annen prevensjon	☐	☐	☐

Hvilken type prevensjon?:

_____

12.6 Til deg som bruker p-pille/minipille: Hvilket merke bruker du nå?:

_____

Etikett

B07114

U/T

Helse-
undersøkelsen
i Hedmark og Oppland

Dato for utfylling:
Dag   Måned   År

U/T1.   DINE STERKE OG SVAKE SIDER

1.1 Svar på grunnlag av slik du har hatt det de siste 6 månedene.
(Sett ett kryss for hver linje)

	Stemmer ikke	Stemmer delvis	Stemmer helt
Jeg prøver å være hyggelig mot andre. Jeg bryr meg om hva de føler........................	☐	☐	☐
Jeg er rastløs. Jeg kan ikke være lenge i ro	☐	☐	☐
Jeg får ofte hodepine, vondt i magen eller kvalme...........................	☐	☐	☐
Jeg deler gjerne med andre (mat, spill, blyanter osv.).............................	☐	☐	☐
Jeg blir veldig sint og har et hissig temperament	☐	☐	☐
Jeg er vanligvis for meg selv. Jeg gjør som regel ting alene.	☐	☐	☐
Jeg gjør vanligvis det jeg får beskjed om.	☐	☐	☐
Jeg bekymrer meg mye.	☐	☐	☐
Jeg er hjelpsom hvis noen er såret, oppskaket eller føler seg dårlig....................	☐	☐	☐
Jeg er stadig urolig, det kribler i kroppen......	☐	☐	☐
Jeg har en eller flere gode venner................	☐	☐	☐
Jeg slåss mye. Jeg kan presse andre til å gjøre det jeg vil..	☐	☐	☐
Jeg er ofte lei meg, nedfor eller på gråten....	☐	☐	☐
Jeg blir som regel likt av andre på min alder	☐	☐	☐
Jeg blir lett forstyrret. Jeg synes det er vanskelig å konsentrere meg........................	☐	☐	☐
Jeg blir nervøs i nye situasjoner. Jeg blir lett usikker.................................	☐	☐	☐
Jeg er snill mot de som er yngre enn meg ...	☐	☐	☐
Jeg blir ofte beskyldt for å lyve eller jukse....	☐	☐	☐
Andre barn eller unge erter eller plager meg	☐	☐	☐
Jeg tilbyr meg ofte å hjelpe andre (foreldre, lærere, andre barn/unge)	☐	☐	☐
Jeg tenker meg om før jeg handler (gjør noe)	☐	☐	☐
Jeg tar ting som ikke er mine, hjemme, på skolen eller andre steder	☐	☐	☐
Jeg kommer bedre overens med voksne enn de på min egen alder..............................	☐	☐	☐
Jeg er redd for mye. Jeg blir lett skremt	☐	☐	☐
Jeg fullfører oppgaver. Jeg er god til å holde på oppmerksomheten	☐	☐	☐
	1	2	3

U/T1.   DINE STERKE OG SVAKE SIDER (forts.)

1.2 Samlet, synes du at du har problemer på ett eller flere av følgende områder: med følelser, konsentrasjon, oppførsel eller med å komme overens med andre mennesker?

Nei	Ja, små problemer	Ja, tydelige problemer	Ja, alvorlige problemer
☐ 1	☐ 2	☐ 3	☐ 4

Hvis du har svart JA, vennligst svar på følgende spørsmål:

Hvor lenge har disse problemene vært tilstede?

Mindre enn en måned	1-5 måneder	6-12 måneder	Mer enn ett år
☐ 1	☐ 2	☐ 3	☐ 4

Forstyrrer eller plager problemene deg?

Ikke i det hele tatt	Bare litt	En god del	Mye
☐ 1	☐ 2	☐ 3	☐ 4

Virker problemene inn på livet ditt på noen av disse områdene?

	Ikke i det hele tatt	Bare litt	En god del	Mye
Hjemme/familien................	☐	☐	☐	☐
Forhold til venner..............	☐	☐	☐	☐
Læring på skolen..............	☐	☐	☐	☐
Fritidsaktiviteter	☐	☐	☐	☐
	1	2	3	4

Er problemene en belastning for de rundt deg (familie, venner, lærere osv.)?

Ikke i det hele tatt	Bare litt	En god del	Mye
☐ 1	☐ 2	☐ 3	☐ 4

U/T2.   MATPAKKE/MATTILBUDET I SKOLEN

2.1 Hvor ofte spiser du matpakke i skoletiden?

Sjelden/ aldri	1-3 ganger pr. mnd	ca. 1 gang i uka	2-3 ganger i uka	4-5 ganger i uka
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

	JA	NEI
2.2 Har din skole kantinetilbud?.....................	☐	☐

Hvis «JA»;
Hvor fornøyd er du med kantinetilbudet ved din skole?

Ikke fornøyd	Litt fornøyd	Ganske fornøyd	Veldig fornøyd
☐ 1	☐ 2	☐ 3	☐ 4

	JA	NEI
Hvis «NEI»; **Ønsker du å få et kantinetilbud ved din skole?**	☐	☐

2.3 I løpet av skoledagen kan du få kjøpt:

Sjokolade	Cola/brus	Chips, potetgull	Melk eller yoghurt	Frukt og grønnsaker
☐	☐	☐	☐	☐

Juice, fruktsaft	Brødskiver/ rundstykker	Boller/ kaker	Baguetter, pizza e.l.	Kaffe, te	Kakao
☐	☐	☐	☐	☐	☐

2.4 Hvor ofte drikker du:

	Sjelden/ aldri	1-3 g. pr. mnd	ca. 1 g. i uka	2-3 g. i uka	4-5 g. i uka	Oftere
Cola/brus	☐	☐	☐	☐	☐	☐
Rush/Battery eller lignende drikker	☐	☐	☐	☐	☐	☐
	1	2	3	4	5	6

U/T3. MESTRING

3.1 Hvilke tema er viktig for at du skal mestre livet ditt i framtiden?

N4

	Ikke viktig	Litt viktig	Viktig	Meget viktig
Kunnskap om personlig økonomi og å kunne planlegge pengebruken	☐	☐	☐	☐
Likeverd og likestilling i hjemmet og på skolen	☐	☐	☐	☐
Kunnskap om sunne vaner.......................	☐	☐	☐	☐
Kunnskap om tobakk og rusmidler, og om skadevirkningene dette har	☐	☐	☐	☐
Kunne bidra til miljøvennlig forbruk	☐	☐	☐	☐
Kunne lage velsmakende og sunn hverdagsmat...	☐	☐	☐	☐
Kjenne til hygieniske krav til matlaging.....	☐	☐	☐	☐
Kunne vaske og vedlikeholde klær og bolig	☐	☐	☐	☐
Søke informasjon om pris og kvalitet på varer og tjenester....................................	☐	☐	☐	☐
Kunne planlegge og gjennomføre trivelige måltider hjemme	☐	☐	☐	☐
Kjenne folkeskikk, og være høflig og hensynsfull...	☐	☐	☐	☐
Kunne ta vare på og reparere noe av det du eier...	☐	☐	☐	☐
Kjenne pris på og næringsinnhold i mat som er ferdiglaget.....................................	☐	☐	☐	☐
	1	2	3	4

U/T4. BEKYMRINGER OG PROBLEMER

4.1 Har du i løpet av de siste 12 mnd. hatt noen av disse problemene?
(Sett ett kryss for hver linje)

	Nei, aldri	Ja, av og til	Flere ganger	Svært ofte
Krangler eller konflikter med foreldrene dine..................................	☐	☐	☐	☐
Bekymringer i forhold til seksualitet	☐	☐	☐	☐ ✓
Psykiske problemer hos foreldre/foresatte	☐	☐	☐	☐
Problemer i forhold til venner....................	☐	☐	☐	☐
Økonomiske problemer hos foreldre/ foresatte...	☐	☐	☐	☐
Rusproblemer hos foreldre/foresatte	☐	☐	☐	☐
Andre problemer......................................	☐	☐	☐	☐
	1	2	3	4

U/T5. SKOLESITUASJONEN DIN

5.1 Hvordan har du det på skolen?
(Sett ett kryss for hver linje)

N4 ✓

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
Jeg trives på skolen	☐	☐	☐	☐
Jeg trives i klassen..................................	☐	☐	☐	☐
Jeg har mye til felles med andre i klassen	☐	☐	☐	☐
Jeg føler meg knyttet til klassen..............	☐	☐	☐	☐
Klassen legger vekt på mine meninger ...	☐	☐	☐	☐
Lærerne legger vekt på meningene mine.	☐	☐	☐	☐
Lærerne mine setter pris på meg	☐	☐	☐	☐
Lærerne hjelper meg med fagene når jeg trenger det...................................	☐	☐	☐	☐
Lærerne hjelper meg med personlige problemer hvis jeg trenger det	☐	☐	☐	☐
	1	2	3	4

5.2 Nedenfor vil du finne noen utsagn om skolen:
(Sett ett kryss for hver linje)

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
✓ Skolen er faglig interessant og lærerik....	☐	☐	☐	☐
✓ Jeg føler skolearbeidet stressende/ slitsomt	☐	☐	☐	☐
✓ Jeg er fornøyd med skole- prestasjonene mine	☐	☐	☐	☐
✓ Det er viktig for meg å gjøre det bra på skolen...	☐	☐	☐	☐
✓ Foreldrene mine synes skolen er viktig...	☐	☐	☐	☐
✓ Jeg føler meg trygg på skolen.................	☐	☐	☐	☐
	1	2	3	4

U/T5. SKOLESITUASJONEN DIN (fortsettelse)

Nå kommer noen spørsmål om mobbing.
Spørsmålene gjelder hvordan du har hatt det de siste 3-4 månedene og ikke bare hvordan du har det akkurat nå.
I tillegg spør vi om du har blitt mobbet eller vært med å mobbe andre i tidligere skoleår.

Før du begynner så les her hva vi mener med mobbing:
Vi sier at en elev **BLIR MOBBET** når en annen elev eller en gruppe av elever **gjentatte ganger** sier eller gjør vonde eller ubehagelige ting mot en elev som har vanskeligheter med å forsvare seg. Om en elev blir ertet på en ubehagelig og sårende måte, er dette også mobbing. Det er også mobbing når en elev med hensikt blir stengt ute fra venneflokken, eller andre elever forteller løgner eller sprer falske rykter om han eller henne. Men det er IKKE MOBBING når to omtrent like sterke (jevnbyrdige) elever slåss eller krangler. Det er heller **ikke mobbing** når noen blir ertet på en snill og vennskapelig måte.

5.3 Hvor ofte er du blitt mobbet på skolen de siste månedene?

Jeg er ikke blitt mobbet på skolen de siste månedene	Bare en sjelden gang	2 eller 3 ganger i måneden	Omtrent 1 gang i uken	Flere ganger i uken
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5.4 Hvis du selv har opplevd mobbing, på hvilken måte har det skjedd? *(Sett ett kryss for hver linje)*

	JA	NEI
Jeg er blitt latterliggjort, kalt stygge ting eller ertet på en ubehagelig og sårende måte............	☐	☐
Andre elever har holdt meg utenfor, stengt meg ute av venneflokken eller oversett meg fullstendig...........	☐	☐
Jeg er blitt slått, sparket, lugget, skubbet eller stengt inne...............................	☐	☐
Andre elever har spredt løgner eller falske rykter om meg og prøvd å få andre til å mislike meg............	☐	☐

5.5 Hvor ofte er du blitt mobbet på skolen på en eller flere av disse måtene (se punkt 5.4) i tidligere skoleår?

Jeg er aldri blitt mobbet på skolen	Bare i ett tidligere skoleår	I mer enn ett tidligere skoleår
☐ 1	☐ 2	☐ 3

5.6 Hvor ofte har du selv vært med på å mobbe en annen elev/andre elever på skolen på en eller flere av disse måtene de siste månedene?

Jeg har ikke mobbet en elev/andre elever på skolen siste månedene	Det har bare hendt en sjelden gang	2 eller 3 ganger i måneden	Omtrent 1 gang i uken	Flere ganger i uken
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5.7 Hvor ofte har du selv vært med på å mobbe en annen elev/andre elever på skolen på en eller flere av disse måtene i tidligere skoleår?

Jeg har aldri mobbet en annen elev/andre elever på skolen	Det har bare skjedd i ett tidligere skoleår	Det har skjedd i mer enn ett tidligere skoleår
☐ 1	☐ 2	☐ 3

U/T6. FRITIDEN DIN

	Stemmer ikke	Stemmer delvis	Stemmer helt
6.1 Jeg har nok å ta meg til i fritiden	☐	☐	☐
Det er tilstrekkelig med tilbud for ungdom i min kommune	☐	☐	☐

6.2 Jeg liker å drive med/gå på, eller vil gjerne drive med/gå på:

N4

Organisert idrett med konkurranser (f.eks. friidrett, fotball, hockey, o.l.)........	☐	☐	☐
Uorganisert idrett (f.eks. alpint, snøbrett, rullebrett, sykling, fotball o.s.v. som lek)..	☐	☐	☐
Annen organisert aktivitet (f.eks. kor, musikkorps, speider o.l.)	☐	☐	☐
Ungdomsklubb	☐	☐	☐
Utesteder som diskotek, kafé, restaurant ..	☐	☐	☐
	1	2	3

U/T6. FRITIDEN DIN (fortsettelse)

6.3 Har du disse tilbudene i kommunen din:

	JA	NEI
Organisert idrett som du ønsker å delta i/deltar i?......	☐	☐
Annen organisert aktivitet du ønsker å delta i/deltar i?	☐	☐
Mulighet for å drive den typen uorganisert sport og annen aktivitet du liker?...............................	☐	☐
Ungdomsklubb?..	☐	☐
Diskotek, kafé eller restaurant?	☐	☐

6.4 Deltar du i annen organisert fritidsaktivitet enn idrett f.eks. kor, orkester, annen forening?

Nei, ingen	Ja, én aktivitet	Ja, flere enn én aktivitet
☐ 1	☐ 2	☐ 3

6.5 Har du tidligere deltatt i annen organisert aktivitet enn idrett, og som du har sluttet med? ....

JA ☐   NEI ☐

Hvis JA, og du har sluttet med annen organisert aktivitet (ta ikke med idrett) i løpet av de 5 siste årene, kan du angi hvor viktig ulike årsaker til å slutte var for deg.

	Svært viktig	Ganske viktig	Ikke viktig
Vennene mine sluttet..............................	☐	☐	☐
Det tok for mye tid	☐	☐	☐
Jeg synes ikke jeg var flink nok..............	☐	☐	☐
Lyst til å gjøre andre ting	☐	☐	☐
Likte ikke miljøet/lederen......................	☐	☐	☐
Krevde for mye spesialisert trening........	☐	☐	☐
Lang reisevei	☐	☐	☐
Begynte med annen aktivitet..................	☐	☐	☐
Det ble for dyrt.....................................	☐	☐	☐
Måtte jobbe mer med skolen	☐	☐	☐
	1	2	3

U/T7. LITT OM RØYK, RUSMIDLER OG HOLDNINGER

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
7.1 Det er lett for ungdom å få tak i sigaretter	☐	☐	☐	☐
Det er lett for ungdom å få tak i øl	☐	☐	☐	☐
Det er lett for ungdom å få tak i vin/brennevin..	☐	☐	☐	☐
Det er lett for ungdom å få tak i hasj.........	☐	☐	☐	☐
Det er lett for ungdom å få tak i andre narkotika	☐	☐	☐	☐
Det er OK for ungdom på min alder å røyke...	☐	☐	☐	☐
Det er OK for ungdom på min alder å drikke alkohol på fest...............................	☐	☐	☐	☐
Det er OK for ungdom på min alder å røyke hasj	☐	☐	☐	☐
Det burde være lovlig å bruke hasj...........	☐	☐	☐	☐
	1	2	3	4

U/T8. HVA VIL DU GJØRE

8.1 Hva vil du gjøre hvis du oppdager eller har mistanke om at en venn/venninne har alvorlige personlige problemer, spiseforstyrrelser eller misbruker alkohol eller narkotika? *(Sett ett kryss for hver linje)*

	JA	NEI	VET IKKE
Ta det opp direkte med vennen/venninnen	☐	☐	☐
Ta det opp med andre venninner/venner.........	☐	☐	☐
Ta det opp med dine foreldre	☐	☐	☐
Ta det opp med vennens/venninnens foreldre	☐	☐	☐
Ta det opp med lærer....................................	☐	☐	☐
Ta det opp med helsesøster...........................	☐	☐	☐
Ta det opp med andre	☐	☐	☐
Ikke ta det opp med noen	☐	☐	☐
	1	2	3

U/T9. HVEM KAN DU SNAKKE MED

9.1 Hvis du har personlige problemer, hvem føler du at du kan snakke med om dette? *(Sett ett kryss for hver linje)*

	JA	NEI	VET IKKE
Venn/venninne(r)..	☐	☐	☐
Foreldre...	☐	☐	☐
Lærer...	☐	☐	☐
Helsesøster	☐	☐	☐
Egen lege	☐	☐	☐
Andre...	☐	☐	☐
	1	2	3

U/T10. FOREBYGGING AV SKADE

10.1 Når du er passasjer i bil, bruker du bilbelte når du sitter? *(Sett ett kryss for hver linje)*

	Aldri	Sjelden	Ofte	Alltid
Foran:	☐	☐	☐	☐
Bak:.........................	☐	☐	☐	☐
	1	2	3	4

10.2 Hvis du har stått slalåm/utfor i løpet av de siste 12 måneder, har du da fått kontrollert bindingene i forhold til din vekt? *(Sett bare ett kryss)*

Ja ☐ 1   Nei ☐ 2   Har ikke stått på ski ☐ 3

10.3 Brukte du legg-/knebeskytter ved dine aktiviteter i løpet av de siste 12 måneder? *(Sett ett kryss for hver linje)*

	Aldri	Sjelden	Ofte	Alltid	Ikke aktuelt
Rulleskøyter/rullebrett	☐	☐	☐	☐	☐
Håndball	☐	☐	☐	☐	☐
Fotball	☐	☐	☐	☐	☐
Annen ballsport	☐	☐	☐	☐	☐
Slalåm/utfor	☐	☐	☐	☐	☐
Snøbrett	☐	☐	☐	☐	☐
Ishockey	☐	☐	☐	☐	☐
Annen aktivitet.............	☐	☐	☐	☐	☐
	1	2	3	4	5

Hvis "Annen aktivitet" - hvilken:

_____

10.4 Brukte du håndledd-/albuebeskytter ved dine aktiviteter i løpet av de siste 12 måneder? *(Sett ett kryss for hver linje)*

	Aldri	Sjelden	Ofte	Alltid	Ikke aktuelt
Sykkel.........................	☐	☐	☐	☐	☐
Rulleskøyter/rullebrett	☐	☐	☐	☐	☐
Håndball	☐	☐	☐	☐	☐
Annen ballsport	☐	☐	☐	☐	☐
Snøbrett	☐	☐	☐	☐	☐
Ishockey	☐	☐	☐	☐	☐
Annen aktivitet.............	☐	☐	☐	☐	☐
	1	2	3	4	5

Hvis "Annen aktivitet" - hvilken:

_____

10.5 Brukte du hjelm ved dine aktiviteter i løpet av de siste 12 måneder? *(Sett ett kryss for hver linje)*

	Aldri	Sjelden	Ofte	Alltid	Ikke aktuelt
Sykkel.........................	☐	☐	☐	☐	☐
Rulleskøyter/rullebrett	☐	☐	☐	☐	☐
Slalåm-/utfor...............	☐	☐	☐	☐	☐
Snøbrett	☐	☐	☐	☐	☐
Ishockey	☐	☐	☐	☐	☐
Ridning	☐	☐	☐	☐	☐
Annen aktivitet.............	☐	☐	☐	☐	☐
	1	2	3	4	5

Hvis "Annen aktivitet" - hvilken:

_____

11.1 Hvor ofte har du drevet med følgende aktiviteter i løpet av de siste 12 måneder?
Vinter er fra oktober til mars. Sommer er fra april til september.
(Sett ett kryss for hver linje)

		Aldri	1-5 ganger i sesongen	1-3 ganger i mnd.	1 gang i uka	Flere ganger i uka
Sykling	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Rulleskøyter/rullebrett	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Håndball	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Fotball	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Annen ballsport	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Ishockey	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Ridning	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Turn	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Kampsport	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Friidrett	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Svømming i basseng	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
Slalåm/utfor	vinter	☐	☐	☐	☐	☐
Snøbrett	vinter	☐	☐	☐	☐	☐
Telemark	vinter	☐	☐	☐	☐	☐
Langrenn	vinter	☐	☐	☐	☐	☐
Annen aktivitet	vinter	☐	☐	☐	☐	☐
	sommer	☐	☐	☐	☐	☐
		1	2	3	4	5

Hvis "Annen aktivitet" - hvilken:
_____

11.2 Deltar du i organisert idrettsaktivitet (fotballklubb, friidrettsklubb o.l.)?

Nei, ingen	Ja, én aktivitet	Ja, flere enn én aktivitet
☐ 1	☐ 2	☐ 3

11.3 Hvor fysisk aktiv er du sammenlignet med de fleste andre på din alder?

Like aktiv	Mer aktiv	Mindre aktiv
☐ 1	☐ 2	☐ 3

Ikke skriv her:

10.3	10.4
☐☐☐	☐☐ ☐☐

10.5	11.1
☐☐	☐☐☐

11.4 Har du tidligere deltatt i en organisert fysisk aktivitet (idrett, dans eller mosjon/leik) som du har sluttet med? ....

JA ☐   NEI ☐

Hvis JA, og du har sluttet med organisert fysisk aktivitet **i løpet av de 5 siste årene**, kan du angi hvor viktig ulike årsaker til å slutte var for deg:

	Svært viktig	Ganske viktig	Ikke viktig
Vennene mine sluttet............................	☐	☐	☐
Det tok for mye tid	☐	☐	☐
Jeg synes ikke jeg var flink nok.............	☐	☐	☐
Lyst til å gjøre andre ting	☐	☐	☐
Likte ikke miljøet/trenerne	☐	☐	☐
Krevde for mye spesialisert trening	☐	☐	☐
Lang reisevei	☐	☐	☐
Begynte med annen aktivitet..................	☐	☐	☐
Det ble for dyrt....................................	☐	☐	☐
Måtte jobbe mer med skolen..................	☐	☐	☐
	1	2	3

11.5 Deltar du i noen organisert fysisk aktivitet nå (idrett, dans eller mosjon/leik)? ....

JA ☐   NEI ☐

Hvis du svarte NEI på spørsmålet over,
Vis hvor enig/uenig du er i følgende utsagn:
NB: *Det er viktig at du besvarer alle utsagnene!(Sett kryss)*

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
Jeg har ingen å gjøre det sammen med .	☐	☐	☐	☐
Jeg liker det ikke	☐	☐	☐	☐
Jeg tror ikke det er så viktig for helsa......	☐	☐	☐	☐
Jeg har ikke noe tilbud	☐	☐	☐	☐
Jeg har ikke tid/overskudd til det.............	☐	☐	☐	☐
Jeg synes det er slitsomt.......................	☐	☐	☐	☐
Ingen av vennene mine gjør det..............	☐	☐	☐	☐
Jeg ser ikke på meg selv som en fysisk aktiv person.............................	☐	☐	☐	☐
	1	2	3	4

11.6 Hvis du driver med fysisk aktivitet (idrett, dans eller mosjon/leik), eller ønsker å gjøre det, føler du deg da mest vellykket når: *(Hvis du driver med flere aktiviteter, tenk utfra den aktiviteten du synes er viktigst)*
(Sett ett kryss for hver linje)

	Helt uenig	Litt uenig	Nøytral	Litt enig	Helt enig
Jeg er den beste............................	☐	☐	☐	☐	☐
Jeg gjør en god innsats	☐	☐	☐	☐	☐
Jeg er helt overlegen	☐	☐	☐	☐	☐
Jeg viser personlig framgang	☐	☐	☐	☐	☐
Jeg overvinner vanskeligheter	☐	☐	☐	☐	☐
Jeg får vist andre at jeg er best	☐	☐	☐	☐	☐
	1	2	3	4	5

11.7 I fysisk aktivitet (idrett, dans eller mosjon/leik) synes mine foreldre at jeg er mest vellykket når: *(Hvis dine foreldre mener forskjellig, tenk utfra den du legger mest vekt på)*

	Helt uenig	Litt uenig	Nøytral	Litt enig	Helt enig
Jeg lærer meg nye ferdigheter	☐	☐	☐	☐	☐
Jeg er flinkere enn andre..............	☐	☐	☐	☐	☐
Jeg trener på det jeg ikke er så flink til..	☐	☐	☐	☐	☐
Jeg vinner	☐	☐	☐	☐	☐
Jeg prøver ut nye ferdigheter	☐	☐	☐	☐	☐
Jeg får bedre resultater enn andre	☐	☐	☐	☐	☐
	1	2	3	4	5

11.8 Hvor mye føler du prestasjonspress fra:

	I liten grad	En del	I stor grad
Skolen og lærerne................................	☐	☐	☐
Foreldre...	☐	☐	☐
Trener/instruktør i fritidsaktiviteter..........	☐	☐	☐
Venner...	☐	☐	☐
	1	2	3

UNGDOMSUNDERSØKELSEN I OPPLAND 2017

Sykehuset Innlandet HF

Deltagelse i denne undersøkelse er frivillig. Svarene er anonyme, og det er derfor ikke mulig å trekke seg fra undersøkelsen etter at skjemaet er fylt ut.

Jeg har fylt 16 år og godtar vilkårene og deltar i undersøkelsen:

☐

Jeg har ikke fylt 16 år, men jeg godtar vilkårene og har samtykke fra foreldre/foresatte til å delta i undersøkelsen:

☐

1) **Skole:**

_____

2) **Kjønn:**

_____

3) **Alder i antall år:**

_____

4) **Alder, antall hele mnd. siden du fylte år:**

_____

EGEN HELSE:

2a)
Har du/eller har du hatt noe av følgende:

	JA:	NEI:
Astma……………………………	☐	☐
Høysnue (pollenallergi, allergisk reaksjon, rennende nese, svie i øynene)…………………………	☐	☐
Eksem…………………………..	☐	☐
Cøliaki…………………………..	☐	☐
Diabetes…………………………	☐	☐

2b)
Har du de siste 12 måneder hatt noe av følgende:

	JA:	NEI:
Psykiske plager som det er søkt hjelp for………………………	☐	☐
Alvorlig skade eller sykdom…………..…	☐	☐

2c)
Har du i løpet av de siste 12 måneder flere ganger vært plaget med smerter i:

	JA:	NEI:
Hode (hodepine, migrene el.)……………………	☐	☐
Nakke/skuldre…………………………	☐	☐
Armer/ben/knær………………………..	☐	☐
Mage………………………………….	☐	☐
Rygg…………………..……………	☐	☐

2d)
Har disse smertene ført til at du har vært hjemme fra skolen?
(oppgi også antall skoledager de siste 12 mnd.)

Nei	Ja, 1-2 dg.	Ja, 3-5 dg.	Ja, 6-10 dg	Ja, mer enn 10 dg.

2e)
Har smertene ført til redusert aktivitet i fritiden?

JA: ☐   NEI: ☐

TANNHELSE

2f)
Hvor ofte pusser du tennene?(*sett bare ett kryss*)

Flere ganger om dagen	En gang om dagen	Annenhver dag	Sjeldnere enn annen-hver dag

2g)
Har du hull i tennene dine?

JA: ☐   NEI: ☐

VEKT OG HØYDE

3a)
Hvor mye veier du? (rund av til nærmeste hele kg):

	hele kg

3b)
Hvor høy er du? (rund av til nærmeste hele cm)

	hele cm

3c)
Omtrent hvor mange måneder er det siden du veide deg sist?
(om du ikke husker dette, men vet ca. høyde og vekt i dag, kryss av på mindre enn 1 mnd.siden)

Mindre enn en måned siden:	

1 mnd. siden:	
2 mnd. siden:	
3 mnd. siden:	
3 mnd. siden:	
4 mnd. siden:	
5 mnd. siden:	
6 mnd. siden:	
7 mnd. siden:	
8 mnd. siden:	
9 mnd. siden:	
10 mnd. siden:	
11 mnd. siden:	
12 mnd. siden:	
Mer enn 12 mnd. siden:	
Vet ikke	

UTDANNING OG FAMILIE

4a)
Hvem bor du sammen med nå? (*sett bare ett kryss*)
(ta ikke med søsken og halvsøsken)

Mor og far:	
Bare mor:	
Bare far:	
Omtrent like mye mor og far	
Mor eller far og ny samboer eller ektefelle	
Fosterforeldre	
Andre:	

4b)
Hvor mange søsken/halvsøsken bor du sammen med?

Ingen:	
1:	
2:	
3:	
4:	
5 eller flere:	

4c)
Mine foreldre er:

Gift/ samboere	Singel/ enslig	Skilt/ separert	En eller begge er døde	Annet

4d)
Jeg tror vår familie, sett i forhold til andre i Norge har:

Dårlig råd ☐   Middels råd ☐   God råd ☐   Svært god råd ☐

4e)
Er far i arbeid nå?

Ja, heltid	Ja, deltid	Arbeidsløs/ trygdet	Hjemme værende	Går på skole/ stude-rer	Død

4f)
Er mor i arbeid nå?

Ja, heltid	Ja, deltid	Arbeidsløs/ trygdet	Hjemme værende	Går på skole/ stude-rer	Død

4g)
Hva er mors høyeste fullførte utdanning?

Ungdomsskole…………………………..……… ☐

Videregående yrkesfag
(f.eks. snekker, rørlegger, elektriker,
frisør, barnehageansatt m/fagbrev, hjelpe-
pleier)…………………………………….….. ☐

3 årig videregående med studiekompetanse……..... ☐

Høyskole (f.eks. lærer, sykepleier, journalist,
politi, ingeniør)…………………………..…… ☐

Universitetet (f.eks. advokat, lege, sivilingeniør,
Siviløkonom, psykolog)………………………… ☐

Vet ikke…………………………….................. ☐

4h)
Hva er fars høyeste fullførte utdanning?

Ungdomsskole…………………………..……… ☐

Videregående yrkesfag
(f.eks. snekker, rørlegger, elektriker,
frisør, barnehageansatt m/fagbrev, hjelpe-
pleier)…………………………………….….. ☐

3 årig videregående med studiekompetanse……..... ☐

Høyskole (f.eks. lærer, sykepleier, journalist,
politi, ingeniør)…………………………..…… ☐

Universitetet (f.eks. advokat, lege, sivilingeniør,
Siviløkonom, psykolog)………………………… ☐

Vet ikke…………………………….................. ☐

4i)
Hva er den høyeste utdanningen du har tenkt å ta?

Ungdomsskole…………………………..……… ☐

Videregående yrkesfag
(f.eks. snekker, rørlegger, elektriker,
frisør, barnehageansatt m/fagbrev, hjelpe-
pleier)…………………………………….….. ☐

3 årig videregående med studiekompetanse……..... ☐

Høyskole (f.eks. lærer, sykepleier, journalist,

politi, ingeniør)…………………………………..

Universitetet (f.eks. advokat, lege, sivilingeniør,
Siviløkonom, psykolog)…………………………… ☐

Vet ikke…………………………………….....…. ☐

4j)
Nedenfor vil du finne noen utsagn om skolen:

	Helt enig	Delvis enig	Delvis uenig	Helt uenig
Skolen er faglig interessant og lærerik				
Jeg føler skolear-beidet stressen-de/slitsomt				
Jeg er fornøyd med skolepresta-sjonene mine				
Det er viktig for meg å gjøre det bra på skolen				
Foreldrene mine synes skolen er viktig				
Jeg føler meg trygg på skolen				

4k)
Hvilken standpunktkarakter fikk du i forrige halvår i:

	1	2	3	4	5	6	Ikke aktuelt
Matte							
Norsk Skriftlig							
Engelsk							
Samf.fag							

4l)
Hvor mye penger brukte du siste uke?
(småinnkjøp pluss større gjenstander som f.eks. musikkanlegg o.l.)

	kroner

4m)
Har du lønnet arbeid i løpet av skoleåret?

JA: ☐   NEI: ☐

4n)
Hvor mange timer i uken arbeider du?

	ca. hele timer

4o)

HELSE ••• SØR-ØST

Hvor mye tjener du i gjennomsnitt pr. måned på dette arbeidet?

	kroner

FYSISK AKTIVITET I FRITIDEN:

5a)
Omtrent hvor mange ganger i uka utenom skole-tid driver du med idrett/mosjon slik at du blir andpusten eller svett?

Aldri:	1 gang i uken:	2-3 ganger i uken:	4-6 ganger i uken:	Hver dag:

5b)
Omtrent hvor mange timer pr. ute-utenom k skoletid driver du med idrett/mosjon?

0 timer	1-2 timer	3-4 timer	5-7 timer	8-10 timer	11 timer eller mer

FYSISK AKTIVITET I SKOLETIDA:

6a)
Hvor ofte har du obligatorisk fysisk aktivitet eller kroppsøving pr. uke i skoletiden?
(f.eks. alle må være med på å gå tur, ha fys. aktivi-tet, ha gym eller lignende)

1 gang pr. uke	2 ganger pr. uke	3 ganger pr. uke	4 ganger pr. uke	Hver dag:

6b)
Hvor mange minutter i uka har du obligatorisk fysisk aktivitet eller kroppsøving pr. uke i skole-tiden?

Mindre enn 45 min:	
Mellom 45-90 min:	
Mellom 91-135 min:	
Mellom 136-180 min:	
Mellom 181-225 min:	
Mellom 226-270 min:	

6c)
Hvor ofte er du så fysisk aktiv i friminuttene at du blir andpusten og svett?

Aldri	
Sjeldnere enn en gang i mnd.	
1-2 ganger i mnd.:	
1-2 ganger i uken:	
3-4 ganger i uken:	
Minst 5 ganger i uken:	

MOTIVASJON FOR FYSISK AKTIVITET:

7a)
Deltar du i fysisk aktivitet i friminuttet fordi:

Alle vennene mine er med:	
Det er gøy:	
Det er lite annet å finne på:	
Det kjennes godt for kroppen:	
Det kjennes godt for hodet/tankene:	
Deltar ikke:	

7b)
Deltar du i kroppsøving/fysisk aktivitet fordi:

Det er moro:	
Jeg ønsker å komme i bedre form:	
Jeg ønsker å unngå fravær:	

7c)
Deltar du i fysisk aktivitet i fritiden fordi:

Alle vennene mine er med:	
Det er gøy:	
Det er lite annet å finne på:	
Det kjennes godt for kroppen:	
Det kjennes godt for hodet/tankene:	
Foreldrene/foresatte ønsker at jeg deltar:	
Deltar ikke:	

SKOLEVEIEN:

8a)
Hvordan kommer du deg vanligvis til skolen i sommerhalvåret?

Med buss/tog (offentlig transport)……………..…… ☐

Med bil/moped……………………………………… ☐

På sykkel…………………………………………… ☐

Jeg går…………………………………………….. ☐

8b)
Hvor lang skolevei har du?

Mindre enn 2 km……………………………….....… ☐

2-4 km……………………………………………… ☐

4-6 km……………………………………………… ☐

6-8 km……………………………………………… ☐

8-10 km……………………………………………… ☐

Mer enn 10 km……………………………………… ☐

8c)
Hvor mange minutter bruker du til skolen hver dag?

0-5 minutter…………………………………………… ☐

6-10 minutter……………………………………..…… ☐

11-20 minutter………………………………………… ☐

21-30 minutter………………………………………… ☐

Mer enn 30 minutter…………………………………… ☐

SKJERMTID/ MEDIEBRUK:

9a) På ukedager, hvor mange timer bruker du pr. dag (gjennomsnittlig) på alt av TV-serier, film, dataspill, sosiale medier?
(rund av til nærmeste time)

Inntil en time:	
1-2 timer:	
3-5 timer:	
Mer enn 5 timer:	

9b) På helgedager, hvor mange timer bruker du pr. dag (gjennomsnittlig) på alt av TV-serier, film, dataspill, sosiale medier?
(rund av til nærmeste time)

Inntil en time:	
1-2 timer:	
3-5 timer:	
Mer enn 5 timer:	

MAT, DRIKKE OG SPISEVANER:

10) Hvor ofte spiser du:

Grønnsaker:

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

Grovbrød/knekkebrød:

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

Frukt/bær:

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

Fet fisk (makrell/laks, ørret):

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

Godteri (sjokolade, potetgull, smågodt, vingummi, is, kjeks, kaker og lignende)**:**

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

Fast Food (ferdigkjøpt mat som hamburger, pizza, pommes frites, kebab og lignende)**:**

HELSE ••• SØR-ØST

Sjelden/aldri:	
1-3 ganger pr. måned:	
1-3 ganger pr. uke:	
4-6 ganger pr. uke:	
1-2 ganger pr. dag:	
3 ganger eller mer pr. dag:	

4-5 ganger pr. uke:	
Oftere:	

11) Hvor mye drikker du vanligvis:

Melk:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr dag:	

Brus med sukker:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr dag:	

Lettbrus/brus uten sukker:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr. dag:	

Juice:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr. dag:	

'

Saft med sukker:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr. dag:	

Saft uten sukker:

Sjelden/aldri:	
1-6 glass pr. uke:	
1 glass pr. dag:	
2-3 glass pr. dag:	
4 glass eller mer pr. dag:	

12a) Hvor ofte drikker du energidrikker
(som f.eks. Adrenaline, Battery, Burn, Monster, Red Bull, Urge Intense)**:**

Aldri:	
Sjelden:	
1-3 ganger pr. mnd.:	
1 gang pr. uke:	
2-3 ganger pr. uke	

12b) Hvor mye energidrikk drikker du vanligvis om ganger, når du drikker energidrikk:

1 liten boks (ca. 250 ml)	
1 mellomstor boks (ca. 330 ml)	
1 stor boks (ca. 500 ml=en halv liter)	
Flere store bokser med samlet mengde tilsvarende 1 liter (f.eks. 3x300 ml, 2x500 ml eller tilsvarende:	
Flere store bokser med samlet mengde ca. 1,5 liter:	
Flere store bokser med samlet mengde tilsvarende mer enn 1,5 liter:	

12c) Tenk på de gangene du drikker energidrikk, hvor ofte drikker du energidrikken sammen med alkohol?

Sjelden/aldri…………………………………… ☐

1-2 ganger pr. uke………………………………… ☐

3-4 ganger pr. uke………………………………… ☐

5-6 ganger pr. uke………………………………… ☐

Hver dag…………………………………….... ☐

13a) Hvor ofte spiser du i løpet av en uke…

Frokost:

Sjelden/aldri:	
1-2 ganger pr. uke.	
3-4 ganger pr. uke	
5-6 ganger pr. uke	
Hver dag:	

Formiddagsmat/matpakke/lunsj:

Sjelden/aldri:	
1-2 ganger pr. uke.	
3-4 ganger pr. uke	
5-6 ganger pr uke	
Hver dag:	

Middag:

Sjelden/aldri:	
1-2 ganger pr. uke.	
3-4 ganger pr. uke	
5-6 ganger pr. uke	

Hver dag:	

13b) Hvor mange ganger pr. uke spiser du mid-dag sammen med familien din:

1:	2:	3:	4:	5	6:	7:	Aldri:

eller føler seg dårlig:			

14b) Svar utfra hvordan det har vært siste 6 måneder:

	Stemmer ikke	Stemmer delvis	Stemmer helt
Jeg er stadig urolig, det kribler i kroppen:			
Jeg har en eller flere gode venner:			
Jeg sløss mye. Jeg kan presse andre til å gjøre det jeg vil:			
Jeg er ofte lei meg, nedfor eller på gråten:			
Jeg blir som regel lik av andre på min alder:			
Jeg er lett forstyrret. Jeg synes det er vanskelig å konsentrere meg:			
Jeg blir nervøs i nye situasjoner. Jeg blir lett usikker:			
Jeg er snill mot de som er yngre enn meg:			

DINE STERKE OG SVAKE SIDER

14a) Nå følger noen standardiserte spørsmål om atferd og psykisk helse:

	Stemmer ikke	Stemmer delvis	Stemmer helt
Jeg prøver å være hyggelig mot andre. Jeg bryr meg om hva de føler:			
Jeg er rastløs. Jeg kan ikke være lenge i ro:			
Jeg får ofte hodepine, vondt i magen eller kvalme:			
Jeg deler gjerne med andre (mat, spill, blyan-ter osv.):			
Jeg er veldig sint og har et hissig temperament:			
Jeg er vanligvis for meg selv. Jeg gjør som regel ting alene:			
Jeg gjør vanligvis det jeg får beskjed om:			
Jeg bekymrer meg mye:			
Jeg er hjelpsom hvis noen er såret, oppskaket			

14c) Svar utfra hvordan det har vært siste 6 måneder:

	Stemmer ikke	Stemmer delvis	Stemmer helt
Jeg blir ofte beskyld for å lyve eller jukse:			
Andre barn eller unge erter eller plager meg:			
Jeg tilbyr meg ofte å hjelpe andre (foreldre, lærere, andre barn/unge)			
Jeg tenker meg om før jeg handler (gjør noe)			
Jeg tar ting som ikke er mine hjemme, på skolen eller andre steder:			
Jeg kommer bedre overens med voksne enn de på min egen alder:			
Jeg er redd for mye. Jeg blir lett skremt:			
Jeg fullfører oppgaver. Jeg er god til å holde på oppmerksomheten:			

15a) Samlet, synes du at du har problemer på ett eller flere av følgende områder:

Med følelser, konsentrasjon, oppførsel eller med å komme overens med andre mennesker:

Nei……………………………………………….. ☐

Ja, små problemer……………………………………… ☐

Ja, tydelig problemer……………………….…………… ☐

Ja, alvorlige problemer………………….…………… ☐

Hvis du har svart ja ovenfor-vennligst svar på kommende spørsmål:

15b) Hvor lenge har disse problemene vært tilstede?

Mindre enn en måned………………………………..... ☐

1-5 måneder……………………………………....…… ☐

6-12 måneder……………………………………...…… ☐

Mer enn ett år……………………………...…………… ☐

15c)
1. Forstyrrer eller plager problemene deg?

Ikke i det hele tatt	Bare litt	En god del	Mye

2. Virker problemene inn på livet ditt hjemme/familien?

Ikke i det hele tatt	Bare litt	En god del	Mye

3. Virker problemene inn på livet i forhold til venner?

Ikke i det hele tatt	Bare litt	En god del	Mye

4. Virker problemene inn på livet ditt ved læring på skolen?

Ikke i det hele tatt	Bare litt	En god del	Mye

5. Virker problemene inn på livet ditt ved fritidsaktiviteter?

Ikke i det hele tatt	Bare litt	En god del	Mye

15d) Er problemet en belastning for de rundt deg?

Ikke i det hele tatt	Bare litt	En god del	Mye

MOBBING

Nå kommer noen spørsmål om mobbing.

Spørsmålene gjelder hvordan du har hatt det de siste 3-4 månedene og ikke bare hvordan du har det akkurat nå.
I tillegg spør vi om du har blitt mobbet eller vært med å mobbe andre i tidligere skoleår.
Før du begynner så les hva vi mener med mobbing:
Vi sier at en elev BLIR MOBBET når en annen elev eller en gruppe av elver gjentatte ganger sier eller gjør vonde eller ubehagelig ting mot en elev som har vanskeligheter med å forsvare seg. Om en elev blir ertet på en ubehagelig og sårende måte, er dette også mobbing. Det er også mobbing når en elev med hensikt blir stengt ute fra venneflokken, eller andre elever forteller løgner eller sprer falske rykter om han eller henne. Men det er IKKE MOBBING når to omtrent like sterke (jevnbyrdige) elever slåss eller krangler. Det er ikke mobbing når noen blir ertet på en snill og vennskapelig måte.

16a) Hvis du selv har opplevd mobbing, på hvilken måte har det skjedd?

	JA	NEI
1.Jeg er blitt latterliggjort/kalt stygge ting eller ertet………………..……...	☐	☐
2. Jeg er blitt holdt utenfor av venneflokken eller blitt oversett………….	☐	☐
3. Jeg er blitt slått/sparket/lugget/ Skubbet eller stengt inne……………….	☐	☐
4. Andre elever har spredt løgner/ Falske rykter om meg og prøvd å få Andre til å mislike meg………………..	☐	☐

16b) Hvor ofte er du blitt mobbet på skolen de siste månedene?

Jeg er ikke blitt mobbet på skolen de siste månedene:	
Bare en sjelden gang:	
2 eller 3 ganger i måneden:	
Omtrent 1 gang i uken:	
Flere ganger i uken:	

16c) Har du selv mobbet andre elever de siste månedene?

Jeg har ikke mobbet en/andre elever på skolen siste måneden:	
Det har hendt en sjelden gang:	
2 eller 3 ganger i måneden:	
Omtrent 1 gang i uken:	
Flere ganger i uken:	

MOBBING I TIDLIGERE SKOLEÅR:

17a) Er du blitt mobbet på skolen i tidligere skoleår:

Jeg har aldri blitt mobbet på skolen…………………… ☐

Bare i ett tidligere skoleår……………………….... ☐

I mer enn ett tidligere skoleår……………………….. ☐

.

17b) Har du selv mobbet andre elever i tidligere skoleår?

Jeg har aldri mobbet en/andre elever på skolen……….. ☐

Det har bare skjedd i ett tidligere skoleår……….…... ☐

Det har skjedd i mer enn ett tidligere skoleår…………... ☐

FRITIDEN DIN

18) Har du tilbud i din kommune om:

	JA	NEI
1. Organisert idrett som ønsker å delta i? (f.eks. håndball, friidrett, fotball)………….	☐	☐
2. Annen organisert aktivitet du ønsker å delta i (f.eks. speider, korps og lignende)...	☐	☐
. 3. Uorganisert sport/aktivitet du liker? (f.eks. bane til løkkefotball, skøytebane ol.)..	☐	☐
4.Ungdomsklubb…………………………...	☐	☐
5. Diskotek/kafe/restaurant?........................	☐	☐

19) Deltar du i:

	Nei, ingen	Ja, en aktivitet	Ja, flere enn en aktivitet
Organisert idrettsakti-vitet (f.eks. håndball, friidrett, fotball)			
Annen org. fritidsak-tivitet enn idrett (f.eks. kor, korps, annet?)			

RØYK OG ALKOHOL

20a) Røyker du eller har du røykt?

Nei, aldri	
Ja, men jeg har sluttet	
Ja, av og til	
Ja, hver dag	

20b) Bruker du eller har du brukt snus?

Nei, aldri	
Ja, men jeg har sluttet	
Ja, av og til	
Ja, hver dag	

20c) Røyker noen av dem du bor med?

Ja, mor	
Ja, far	
Ja, mors eller fars samboer	
Ja, andre	
Nei, ingen	

20d)Har du noen gang drukket alkohol?

Ja	
Nei	

20e) Har du noen gang drukket så mye alkohol at du har vært beruset (full)?

Nei, aldri	
Ja, en gang	
Ja 2-3 ganger	
Ja, 4-10 ganger	
Ja, mer enn 10 ganger	

20f) Omtrent hvor ofte har du i løpet av det siste året drukket alkohol?

4-7 ganger i uka	
2-3 ganger i uka	
Ca. en gang i uka	
2-3 ganger pr måned	
Omtrent en gang i måneden	
Noen få ganger siste år	
Har ikke drukket alkohol siste år	

SØVNVANSKER

21a)
(Svar med et punkt i hele 24 timer, slik at 10 om kvelden angis som 22)

1. Når legger du deg vanligvis på skoledager/ hverdager?	
2. Når legger du deg vanligvis på fridager/i helger?	
3. Når våkner du vanligvis på skoleda-ger/hverdager?	
Når vakner du vanligvis på fridager i helger?	

21b)
(oppgi svaret i timer og minutter)

	Timer:	Min:
Hvor lang tid bruker du vanligvis på å sovne på skoledager/hverdager		
Hvor lang tid bruker du vanligvis på å sovne fridager/i helger?		

22a) Hvor mange ganger våkner du opp i løpet av natten?

Aldri	
En gang	
2 eller 3 ganger	
Mer enn 3 ganger	
Vet ikke	

22b) Hvor stort problem har du med trøtthet på dagtid slik at det er vanskelig å holde deg våken når du holder på med aktiviteter?

Ikke noe problem i det hele tatt	
Et lite problem	
Mer enn et lite problem	
Et stort problem	
Et veldig stort problem	

22c) Hviler du på dagtid?

Aldri	
Av og til på skoledager	
Av og til på helgedager	
Bare når jeg er syk	

22d) Hvor ofte føler du at du har fått nok søvn?

Alltid	
Vanligvis	
Av og til	
Sjelden	
Aldri	

22e) Opplever du at du har søvnproblemer?

Nei	
Noe	
Mye	
Veldig mye	

TUSEN TAKK FOR AT DU TOK DEG TID TIL Å SVARE!

REGULAR ARTICLE

ACTA PÆDIATRICA
NURTURING THE CHILD

WILEY

No significant associations between breastfeeding practices and overweight in 8-year-old children

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Abstract

Aim: The aim was to examine if breastfeeding practices were associated with body mass index (BMI) and risk of overweight or obesity in third grade (8 years) of elementary school.

Methods: In a regional cohort, we related BMI *z*-scores and presence of overweight or obesity at 8 years of age with ever being breastfed and with duration of exclusive and partial breastfeeding after adjusting for potential confounders. Parents completed questionnaires on breastfeeding and sociodemographic and lifestyle factors at school entry, and public health nurses measured height and weight. For non-participants, the nurses anonymously reported these measurements together with sex and age.

Results: 90% of participants had been breastfed. In adjusted analyses, BMI *z*-scores were not significantly related to whether or not the child had been breastfed (*P* = .64), or to the duration of exclusive (*P* = .80) or partial breastfeeding (*P* = .94). Logistic regression also showed no significant association between breastfeeding measures and overweight or obesity.

Conclusion: This study on 8-year-old Norwegian children did not support a commonly held notion that breastfeeding reduces the risk of overweight or obesity.

KEYWORDS
BMI *z*-score, breastfeeding, child, obesity, overweight

Abbreviations: BMI, body mass index; WHO, World Health Organization.

1 | INTRODUCTION

It is widely accepted that overweight or obesity in childhood has a high, negative impact on adult health and well-being in a global perspective.[1] Established risk factors for childhood overweight or obesity include environmental, sociodemographic and behavioural factors.[2] The World Health Organization (WHO) endorses breast-feeding as a means of promoting optimal growth in early infancy and limited weight gain later in life.[3] The WHO growth standards are based on children who are exclusively breastfed for at least 4 months according to strict feeding criteria.[4] This implies that breastfed children represent the norm in terms of growth.[5]

Nordic breastfeeding recommendations state that extended periods of both exclusive and partial breastfeeding have a protective effect against overweight and obesity in childhood and adolescence.[6] This notion accords with WHO claims and is supported by meta-analyses of observational studies.[7-9] However, the Belarusian PROBIT study and other smaller, randomized studies have not shown a protective effect of breastfeeding promotion on overweight and obesity beyond a child's second year.[10,11] The inconsistent results of such studies challenge the assumption of causality between breast-feeding and childhood overweight and obesity.[12] Motivation and ability to breastfeed are commonly associated with socio-economic and behavioural factors, and relationships between breastfeeding and childhood overweight and obesity may, therefore, be difficult to interpret.[13] Indeed, in a meta-analysis by Horta et al[8], which included randomized, controlled trials and observational studies, adjustments for potential confounders led to a decreasing protective effect of breastfeeding.

Current Norwegian guidelines recommend exclusive breastfeeding for 6 months and continued partial breastfeeding until the child is at least 12 months old.[14] In a recent large-scale, regional register study, 74% of mothers exclusively breastfed and 17% partially breastfed their infants at 6 weeks, and the respective figures were 19% and 55% at 6 months.[15] Given that breastfeeding is widely adopted in Norway and characterised by large variations in extent and duration, our aim was to examine whether any breastfeeding or whether duration of exclusive and partial breastfeeding was associated with body mass index (BMI) z-scores and a risk of overweight or obesity at 8 years of age in a regional cohort after adjusting for potential confounders.

2 | METHODS

2.1 | Population

The parents of all children who started school in 2007 in Oppland County, Norway, were invited to participate in the study during the routine school-entry health assessments at 5-6 years of age. Consenting parents completed a questionnaire on breastfeeding practices, lifestyle factors of the child and family, anthropometric measurements and sociodemographic data of the family and health of the child. School nurses measured the height and weight of all

Key notes

- Body mass index (BMI) z-score in the third grade (8 years of age) was not significantly associated with breastfeeding practices.
- There was no significant association between duration of breastfeeding in infancy and BMI z-score or overweight or obesity, indicating no significant dose-response relationship.
- In this cohort with high frequency of breastfeeding, we do not support previous observational studies of associations between breastfeeding and overweight in children from high-income populations.

eligible children in third grade of elementary school (about 8 years of age). For the children with parental consent, the measurements were merged with data obtained on school entry, and length and weight at birth reported by the obstetric departments. For children without parental consent, the nurses anonymously reported sex, current age, height and weight to the researchers. Oppland is a predominantly rural county with approximately 185 000 inhabitants living in 26 municipalities. Two of the municipalities have cities of 25 000-30 000 inhabitants; the rest are rural areas with towns of variable sizes and 44% of the population lives in scattered areas.[16]

2.2 | Outcome and adjusting measures

Body mass index standard deviation score (z-score) in third grade was the primary outcome and overweight or obesity vs not the secondary outcome. BMI z-scores were based on updated Norwegian growth reference data,[17] and overweight or obesity were defined according to the International Obesity Task Force.[18]

Explanatory variables were obtained before school entry, and included whether the child had been breastfed or not, whether the child had been exclusively breastfed for <4 months, duration of partial breastfeeding (months) and duration of exclusive breastfeeding (months). The additional adjusting variables represented four additional thematic groups: lifestyle parameters, anthropometric data, sociodemographic factors and general health of the child. *Lifestyle parameters* of the child and family included: proxies for child nutrition (eating vegetables <5 times/wk vs more often and eating four main meals including: cereals or sandwich for breakfast, sandwiches and fruit for lunch, a hot meal prepared at home for dinner and sandwiches for supper <5 days per week vs more often), proxies for physical activity (a level of exertion generating heavy breathing or sweating <4 times per week vs more often and daily screen time >2 hours vs shorter) and parental smoking (yes/no). *Anthropometric data* included weight and length of the child at birth. Current parental and sibling heights and weights were reported by the parents. S*ociodemographic factors* included: maternal age at delivery, the

TABLE 1 Characteristics of the participants and non-participants of the study

	Total	Participants	Non-participants	
	(n = 2012)	(n = 951)	(n = 1061)	P-value*
Boys, n (%)	996 (49.5)	440 (46.3)	556 (52.4)	.006
Age (years), mean (SD)	8.3 (1.0)	8.26 (1.0)	8.3 (1.1)	.98
Height (cm), mean (SD)	131.6 (8.1)	131.78 (8.2)	131.3 (8.0)	.22
Weight (kg), mean (SD)	29.7 (7.2)	29.80 (7.1)	29.7 (7.3)	.67
Body mass index (kg/m^2), mean (SD)	17.0 (2.6)	17.0 (2.5)	17.0 (2.6)	.83
Overweight or obese[a], n (%)	415 (20.6)	201 (21.1)	214 (20.2)	.62
Girls	234 (23.0)	116 (22.7)	118 (23.4)	
Boys	181 (18.2)	85 (19.3)	96 (17.3)	

Abbreviation: SD, standard deviation.
[a]Based on body mass index, iso-BMI ≥ 25.
*Chi-square for categorical variables and Student`s test for continuous variables.

child's sex, current marital status of the parents, number of children in the family, maternal and paternal education ≤12 years vs longer, ≥1 parent originating from countries outside Europe or North America or not and residency in rural districts vs the two cities. *Proxy variables for general health of the child* included premature vs term birth, having had caries or not, ever having been treated with antibiotics or not, having suffered a chronic disease or not and using asthma medication beyond 2 years of age or not.

2.3 | Statistical analysis

Differences in means and proportions between participants and non-participants were calculated using the Student's *t* test and Pearson's chi-square test. Associations were investigated between each of the breastfeeding variables and BMI *z*-score and having overweight or obesity or not, respectively, using unadjusted and adjusted linear and logistic regression analyses Differences in smoking habits and education for mothers that report exclusive breastfeeding more or less than 4 months were also investigated using Pearson's chi-square test. All listed variables in the adjusted models were included since previous research has found them to be associated with overweight or obesity.[9,19] Multicollinearity was assessed using variance inflation factor (VIF), and the significance level was set to 5%. Interactions between duration of partial breastfeeding and maternal smoking and duration of partial breastfeeding and maternal education were tested in additional models. Statistical analyses were carried out using SPSS Statistics for Windows, Version 23.0.0.2 Armonk, NY: IBM Corp and STATA 15.0 software (STATA).

2.4 | Ethics

Signed consent from one parent was obtained for each participating child, and the Regional Committee for Medical Research Ethics approved the study (project number: 1.2006.3491).

3 | RESULTS

Consent was obtained from parents of 951 (47%) of the 2012 eligible children. Participating children did not differ significantly from non-participants in mean age, height, weight, BMI or in rates of overweight or obesity, but the proportion of boys was slightly lower among the participants (Table 1). Of the participating children, 21% had overweight or obesity and 90% had been exclusively breastfed for a mean (standard deviation) duration of 4.6 (2.6) months and partially breastfed for 10.7 (6.1) months.

Except for the unadjusted linear regression analysis for <4 months of exclusive breastfeeding, none of the univariate analyses displayed significant associations between breastfeeding practises and BMI. Furthermore, we found no significant adjusted associations between duration of partial breastfeeding (Table 2) or any of the other breastfeeding measures and neither BMI *z*-score, nor rates of overweight or obesity in linear or logistic regression analyses (Table 3). We found a significantly higher fraction of less educated mothers among those who reported exclusive breastfeeding <4 months as compared with ≥4-month exclusive breastfeeding (difference 0.18 [0.07, 0.29], *P* < .001). There were no indications of multicollinearity (VIF scores were ≤1.3 in multivariable regression analyses) or, in additional analyses, significant interactions between duration of partial breastfeeding and maternal education (*P* = .61) or maternal smoking (*P* = .52) (data not shown).

4 | DISCUSSION

Body mass index *z*-score or having overweight or obesity in the third grade (at about 8 years of age) were not significantly related to being breastfed or not, or to the duration of exclusive or partial breastfeeding.

We found indications of an association between being exclusively breastfed <4 months in univariate analyses, but not in adjusted analyses for neither linear, nor logistic regression. The result

TABLE 2 Unadjusted and adjusted linear regression analyses[a,b]

	Unadjusted analysis				Adjusted analysis		
	Mean (SD) or %	Coef[c]	95% CI	*P*-value	Coef[c]	95% CI	*P*-value
Breastfeeding practices							
Ever breastfed	90.3	0.209	−0.02, 0.44	.075			
<4 mo of exclusive breastfeeding	28.1	0.230	0.08, 0.37	.003			
Exclusive breastfeeding (months)	4.6 (2.6)	−0.009	−0.04, 0.02	.544			
Partial breastfeeding (months)[b]	10.7 (6.1)	−0.007	−0.02, 0.01	.242	0.00	−0.01, 0.01	.941
Lifestyle of the child and family							
Eating vegetables <5 times/wk	49.9	0.004	−0.13, 0.14	.959			
Not having regular meals[b,d]	29.5	0.040	−0.11, 0.19	.569	0.06	−0.11, 0.23	.466
Activity <4 times/wk[b]	47.7	−0.070	−0.20, 0.07	.357	−0.05	−0.20, 0.11	.555
Screen time > 2 h/d[b]	31.1	0.160	0.01, 0.31	.035	0.03	−0.14, 0.19	.774
Maternal smoking[b]	19.1	0.470	0.30, 0.64	<.001	0.34	0.12, 0.56	.003
Paternal smoking[b]	21.7	0.220	0.05, 0.38	.009	−0.04	−0.25, 0.16	.689
Anthropometric data							
Birth length *z*-score	0.07 (1.0)	0.104	0.03, 0.18	.004			
Birth weight *z*-score[b]	−0.11 (1.1)	0.170	0.11, 0.23	<.001	0.12	0.06, 0.19	<.001
Maternal BMI[b]	24.3 (3.8)	0.074	0.06, 0.09	<.001	0.05	0.03, 0.08	<.001
Paternal BMI[b]	26.5 (3.3)	0.090	0.07, 0.11	<.001	0.06	0.04, 0.09	<.001
Mean sibling BMI *z*-score[e]	−0.24 (1.2)	0.230	0.16, 0.30	<.001			
Sociodemographic factors							
Age of mother at delivery (years)	30.0 (4.8)	0.004	−0.01, 0.02	.551			
Boy[b]	46.3	0.173	0.04, 0.31	.013	0.27	0.12, 0.42	.001
Single caretaker[b]	12.5	0.320	0.11, 0.52	.003	0.23	−0.05, 0.50	.108
No siblings	8.9	0.080	−0.16, 0.32	.523			
Maternal education ≤12 y[b]	44.2	0.210	0.07, 0.34	.003	−0.05	−0.22, 0.12	.567
Paternal education ≤12 y[b]	60.6	0.320	0.18, 0.46	<.001	0.07	−0.10, 0.24	.422
≥1 parent originating outside Europe or North America	2.5	0.060	−0.38, 0.49	.803			
Rural living (<20 000 inhabitants)[b]	65.8	0.320	0.18, 0.47	<.001	0.36	0.20, 0.52	<.001
General health of the child							
Prematurity (gestational week <37)	6.4	0.160	−0.12, 0.43	.272			
Caries[b]	18.7	0.210	0.04, 0.39	.020	0.12	−0.09, 0.34	.255
Treatment with antibiotics[b]	58.7	0.120	−0.01, 0.26	.077	0.11	−0.04, 0.27	.144
Chronic diseases[f]	1.6	0.140	−0.40, 0.69	.603			
Asthma medication after 2 y of age	11.6	0.080	−0.14, 0.29	.477			

Note: Dependent Variable: Body mass index (BMI) *z*-score in third grade.
Abbreviation: CI, Confidence Interval.
[a]Adjusted R^2 = 17.8%.
[b]Variables included in multivariable analysis.
[c]Unstandardized regression coefficient.
[d]Not eating all of the four daily principal meals >5 times / week.
[e]N = 551.
[f]Coeliac disease, diabetes, cerebral paresis, autism, chromosome disorders and congenital malformations.

for the crude analysis can be explained by our finding of an association between breastfeeding and socio-economy, and is in line with earlier research showing that exclusive breastfeeding at 4 months is associated with socio-economic factors.[13]

Our results are in agreement with those of the PROBIT study where breastfeeding was not found to have any protective effect on overweight and obesity beyond the age of 2 years[11] and do not agree with the findings of most other observational studies in

TABLE 3 Adjusted regression analyses for all breastfeeding exposures

	Linear regression (dependent variable: BMI z-score)			Logistic regression (dependent variable: OWOB)			
	Coef[a]	95% CI	P-value	%	Odds Ratio	95% CI	P-value
Ever breastfed[b]	−0.06	−0.34, 0.21	0.64	20.1	0.99	0.48, 2.02	0.97
<4 mo of exclusive breastfeeding[c]	0.06	−0.11, 0.21	0.51	0.06	1.06	0.67, 1.66	0.80
Exclusive breastfeeding (months)[d]	0.00	−0.03, 0.04	0.80	20.3	0.98	0.90, 1.08	0.77
Partial breastfeeding (months)[e]	0.00	−0.01, 0.01	0.94	19.0	1.02	0.99, 1.06	0.25

Abbreviation: CI, Confidence Interval.

[a]Unstandardized regression coefficient.

[b]Adjusted for all variables included in Table 2 except <4 mo of exclusive breastfeeding, exclusive breastfeeding and partial breastfeeding.

[c]Adjusted for all variables included in Table 2 except ever breastfed, exclusive and partial breastfeeding.

[d]Adjusted for all variables included in Table 2 except ever breastfed, <4 mo of exclusive breastfeeding, and partial breastfeeding.

[e]Adjusted for all variables included in Table 2 except ever breastfed, <4 mo of exclusive breastfeeding and exclusive breastfeeding.

children, adolescents and adults.[8] However, it has been argued that the differences between the control and intervention groups of the PROBIT study were too small to result in a difference on child obesity, and that the result may not be easily generalised, as the prevalence of overweight and obesity was substantially lower than for instance in the US.[20] Furthermore, in high-income countries, such as Norway, breastfeeding and the duration of breastfeeding are associated with a number of beneficial health and lifestyle factors.[15,21] The risk of increasing BMI with unfavourable social characteristics in the current study (Table 2) underscores the importance of adjusting for such factors when assessing the importance of breastfeeding per se.

Studies from low- and medium-income countries may not provide a valid comparison since breastfeeding is not necessarily associated with the same social and lifestyle determinants as in high-income countries.[22,23] Given the relative homogeneity of our population and the lack of appreciable differences in weight and height between the participants and non-participants, we suggest that the main potential confounders were accounted for, and that potential residual confounding was limited.[24] We, therefore, suggest that the lack of a significant association between breastfeeding and overweight and obesity at early school age is a valid finding in a population from a high-income country. A previous study from Norway and Belgium has also suggested that environmental and genetic backgrounds are of greater importance for growth than breastfeeding, even in sub-populations of breastfed infants with non-smoking mothers.[5]

From this cohort, we have previously reported that exclusive breastfeeding for at least 4 months was not significantly associated with a risk of overweight and obesity at pre-school age.[25] The present study adds that there were no significant effects on BMI or risk of overweight or obesity in the third grade, an age at which children are becoming more independent. This study also adds that there were no indications of dose-responsive relationships between the extent or duration of breastfeeding and BMI z-score or overweight or obesity in the third grade.

A key strength of this study was the comprehensive data obtained on breastfeeding duration, sociodemographic factors and health and lifestyle characteristics of the children and their families. The relatively low participation rate was a weakness, but the participating children and their families were considered representative of the regional population since their anthropometric measurements and sex distribution were similar to those who did not participate. Also, we did not have data on maternal BMI during pregnancy. Such data could probably have contributed in exploring the relationship between determinants of early life and BMI in childhood.[26] Information was volunteered by the parents when the children were 5 years old and may be inaccurate for instance due to recall bias. However, studies have shown that a recall of duration of breastfeeding is quite accurate after three[27] six[28] and even 20 years,[29] although there were slight overestimations of duration of breastfeeding. This may also be true for the current cohort since the mean duration of exclusive breastfeeding was slightly longer than reported in previous studies from other parts of Norway where data were collected prospectively.[13,15] Less accurate recall on breastfeeding duration has been reported among maternal smokers and multiparous mothers,[28] but we found no significant interaction for duration of breastfeeding and maternal smoking. We, therefore, assume that maternal smoking likely had little impact on the results of our study. Unfortunately, our data did not include information on parity. Another limitation is the possibility of a type II error of a not found effect, as our population had a low frequency of not breastfed children. This may lead to a lower power for our study Another factor is whether parental education is the best indicator of socio-economic status, or whether additional information on family income and occupation would have given a more accurate picture.

5 | CONCLUSION

This study on 8-year-old Norwegian children did not corroborate previous observational studies which suggest that breastfeeding reduces the risk of childhood overweight and obesity.

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CONFLICT OF INTEREST

The authors have no conflicting interests to declare and have signed the ICMJE uniform disclosure form at http://www.blackwellpublishing.com/pdf/apa_contributors.pdf

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II

RESEARCH ARTICLE

Sex-related change in BMI of 15- to 16-year-old Norwegian girls in cross-sectional studies in 2002 and 2017

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Abstract

Background: The prevalence of overweight and obesity (OWOB) has stabilized in some countries, but a portion of children with high body mass index (BMI) may have become heavier. This study aimed to describe the distributions of BMI and the point prevalence of OWOB in Norwegian adolescents in 2002 and 2017.

Methods: A cross-sectional study involving 15- to 16-year-old adolescents in Oppland, Norway, was undertaken in 2002 and 2017. We calculated their BMI, BMI z-scores (BMIz), and the prevalence of OWOB.

Results: The mean BMI increased from 20.7 to 21.4 ($p < 0.001$) for girls but remained unchanged at 21.5 vs 21.4 ($p = 0.80$) for boys. The prevalence of OWOB increased from 9 to 14% among girls (difference 5, 95% CI: 2, 8) and from 17 to 20% among boys (difference 3, 95% CI: − 1, 6%). The BMI density plots revealed similar shapes at both time points for both sexes, but the distribution for girls shifted to the right from 2002 to 2017.

Conclusion: Contrary to previous knowledge, we found that the increase in OWOB presented a uniform shift in the entire BMI distribution for 15–16-year-old Norwegian girls and was not due to a larger shift in a specific subpopulation in the upper percentiles.

Keywords: Adolescent, Body mass index, Body mass index distribution, Obesity, Overweight, Sex differences

Background

The relationship between body mass index (BMI) in adolescence and subsequent health in adulthood is well established [1–3], and both overly low and overly high BMI values are of concern [4]. The prevalence of adolescent overweight and obesity (OWOB) has increased over the last decades [5], and studies have found that this change is primarily due to increasing BMI in subgroups in the upper percentiles of the BMI distribution [6].

Population changes in BMI distributions over time have been studied in many countries [7–9], including the US [10]. However, relatively few European studies have addressed this issue in adolescents, and even fewer are based on data from the last decade when the obesity epidemic is said to have stabilized in some countries [11].

Adolescents with obesity have a high risk of becoming adults with obesity [12]. As both the biology of OWOB [13] and comorbidities due to central fat distribution differ by sex [14], sex-related trends in adolescent OWOB are important to elucidate for public health reasons.

In this study, we compared BMI distributions and the prevalence of OWOB in Norwegian adolescents in 10th grade (15–16 years of age) at 15-year intervals stratified by sex. Our aim was to explore whether an increasing mean BMI and prevalence of OWOB was due to increasing BMI within a subgroup of adolescents.

Methods

Subjects

This cross-sectional study was based on questionnaires answered by 10th grade students (15–16 years old) in high schools in the district of Oppland, Norway, in
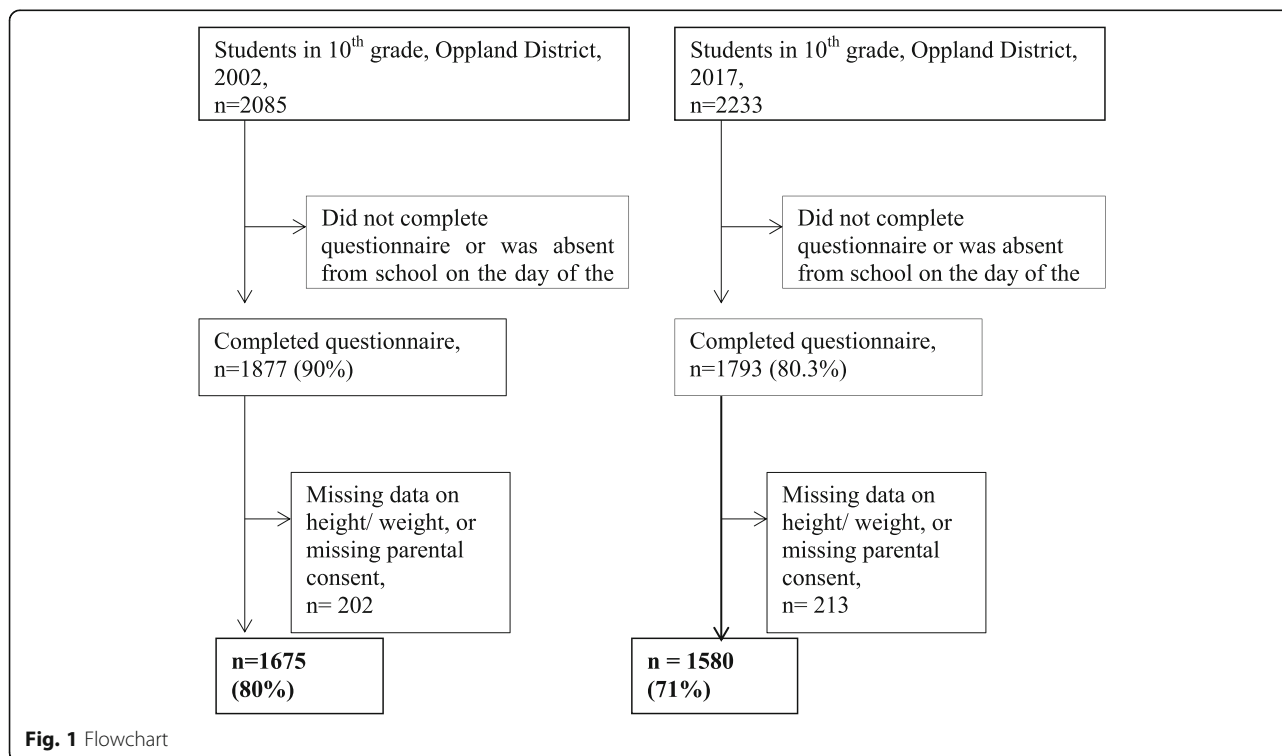
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Fig. 1 Flowchart

April–June 2002 (n = 2085) and in April–May 2017 (n = 2233) (Fig. 1). Oppland is one of 18 counties in Norway and had a population of 183,000 in 2002 and 190,000 in 2017. The county is predominantly rural but has two major cities, each with populations of 25,000-30,000.

Protocol and measures

The Norwegian Institute of Public Health conducted the first survey in 2002 [15]. We conducted the second in 2017 in collaboration with the County Governor of Oppland, the supreme authority of all high schools in the county.

The survey was a paper-questionnaire in 2002 and a web-based questionnaire in 2017. Central questions including health, nutrition, activity, and perceived familial socioeconomic status from 2002, were repeated in 2017. Current weight and height measurements were self-reported in both surveys. The questionnaire used in 2017 was piloted among 842 students in 22 schools in 2015–2016. The 2002 questionnaire lacked the date of height and weight measurements. This date was needed to calculate z-scores; thus, the date of questionnaire completion was used.

Variables

Outcome variables

Anthropometric measurements included self-reported weight (to the nearest kg) and height (to the nearest cm). Based on the self-reported anthropometric data,

three outcome variables were calculated: BMI, BMI z-score (BMIz), and OWOB vs. under-weight and normal-weight. For both 2002 and 2017-data, we based BMIz on updated Norwegian growth reference data [16] and defined OWOB according to the International Obesity Task Force (IOTF) [17].

Background data (Table 1)

Information on sex and age was available for all participants. The following background data were also collected.

Socio-demography of the family: We asked the adolescents if they lived with any siblings, how they classified their family economy compared to other families (poor, average, good, very good), if the parents lived together, and if the parents had full-time employment (full-time/ part-time/ unemployed or receiving social security services/ housewife/ student/ dead). We also included a question on frequency of teeth brushing (< every second day, every second day, once daily, >once daily), as higher family socioeconomic status is associated with greater odds of teeth brushing twice a day or more [18]. As a measure of rural living, place of residence was dichotomized into more or less than 20, 000 inhabitants. *Smoking*: We recorded smoking habits of the adolescents (never, used to but quit, sometimes, daily) and of their parents (yes/no). *Mental health*: We asked the adolescents if they had sought help for mental health problems in the past 12 months (yes/no). *Activity*: We recorded

Table 1 Descriptive statistics of the background variables

	2002			2017		
	N	%	OWOB %[a]	N	%	OWOB %[a]
Sex	1675	823		1580	814	
Girl	823	49.1	9.0	814	51.5	14.0
Boy	852	50.9	17.0	766	48.5	20.0
Age, years (mean) *SD*	1675	(15.9) *0.3*		1580	(15.8) *0.4*	
Sociodemography of the family						
Not living with siblings	1631	17.0	14.4	1566	16.5	22.1
Poor family economy	1656	3.5	24.1	1572	4.0	23.8
Parents not living together	1664	27.1	13.1	1573	32.1	20.0
Father working full time	1644	84.2	12.2	1560	84.5	16.4
Mother working full time	1654	57.8	11.9	1569	70.2	16.0
Teeth brushing ≤ once daily	1670	25.7	18.4	1573	24.1	24.0
Rural living	1675	74.1	13.0	1580	72.3	18.7
Smoking						
Never smoked	1671	62.4	13.2	1567	87.0	16.3
Parental smoking	1675	35.8	14.0	1580	12.4	23.0
Mental health issues						
Sought help for mental health issues[b]	1573	5.2	14.6	1541	13.0	21.9
Activity						
Spare-time physical activity < 4 times weekly[c]	1570	56.9	14.3	1576	55.9	19.3
Screen time > 2 h/daily	1666	57.6	14.8	1571	68.7	17.6
Participates in organized spare-time sports	1659	43.5	9.3	1563	56.8	12.2
Walking or riding bike to school	1665	35.6	11.6	1577	39.9	14.6
Student education						
Educational plans > 12 years	1659	46.6	11.7	1573	61.0	13.0
Best or second-best grades[d]	1555	55.3	11.2	1506	67.8	14.7
Positive opinion on education[e]	1642	68.9	11.9	1565	78.9	16.2
Nutrition						
Daily breakfast	1673	65.8	13.9	1576	62.9	15.3
Drinking sugar-containing soda ≥ daily	1664	37.5	14.4	1561	13.4	16.3
Eating candy ≥ daily	1660	17.7	9.9	1566	8.2	14.8

[a]% overweight and obesity (OWOB) within the given category
[b]during the last 12 months
[c]activity generating sweating or heavy breathing
[d]in ≥ 1 of 4 subjects: Norwegian writing, mathematics, social science, English
[e]Answered yes to ≥1 of the questions "my education is interesting and I learn a lot", "good grades are important to me", and "my parents find education important"

how frequently the adolescents participated in spare-time activities that generated heavy breathing or sweating (never, once per week, 2–3 times per week, 4–6 times per week, daily), how long they watched a screen (phone, computer, TV, tablet) daily during out-of-school hours (< 1 h, 1–2 h, 3–5 h, > 5 h), if they attended organized spare-time sport activities (yes/no) and if they rode a bike or walked to school (yes/no).

We asked the adolescents to describe *student education* by three proxies: educational plans (planning for an education for 9 years, 11 years, 12 years, college or university degree), achievement of good grades (best or second-best grade in ≥1 of the following subjects: Norwegian writing, mathematics, English, social science), and whether they had a positive opinion on education (answered agree/partly agree to ≥one of the three questions "my education is interesting, and I learn a lot", "good grades are important to me", and "my parents find education important"). The adolescents also answered questions regarding *nutrition* by reporting how often

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they ate breakfast (seldom/never, 1–2 times per week, 3–4 times per week, 5–6 times per week, daily), drank sugar-sweetened soda (seldom/never, 1–6 glasses a week, 1 glass daily, 2–3 glasses daily, ≥4 glasses daily) and how often they consumed candy (seldom/never, 1–3 times monthly, 1–3 times weekly, 4–6 times weekly, 1–2 times daily, ≥3 times daily).

Statistical analyses

We calculated percentages, means and standard deviations for all included variables. The following background variables were dichotomized in the descriptive analysis (Table 1): Family economy into poor vs other, parental employment into full-time employment vs other, teeth brushing into ≤ once daily vs other, smoking habits into never vs other, spare-time physical activity ≥4 times per week vs other, daily screen time > 2 h daily vs other, educational plans > 12 years vs other, good grades into best or second-best grade in ≥1 of 4 subjects: Norwegian writing, mathematics, social science or English vs other, drinking sugar-containing soda ≥ daily vs other and consumption of candy ≥ daily vs other.

We calculated mean differences by using student's t-tests, and risk differences by the cohort study command in STATA.

Data were analyzed using STATA 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017). The 95% CI of the difference in various percentiles between the two time points was calculated using bootstrap resampling with 1000 replicates. The distributions were created with Epanechnikov kernel density plots in R Version 3.4.2. Vienna, Austria: R Foundation for Statistical Computing, 2017, www.R-project.org).

Results

The mean age was 15.9 years (SD 0.3) in 2002 ($n = 1675$) and 15.8 years (SD 0.4) in 2017 ($n = 1580$). The proportions of boys were 50.9% in 2002 and 48.5% in 2017 (Table 1).

The 2017 cohort differed from the 2002 cohort in that more mothers worked full time, and that fewer parents smoked cigarettes. Further, fewer adolescents smoked and brushed their teeth ≤ once daily, but a larger portion

sought help for mental health problems in 2017. More adolescents had screen time > 2 h daily, but more also participated in organized spare-time sports in 2017. There were more adolescents with a positive attitude towards higher education, and more adolescents achieved better grades and had plans for education beyond 12 years in 2017. Fewer adolescents consumed candy and sugar-containing soda daily in 2017 (Table 1).

The prevalence of OWOB increased by most background variables, including the sociodemographic variables, when comparing 2002 and 2017. (Table 1).

For girls, the mean BMI increased from 20.7 to 21.4 (mean difference 0.70, 95% CI: 0.40, 0.99, $p < 0.001$), while the mean BMI, at 21.5–21.4, was stable among boys ($p = 0.80$, Table 2).

The prevalence of OWOB increased from 9 to 14% among girls (difference 5 percentage points%, 95 CI: 2, 8) and from 17 to 20% among boys (difference 3 percentage point, 95% CI: – 1, 6) (Table 3).

The shapes of the BMI density plots for both boys and girls were similar in 2002 and 2017 (Fig. 2). The mean BMIz increased significantly from – 0.07 to 0.22 (mean difference 0.29, 95% CI: 0.18, 0.39) among girls, while the numbers were stable at 0.19 (mean difference 0.00, 95% CI (– 0.10,0.10) among boys. For girls, a persistent mean difference in BMIz between 0.21 and 0.35 was found across all percentiles (5th -95th). For boys, mean differences per percentile ranged between – 0.06 and 0.09 (Table 4).

Discussion

The mean BMI and the prevalence of OWOB increased among Norwegian adolescent girls from 2002 to 2017. This change was due to an increase throughout the BMI distribution and is opposed to both our hypothesis and some previous findings [8, 9, 19]. No such change was seen for boys.

We found that the percentage of OWOB increased from 2002 to 2017 for almost all background variables, including the sociodemographic indicators. This finding is also supported by other studies [20] and it could be speculated that behavior has changed across socio-

Table 2 Mean anthropometric measurements of the participants, mean difference

	Girls		Mean difference, 95% CI	*p*-value	Boys		Mean difference, 95% CI	*p*-value
	2002	2017			2002	2017		
Height, cm	166.4	166.7			176.4	177.5		
Weight, kg	57.5	59.7			67.0	67.7		
BMI[a]	20.7	21.4	0.7 (0.37,0.95)	<0.001	21.5	21.4	−0.04 (− 0.35,0.27)	0.8
BMIz[b]	−0.07	0.22	0.29 (0.18,0.39)	<0.001	0.19	0.19	0.00(−0.10,0.10)	0.5

[a]Body Mass Index (BMI)
[b]BMI z- score (BMIz)

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Table 3 Anthropometric measurements of the participants, risk difference

	Girls		Risk Difference, 95% CI	*p*-value	Boys		Risk difference, 95% CI	*p*-value
	2002	2017			2002	2017		
OWOB[a] %	9	14	5 (2,8)	0.002	17	20	3 (−1,6)	0.18
OB[b] %	1.8	2.5	0.7 (−0.7,2)	0.35	2.5	2.7	0.2 (−1,2)	0.73

[a]OWOB = overweight and obesity, age and sex-adjusted BMI > 25
[b]OB = obesity, age- and sex-adjusted BMI > 30

demographic levels towards a lifestyle favoring weight gain [21].

Public health promotion strategies and health-related habits are comparable between Norway and other European countries in many aspects. All children pay visits to the school nurse at 6, 8 and 13 years of age with additional visits for vaccines. The diet in Norway is generally varied [22] and adherence to nutritional guidelines among adolescents resemble that of other European countries [23]. Finally, the percentage of Norwegian adolescents meeting recommendations for daily physical activity corresponds to results from other European studies on adolescents [24] [25]. Still, the prevalence of OWOB is increasing among both Norwegian adolescents and adults [22], as in many other European countries [26].

Our finding of increased OWOB prevalence in girls is supported by a nationwide Norwegian report carried out during the same period [24]. There is a possibility that a

sex-related increase in BMI appeared among boys before our study; mean weights for boys entering the military muster at age 17 increased between 1995 and 2008 and seemed to stabilize and decrease thereafter [27]. A regional study also revealed a higher BMI and an increasing prevalence of overweight and higher BMI values above the upper percentiles among adolescent Norwegian boys between 1966 and 1969 and 1995–1997 [28]. International, long-term studies of adolescents have shown mixed results; the mean BMI increased more among European girls than European boys between 1975 and 2016 [29], whereas global trends of OWOB between 1980 and 2013 displayed only small sex-related differences [30]. However, national and international trends in adolescent BMI and OWOB are difficult to compare due to low numbers of studies and differences in methodologies and results. This point is illustrated by the latter two studies where different growth-curves are
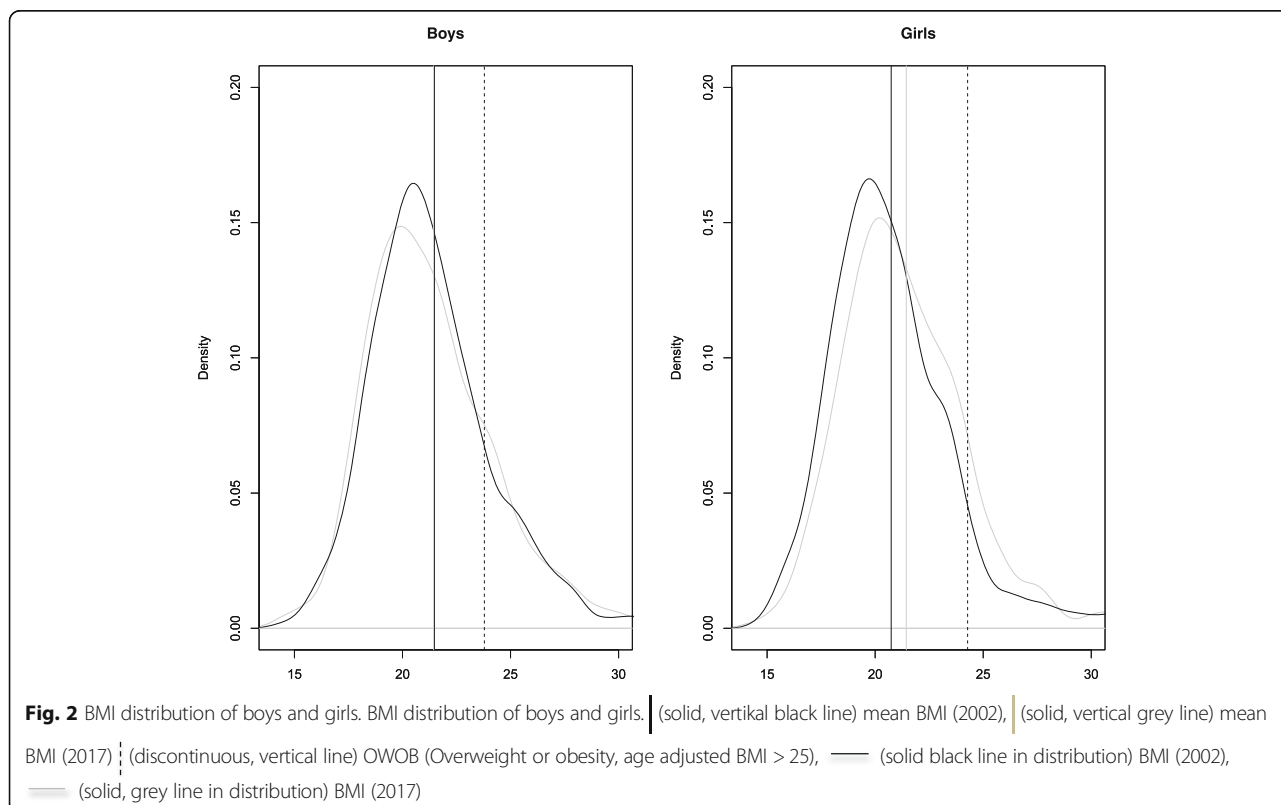

Fig. 2 BMI distribution of boys and girls. BMI distribution of boys and girls. | (solid, vertikal black line) mean BMI (2002), | (solid, vertical grey line) mean BMI (2017) ┊ (discontinuous, vertical line) OWOB (Overweight or obesity, age adjusted BMI > 25), —— (solid black line in distribution) BMI (2002), —— (solid, grey line in distribution) BMI (2017)

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Table 4 Mean differences (change in BMIz from 2002 to 2017 by percentile)

	Difference	95% CI
Girls		
Percentile		
5	0.21	(0.02, 0.44)
10	0.31	(0.12, 0.51)
25	0.33	(0.19, 0.47)
50	0.29	(0.15, 0.43)
75	0.35	(0.19, 0.51)
90	0.30	(0.10, 0.51)
95	0.22	(0.15, 0.58)
Boys		
Percentile		
5	0.09	(−0.14, 0.32)
10	−0.06	(−0.22, 0.11)
25	−0.05	(−0.20, 0.09)
50	−0.03	(−0.14, 0.09)
75	0.06	(−0.08, 0.21)
90	0.00	(−0.18, 0.17)
95	0.09	(−0.11, 0.29)

used, resulting in different cut-points for overweight and obesity.

The average BMIs for girls in our study (20.7 and 21.4) are in the normal-weight range for both time-points. Nevertheless, the increase in mean BMI is of clinical value, as changes in the mean value of a trait of a disease have established consequences for the frequency of illness [31]. Further, this will have consequences for the future prevalence of OWOB. Another important point is that the entire BMI-distribution for girls has shifted upwards on the BMI-scale from 2002 to 2017. This is underlined by the equal average increases in BMIz across percentiles for girls. This finding is concerning since girls, due to biological differences, gain increased fat mass compared to boys during adolescence [32].

For adolescent girls, our finding of an increased BMI throughout the total distribution may reveal a sex-specific obesogenic effect at the population level, and earlier studies have shown sex-related differences in weight gain due to both biological, behavioral and traumatic experiences [13, 33–35]. Due to the limitations of the cross-sectional design and the lack of other body measurements and biological tests, we were not able to explore changes in important risk factors that could explain the shift in OWOB and BMI scores.

Nevertheless, some perspectives regarding the increased BMI among girls seem relevant to consider. First, the adolescents in this study were exposed to the obesity epidemic both pre-, peri- and postnatally and were born prior to (1986) and at the height (2001) of a period of increasing birthweights in Norway [36]. A higher birthweight is correlated with an increased risk for later overweight [37, 38], although not with central adiposity or fat mass per se [39, 40]. The crossing of percentiles during the period from birth to adiposity rebound at 5–6 years of age has been seen as a critical period for later obesity, but might reflect increased growth in children that are already heavier instead [41]. Girls with higher BMI also tend to have earlier menarche, but the directionality of this relationship remains unclear [42]. In sum, children with high birthweight are vulnerable to subsequent higher BMI, but no clear pathway from high birthweight through adiposity rebound in pre-school age, early menarche and subsequent OWOB has been established.

Second, the obesity epidemic is a rather recent phenomenon that began 3 to 4 decades ago. Disentangling of the possible biological, societal, and environmental contributors to the etiology of obesity is ongoing. An example is the relatively newly gained knowledge of sex-specific increases in BMI and a higher risk of overweight in relation to dioxin exposure [43]. The main human sources of dioxins are foods, including meat, fatty fish, and dairy products, but dioxins are also concentrated in breast milk [44, 45]. We do not have a detailed record of food-intake, and therefore no measure of dioxin exposure in our study. Still, 90% of the adolescent cohort from 2017 had been breastfed, [46] and exclusive breastfeeding in Norway increased between 1998 and 2006 [47]. The possibility of breastfeeding as a mediator of adolescent OWOB contradicts the traditional view of breastfeeding as a protective factor from later overweight [48].

A strength of this study was that we explored the entire BMI distribution. This provides more extensive information than only BMI means or OWOB percentages. We used BMI, as this is currently the recommended screening test for obesity. We are not aware of any recent studies exploring secular change in BMI distributions in adolescents in other populations.

A notable weakness of our study was that height and weight were self-reported. We assume, however, that self-reporting may have reduced the number of refusals. A meta-analysis on self-reported BMI revealed an underestimation of the prevalence of overweight and obesity among girls and older children [49]. In addition, a Norwegian study found that adolescent girls significantly underestimated their BMI [50], yet with a high degree of agreement between self-reported and measured anthropometrics measured by intraclass correlation (intra-class coefficient for BMI was 0.87 in girls). Online registration of self-reported height and weight has

also been found to have high validity when compared to clinical examination [51]. This may imply a risk that our results underestimate the real BMI levels especially in girls, but likely so in both populations.

Another weakness is the lack of other metrics to explore overweight and obesity, i.e., waist circumference or percentage of body fat. BMI tends not to reflect percentage of body fat accurately [32], and especially among girls, an increase in waist circumference that is not explained by increase in BMI has been found [52].

Our study also lacks a measure of pubertal status. Females gain relatively more fat mass than boys during puberty and on average start puberty 2 years prior to boys. As the mean age of menarche in Norway has been stable at 13.2 years for the last 70 years [53] most girls in our study at both time points will have reached puberty. It is unlikely that puberty could explain the change in BMI for girls from 2002 compared to 2017.

The 2002 questionnaire lacked a date for when height and weight were measured, this may have led to modestly less precise calculations of BMIz. As both data-collections were conducted during the same months of the year, we again consider the datasets comparable.

A selection bias caused by a lower response rate among a larger group in the upper percentiles in 2017 cannot be completely ruled out. However, we have no specific indications of differences amongst the two groups of non-responders, and response rates of 80% (2002) and 70% (2017) are comparable to earlier observational studies on childhood OWOB [54].

We found sex-related trends in BMI and OWOB among Norwegian 15- to 16-year-olds. Girls had an increasing prevalence of OWOB and an increased mean BMI over the last 15 years represented by a uniform right shift in the entire BMI distribution. Thus, a shift of the entire BMI distribution in girls is explaining the increased prevalence of OWOB. Using OWOB to describe how a population is affected by an obesogenic environment accordingly has inherent limitations as the number of individuals above this cutoff vastly underestimates the number affected. Although the Norwegian rates of OWOB for children and adolescents are low compared to those in other European countries [26], we know that increasing BMI in late adolescence increases the risk of death from coronary heart disease in adulthood [1]. As cardiovascular disease is a common cause of death, especially in women, the impact of our observed trend on future health may be significant.

Conclusion

We found that the increase in OWOB among 15–16-year old Norwegian girls presented a uniform shift in the entire BMI distribution, and was not due to a larger shift in a specific subpopulation in the upper percentiles. This

finding may have significant implications on future health in Norwegian women.

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A Cross-Sectional Study of the Relationship Between Mental Health Problems and Overweight and Obesity in Adolescents

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Background: There is a suggested coexistence between obesity and mental health discomfort in adolescence. The objective of this study was to explore if mental health indices covaried with body mass index (BMI) in adolescence and if there were gender-related disparities.

Methods: Data were collected in two cross-sectional surveys of 10th-grade students (15 to 16 years old) carried out in 2002 and 2017. The questionnaires included self-reported height and weight, questions covering mental health using the Strengths and Difficulties Questionnaire (SDQ), lifestyle, and sociodemographic variables. We estimated the associations between SDQ subscale scores and BMI and the prevalence of overweight and obesity in linear and logistic multivariable models. We also estimated the extent to which gender modified these associations.

Results: BMI was positively associated with peer problems [beta (β): 0.08, (95% confidence interval 0.01, 0.14)], indicating that for every point increase in peer problems subscore, BMI increased by 0.08 kg/m^2. The association between internalizing (i.e., peer and emotional) problems and BMI and conduct problems and BMI was different for boys and girls ($p < 0.05$ for all effect modifications).

Conclusion: In this repeated cross-sectional study across 15 years, we found that peer problems were associated with BMI in Norwegian adolescents. We also found that there is a possibility that adolescent boys and girls report different mental health symptoms related to increased BMI. This finding implicates a need for gender-specific attention when assessing risk factors for increased BMI in adolescents.

Keywords: adolescence, body mass index, gender, mental health problems, obesity, overweight, SDQ

INTRODUCTION

The adolescent years are highly influential to health in adulthood (1), as essential capabilities related to physical and mental health and well-being develop during adolescence (2). However, unhealthy habits may also be established during this period of life (3), and global trends of unhealthy lifestyle represent a threat to adolescent health (2). Further, many common mental health problems commence during adolescence, especially in girls (4).

The adolescent disease burden has changed in most western countries during the last 25 years, with a shift from injuries and contagious diseases toward non-transmissible conditions like obesity and mental health problems (5). Studies reveal significant increases in the prevalence of both obesity and internalizing symptoms in adolescents globally (6, 7), resulting in comparable global prevalence estimates for both conditions (8).

Earlier studies have explored the possible association between mental health discomfort and increased body mass index (BMI) in adolescents. A threshold effect of BMI on mental health indices has been found (9), and the association differed between clinical and population-based samples (10). Further, the direction of the association between adolescent BMI and mental health discomfort has been found as possibly reciprocal or even lacking (11, 12). A knowledge gap regarding BMI and externalizing mental health discomfort has also been found (13, 14). For gender-related differences, suggestions have been made regarding depression and BMI (15) and externalizing problems and BMI, although with several limitations (15). In sum, the findings on the possible association between mental health and BMI in adolescence need to be further explored.

Our first aim was to investigate if mental health indices covaried with increased BMI in a population-based study of 15 to 16-year-old adolescents. We used four subscales from the Strengths and Difficulties Questionnaire (SDQ); emotional symptoms, peer problems, conduct problems, and hyperactivity as indices of mental health problems. The second aim was to examine if these associations differed between genders.

We hypothesized that for each subscale on SDQ, reports of more mental health problems would be associated with a higher BMI. Regarding gender differences, we hypothesized that BMI in girls would be affected by emotional and peer problems, and BMI in boys would be influenced by conduct and hyperactivity problems.

MATERIALS AND METHODS
Procedure and Participants
Data were collected in two cross-sectional surveys among 10th-grade students (15 to 16 years old) in lower secondary schools in the district of Oppland, Norway, in 2002 and 2017. The district of Oppland had a total population of 183,000 in 2002 and 189,000 in 2017 and is predominantly a rural district with three towns with populations up to 30,000 each. The survey contained questions on mental health, nutrition, leisure-time sports, and current weight and height. In 2002, the Norwegian Institute of Public Health conducted the survey, and in 2017, our research group conducted it in collaboration with the county governor of

Oppland. There were pilot studies of the questionnaires among 10th-grade students both in 2002 (16) and 2017. Participation was voluntary, and the surveys were completed during one school hour. In Norway, 10 years of education is mandatory, and thus all 15 to 16-year-old adolescents in the district were invited to the survey. The survey was done in all 46 schools in Oppland in 2002 and in all 43 public schools in 2017. Totally, 1,877 of 2,085 (90% of adolescents) completed the questionnaire 2002, and 1,788 of 2,233 (80% of adolescents) completed the questionnaire in 2017. However, due to missing consent and missing data on height or weight, the study sample comprises 3,196 participants, 1,642 in 2002, and 1,554 in 2017 (**Figure 1**). The mean age of the adolescents was 15.9 years in 2002 and 15.8 years in 2017. The surveys included 809 girls at both time points, which were 49.3% of the participants in 2002 and 52.1% in 2017. **Table 1** displays the other adjusting variables in the two surveys.

Outcome Variables
Planning for linear and logistic regression analyses, we calculated two outcome variables based on the self-reported anthropometric data weight to the nearest kilogram and height to the nearest centimeter. First, we calculated BMI (kg/m^2) as a continuous variable. Second, we calculated the binary variable normal weight vs. the combined overweight and obesity (OWOB). Thus, we excluded underweight adolescents from the logistic analyses.

We used the Norwegian national reference to calculate age and gender-adjusted BMI, and these values were dichotomized according to the cutoff values for the binary OWOB in the International Obesity Task Force (17, 18). Compared to the Norwegian BMI percentiles, the cutoff for OWOB in 15 to 16-year-old girls follows the 90th percentile. For boys, the cutoff in 15 to 16-year-old boys is located between the 75th−90th percentile (19).

Exposure Variables
The SDQ was designed as an assessment questionnaire for children's mental health problems (20) and is publicly available (21). The questionnaire can be completed by the adolescents themselves or their parents or teachers, and it is validated internationally as well as in Norway (22–25). We used the self-reported version developed for 11 to 16-year-old children and adolescents (20, 23, 26). It includes 25 items equally divided into five subscales, measuring emotional symptoms, peer problems, conduct problems, hyperactivity, and prosocial behavior. The participants indicated on a three-point Likert scale to which extent a symptom applied to them. Each item was scored 0 for "Not true," 1 for "Somewhat true," or 2 for "Certainly true." The subscale scores range from 0 to 10. On the four subscale scores used in this paper, higher scores indicate more problems. A subscale for internalizing problems (emotional symptoms and peer problems), externalizing problems (conduct problems and hyperactivity), and total difficulties score (externalizing and internalizing problems) can also be calculated (27). SDQ also includes an impact score, which reflects the child's distress and impairment.

In line with our hypothesis, we focused on the four problem subscales. The remaining subscales were beyond our scope.

FIGURE 1 | Flowchart.
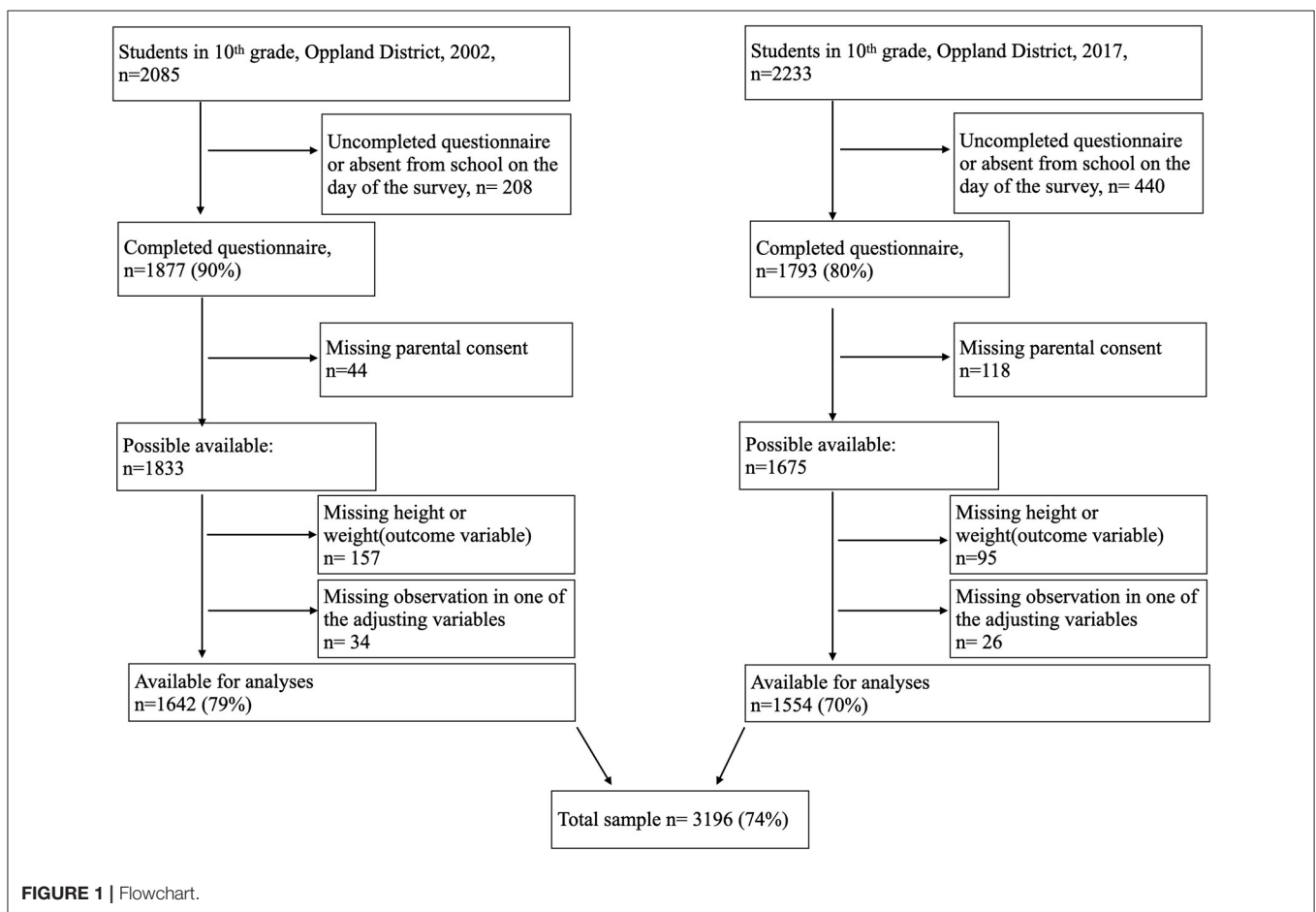
We scored the SDQ according to the syntax available on the SDQ website (21). We accordingly created subscale scores if at least three out of five items were answered and replaced missing values by mean values.

Adjusting Variables

We collected information on gender (boy or girl) and age (years and months). We asked if they attended organized leisure-time sports (yes or no) and how often they had breakfast (seldom/never, 1–2 times per week, 3–4 times per week, and 5–6 times per week, daily) and subsequently dichotomized the answers into eating daily breakfast (yes or no) as a proxy for healthy nutrition. We also asked the participants how they perceived their family's economic situation compared to other families (poor, average, good, or very good) as a measure of subjective social status. We used perceived family economy as a categorical variable in the adjusted analyses.

Statistical Analyses

We estimated the associations between the outcomes BMI (adjusted for age and gender) and OWOB and the four problem subscales of SDQ, conduct problems, hyperactivity, peer problems, and emotional symptoms, using multivariable linear and logistic regression models. We calculated crude and adjusted estimates. Besides, we included effect modifications between genders and the different exposure variables (SDQ subscale score) in order to calculate the gender-specific estimates. The effect modifications term was estimated as a product term. We conducted each multivariable regression analysis separately using the SDQ subscale score as a continuous exposure variable.

Next, we adjusted for clustering on schools by calculating robust standard errors for the 2017 survey only, since data on schools lacked from the 2002 survey. The change in standard errors following adjustment for clustering on school was minimal, which justifies using (cluster-) unadjusted standard errors and p-values. We assessed the internal consistency of the SDQ subscale scores using McDonald's Omega and reversed the coding of the items obeys, attends, reflects, friend, and popular prior to this calculation.

Data were analyzed using STATA 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017). McDonald's Omega was calculated using JASP [JASP Team (2019) Version 0.11.1].

RESULTS

The response rates were 79% in 2002 and 70% in 2017 (**Figure 1**). The mean BMI was 21.1 kg/m^2 in 2002 and 21.4 kg/m^2 in 2017.

TABLE 1 | Characteristics of study participants.

	2002 n = 1,642	2017 n = 1,554
Gender		
Male	833 (50.7)	745 (47.9)
Female	809 (49.3)	809 (52.1)
Age; years, mean (SD)	15.9 (0.3)	15.8 (0.3)
Weight; kg, mean (SD)	62.2 (11.0)	63.5 (11.3)
Height; cm, mean (SD)	171.5 (8.5)	171.9 (8.6)
BMI (kg/m²); mean (SD)	21.1 (3.0)	21.4 (3.1)
BMI z-score; mean (SD)[a]	0.06 (1.0)	0.19 (1.0)
Weight class[b]		
Underweight	143(8.7)	98 (6.3)
Normal weight	1,286 (78.3)	1,196 (77.0)
Overweight	179 (10.9)	220 (14.2)
Obesity	34 (2.1)	40 (2.6)
Adjusting variables		
Perceived family economy		
Poor	58 (3.5)	62 (4.0)
Average	637 (38.8)	471 (30.3)
Good	869 (52.9)	848 (54.6)
Very good	78 (4.8)	173 (11.1)
Member of leisure-time sports team	714 (43.5)	882 (56.8)
Eating daily breakfast	1,086 (66.1)	978 (62.9)

N = 3,196.
Data are presented as n (%) unless indicated otherwise.
[a] BMI adjusted for age and gender.
[b] According to International Obesity Task Force (IOTF).
BMI, body mass index.

TABLE 2 | SDQ scores in Norwegian adolescents by gender in the two surveys from 2002 and 2017.

	SDQ variable	N	Mean (SD)	Range[a]
2002				
Male	Total difficulties	827	8.9 (4.6)	0–28
	Conduct problems	828	2.1 (1.6)	0–10
	Hyperactivity	827	3.6 (2.0)	0–10
	Peer problems	827	1.7 (1.6)	0–8
	Emotional symptoms	828	1.5 (1.7)	0–9
	Prosocial behavior	828	6.8 (1.9)	1–10
	Impact score	822	0.3 (0.9)	0–7
Female	Total difficulties	809	10.3 (5.1)	0–34
	Conduct problems	809	1.9 (1.4)	0–9
	Hyperactivity	809	3.7 (2.0)	0–10
	Peer problems	809	1.4 (1.4)	0–10
	Emotional symptoms	809	3.2 (2.4)	0–10
	Prosocial behavior	809	7.9 (1.6)	0–10
	Impact score	804	0.5 (1.2)	0–10
2017				
Male	Total difficulties	743	9.7 (5.2)	0–33
	Conduct problems	743	1.8 (1.6)	0–8
	Hyperactivity	743	4.0 (2.1)	0–10
	Peer problems	743	1.8 (1.7)	0–9
	Emotional symptoms	743	2.1 (1.9)	0–10
	Prosocial behavior	742	7.2 (1.9)	0–10
	Impact score	741	0.3 (1.0)	0–8
Female	Total difficulties	809	11.1 (5.5)	0–36
	Conduct problems	809	1.4 (1.4)	0–9
	Hyperactivity	809	3.7 (2.1)	0–10
	Peer problems	809	1.8 (1.7)	0–9
	Emotional symptoms	809	4.2 (2.6)	0–10
	Prosocial behavior	809	8.0 (1.7)	1–10
	Impact score	806	0.9 (1.7)	0–9

[a] Range refers to the minimum and maximum scores in our study sample.
SDQ, Strengths and Difficulties Questionnaire.

Compared to 2002, fewer of the adolescents were underweight or normal-weight and more were overweight or obese in 2017 (**Table 1**).

Table 2 displays the mean SDQ subscale scores stratified by gender for the two time points.

Table 3 displays results from the linear regression analyses. When investigating the association between mental health indices and BMI for boys and girls combined, an increasing BMI was associated with more peer problems (**Table 3**). Gender modified the associations between emotional symptoms and BMI (**Figure 2**), between peer problems and BMI (p for both effect modifications <0.01), and between conduct problems and BMI [β, −0.14 (95% CI −0.28, −0.02) (p for effect modification 0.03)]. There were significant associations between both peer problems and emotional symptoms and increased BMI in girls, and between conduct problems and increased BMI in boys (**Table 3**). The logistic regression models revealed similar results as the linear models (**Table 4**).

The statistical models explained little of the total variation in the adolescents' BMI with an $R^2 = 0.02$.

The McDonald's Omega for the subscale scores was 0.75 for the emotional subscale, 0.59 for the peer subscale, 0.61 for the hyperactivity subscale, 0.52 for the conduct subscale, 0.75 for the impact subscale, and 0.63 for the total difficulties subscale.

The intra-class correlation for schools and BMI in 2017 was 0.007. Adjusting for clustering on schools in 2017 in all full models displayed in **Table 3** did not alter any standard errors or p-values (data not shown).

Figure 2 depicts the unadjusted association between emotional symptoms and BMI stratified by gender using the lfit-command in STATA.

DISCUSSION

Our hypotheses were partly supported. We found that higher values of peer problems were associated with higher values of BMI. Furthermore, gender significantly modified the associations. For girls, emotional symptoms, and also peer problems, were associated with an increased BMI, while conduct

TABLE 3 | Regression coefficients (β) with 95% confidence intervals for the relationship between SDQ subscale scores and BMI in Norwegian adolescents in total and by gender.

Exposures	Boys and girls combined			Boys	Girls
SDQ subscale scores, including total difficulties (sum score) and impact score	Crude	Adjusted[a]	Effect-modification term[b]	Adjusted[c]	Adjusted[c]
Total difficulties (n = 3,188)	**0.03 (0.01,0.05)**	0.02 (−0.01,0.03)	0.03 (−0.01,0.07)	−0.005 (−0.04,0.03)	0.02 (−0.005,0.05)
Conduct problems (n = 3,189)	0.06 (−0.01,0.13)	0.03 (−0.04,0.10)	**−0.14 (−0.28,−0.02)**	**0.10 (0.01,0.19)**	−0.05 (−0.15,0.06)
Hyperactivity (n = 3,188)	0.01 (−0.04,0.06)	−0.02 (−0.07,0.04)	−0.03 (−0.13,0.07)	−0.002 (−0.07,0.07)	−0.03 (−0.11,0.04)
Peer problems (n = 3,188)	**0.14 (0.07,0.20)**	**0.08 (0.01,0.14)**	**0.20 (0.07,0.33)**	−0.02 (−0.11,0.07)	**0.18 (0.08,0.27)**
Emotional symptoms (n = 3,189)	0.03 (−0.02,0.07)	0.02 (−0.03,0.07)	**0.15 (0.05,0.25)**	−0.08 (−0.16,0.002)	**0.07 (0.01,0.13)**
Prosocial behavior (n = 3,188)	0.01 (−0.05,0.07)	**0.07 (0.01,0.12)**	0.11 (−0.01,0.23)	0.02 (−0.06,0.10)	**0.12 (0.04,0.21)**
Impact score (n = 3,173)	0.07 (−0.01,0.20)	0.03 (−0.05,0.12)	−0.05 (−0.24,0.14)	0.07 (−0.09,0.23)	0.02 (−0.08,0.12)

[a] Adjusted for gender, age, year of survey, perceived family economy, member of leisure-time sports team, and eating daily breakfast.
[b] The effect modification term of gender and the exposure variable is adjusted for age, gender, year of survey, perceived family economy, member of leisure-time sports team, and eating daily breakfast.
[c] The exposure variable is adjusted for the effect modification term, gender, age, year of survey, perceived family economy, attended leisure-time sports team, and eating daily breakfast.
The n displays number of cases included in the adjusted models, including all participants without any missing information.
Numbers in bold indicate statistically significant estimates.
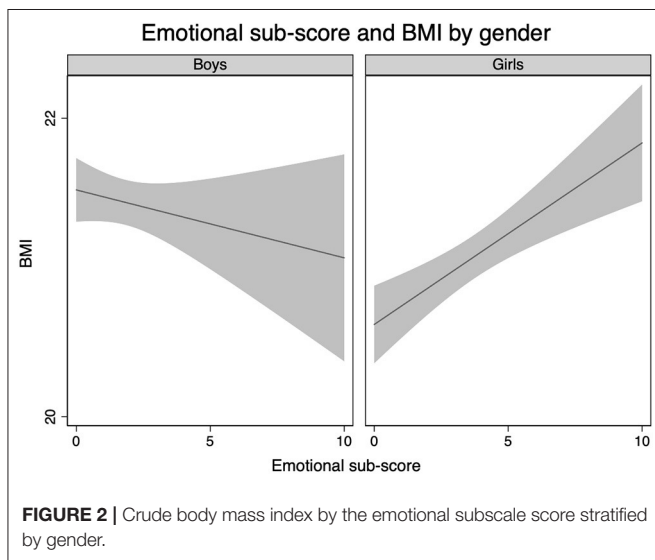BMI, body mass index; SDQ, Strengths and Difficulties Questionnaire.

FIGURE 2 | Crude body mass index by the emotional subscale score stratified by gender.

(31), and thus there is also a possibility that the association is directed from OWOB to peer problems.

We found gender-related patterns in the association between mental health discomfort and BMI. In girls, we found higher subscale scores of both peer problems and emotional symptoms associated with a significantly increased BMI compared to boys. Our finding is in line with previous studies that found gender-related associations between depression and BMI (15, 32, 33) and peer problems and BMI (34). Another study did not find gender-related differences in the association between depression and BMI (12). In boys, we found that those who reported more conduct problems also reported a significantly higher BMI compared to girls. This finding is in line with a previous study reporting an association between behavioral problems and increased BMI in boys (15).

Another important aspect in our found gender-specific pattern in mental health discomfort and BMI can be how boys and girls answer the SDQ. A study found that boys reported more conduct problems and girls reported more emotional symptoms (25). Hence, our study support this gender-specific pattern in reporting symptoms of mental discomfort, and that this is also associated with OWOB.

There is a possibility that the association between mental health discomfort and BMI is mediated through health-related behavior. An underlying factor for health-related behavior, mental health, and obesity is sociodemographic affiliation (35–37). As found in **Table 1**, only 4% of the adolescents in our study perceived their family economy as poor at both time points. This finding is in line with the egalitarian societies found in Scandinavia. Recent statistics also reveal that only 10% of the total population in Norway have a persistent, low income (38). Thus, results from studies that are affected by sociodemographic affiliation can possibly differ between egalitarian societies and societies with larger differences between sociodemographic groups, as the health-related inequalities are more challenging

problems were associated with an increased BMI in boys. Contrary to our hypotheses, we found no association between the hyperactivity subscale and BMI in either of the adjusted analyses. Although the explained variance in BMI was low, these findings can indicate that the association between mental health discomfort and BMI displays gender-related patterns.

We found an association between peer problems and BMI. The association is underpinned by the findings of Strauss and Pollack, who revealed that overweight in adolescence may be a marker of social marginalization and that overweight adolescents had fewer friends compared to normal-weight peers (28). Also, overweight and obese adolescents are at higher risk of being victims of both aggression (29) and relational bullying, including friendship withdrawals (30). OWOB is also found as stigmatizing

TABLE 4 | Crude and adjusted odds ratio with 95% confidence intervals for the relationship between SDQ subscale scores and overweight and obesity in reference to normal weight in total and by gender.

Exposures	Boys and girls combined			Boys	Girls
SDQ subscale scores, including total difficulties (sum score) and impact score	Crude	Adjusted[a]	Effect-modification term[b]	Adjusted[c]	Adjusted[c]
Total difficulties (n = 2,947)	**1.02 (1.01,1.04)**	1.01 (0.99,1.03)	1.03 (0.99,1.07)	1.00 (0.98,1.03)	**1.03 (1.00,1.06)**
Conduct problems (n = 2,948)	**1.07 (1.01,1.14)**	1.03 (0.96,1.10)	1.02 (0.89,1.16)	1.02 (0.94,1.11)	1.03 (0.98,1.15)
Hyperactivity (n = 2,947)	1.00 (0.96,1.06)	0.98 (0.93,1.03)	0.98 (0.89,1.08)	0.99 (0.93,1.05)	0.96 (0.89,1.04)
Peer problems (n = 2,947)	**1.15 (1.09,1.22)**	**1.10 (1.03,1.16)**	**1.13 (1.01,1.27)**	1.04 (0.96,1.13)	**1.17 (1.07,1.28)**
Emotional symptoms (n = 2,948)	1.00 (0.97,1.05)	1.02 (0.97,1.07)	**1.11 (1.01,1.22)**	0.96 (0.90,1.03)	**1.07 (1.01,1.13)**
Prosocial behavior (n = 2,947)	0.99 (0.94,1.04)	**1.06 (1.00,1.12)**	1.08 (0.95,1.22)	1.04 (0.97,1.11)	**1.12 (1.01,1.24)**
Impact score (n = 2,933)	**1.07 (1.00,1.15)**	1.06 (0.97,1.14)	1.06 (0.90,1.25)	1.01 (0.88,1.16)	1.08 (0.98,1.18)

[a] Adjusted for gender, age, year of survey, perceived family economy, member of leisure-time sports team, and eating daily breakfast.
[b] The effect modification term of gender and the exposure variable is adjusted for age, gender, year of survey, perceived family economy, member of leisure-time sports team, and eating daily breakfast.
[c] The exposure variable is adjusted for the effect modification term, gender, age, year of survey, perceived family economy, attended leisure-time sports team, and eating daily breakfast.
The n displays number of cases included in the adjusted models, including all participants without any missing information.
Numbers in bold indicate statistically significant estimates.
BMI, body mass index; SDQ, Strengths and Difficulties Questionnaire.

to uncover in the more egalitarian societies. Still, even if these inequalities are interpreted as minor, further awareness is needed as a recent study found that low sociodemographic status is a risk factor for a cascade of diseases that began with psychiatric disorders as a young adult and were associated with later physical diseases that included OWOB (39). Thus, the known differences in health-related outcomes appear firmly attached to mental health in adolescence and support future research in this area.

Unlike another community-based study (12), we found an association between mental health discomfort and BMI in adolescence. Although the estimates are small, health professionals should be aware of this possible link between mental discomfort and physical health in the general population of adolescents.

As behavior and biology both differ by gender and age during adolescence, the observed gender-related association between mental health discomfort and higher BMI might be different in a sample with a broader age span. Therefore, further studies should explore if the associations are different among older adolescents.

Strengths and Limitations

We consider the study to have multiple strengths. First, the association between higher BMI and mental health discomfort is found regardless of the 15-year time span and two separate populations. Thus, the association is less likely confounded by small subgroups (12). Second, through the use of SDQ as a well-validated measure of mental health discomfort, we explored both internalizing and externalizing mental health discomfort. The measures of mental health were also not focused on diagnosis. We explored our data according to the well-validated five-factor structure (25). Third, we adjusted the multivariable models for relevant lifestyle variables with well-established associations with BMI. We used daily breakfast as an indicator of a healthy nutritional profile (40) and participation in organized leisure-time sports as a reflection of objectively measured physical

activity in accordance with previous studies (41). Fourth, we used a subjective social status to indicate adolescent sociodemographic affiliation, as done by others (42, 43). Subjective social status has been found to reveal distinctive aspects of the social and economic associations besides the objective measures of education, occupation, and income (43) that are not often accomplished by adolescents.

There are some limitations to the current study. First, our data were self-reported. The possibility of random errors due to the self-reported questionnaire contributes to a lower power and an increased chance of type 2 errors. However, results from self-reported SDQ are comparable to the parental-reported SDQ (24), and we consider that self-reporting might have reduced the number of refusals. Second, we did not explore the factor structure of the SDQ, which could have provided information regarding the psychometric results. The poor internal reliabilities for the conduct, hyper, and peer problem subscales might reflect the included negatively worded items, as also found in other studies (44, 45). Thus, the suggested three-factor structure for use in a healthy population could have been approached (27), but this structure is to the best of our knowledge not validated in a Norwegian population. Third, symptom scales such as the SDQ should be interpreted within the cultural frames of the population, and especially regarding behavioral and emotional aspects. Still, more similarities than differences between different populations are found (8). Fourth, the direction of the association between mental health discomfort and obesity is possibly bidirectional (11, 15), but we cannot make such conclusions due to the cross-sectional design.

We suggest that school nurses, practitioners, parents, peers, and researchers should be sensitive to mental health discomfort in adolescents with higher BMI and be aware that the association between mental health and increased BMI may differ for girls and boys. It should be noted, however, that most adolescents with higher BMI in our study did not report mental health discomfort.

Furthermore, gender-related approaches in preventing higher BMI may be useful. There is a need for more research on the complex interplay between mental health and weight status in adolescents.

CONCLUSION

We found a small association between peer problems and higher BMI in adolescence. We also found that the association between different subscales of the SDQ and BMI was different for boys and girls. This finding indicates that emotional symptoms and peer problems in girls and conduct problems in boys are associated with an increased BMI. Further, there is still a need to explore the gender-related differences in preventive work in adolescent OWOB.

DATA AVAILABILITY STATEMENT

The datasets generated for this study will not be made publicly available because the data collected in 2002 belong to the Norwegian Public Health Institute, and is licensed for the current study.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Regional Committee for Medical Research Ethics South East approved the studies (2017 Project No. 2016/1755). Written informed consent to participate in this study was provided by participants, and where necessary, the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AB, TS, and MH-A contributed to the conception and designed of the study. AB and TS planned the data-analysis. AB performed the data analyses. AB, IF, IO, KB, TS, and MH-A interpreted the data, and drafted and completed the manuscript. All authors contributed to the article and approved the submitted version.

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IV

1 *Article*

2

Health-related behaviors in adolescents mediate the association between subjective social status and BMI

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23

24 **Abstract:** The aim of this study was to explore the association between adolescent subjective social
25 status (SSS) and body mass index (BMI) at two different time points and to determine whether this
26 association was mediated by health-related behaviors. Tenth-grade students (15–16 years old) in the
27 District of Oppland, Norway, completed questionnaires in cross-sectional surveys in 2002 (n=1596)
28 and 2017 (n=1534). We measured SSS by assessing four categories of perceived family economy and
29 performed structural equation modeling, including a latent variable for unhealthy behavior derived
30 from cigarette smoking, snuff-use, and alcohol-drinking as well as dietary and exercise as mediators.
31 We found no association between SSS and BMI in 2002 (standardized ß -0.02, (95% confidence interval
32 (CI) -0.07,0.03)). However, an association was present in 2017 (standardized ß -0.05 (95% CI -0.10, -
33 0.001)), indicating that BMI decreased by 0.05 standard deviations (0.05 x 3.1 = 0.16 BMI unit) for
34 every one-category increase in SSS. This association was mediated by exercise (standardized ß -0.013
35 (95% CI -0.02, -0.004) and unhealthy behavior (standardized ß -0.009 (95% CI-0.002, -0.04)). In this
36 repeated cross-sectional survey of 15–16-year-old Norwegian adolescents, we found a direct effect

between SSS and BMI in 2017. We also found that the association was mediated through health-related behavior.

Keywords: Adolescents, Body Mass Index, Health Behavior, Obesity, Subjective Social Status, Structural Equation Modeling

1. 1. Introduction

Overweight and obesity (OWOB) in adolescence is a threat to present and future health [1, 2]. Treatment of OWOB has resulted in few long-term success stories [3]. Therefore, it seems necessary to focus on risk factors for OWOB to develop prevention strategies.

Lower sociodemographic status has repeatedly been found to be associated with a risk for increased BMI in adolescents, and the mechanism of this association is a matter of discussion [4]. A leading hypothesis in high income countries is that lower sociodemographic status is associated with more unhealthy behaviors, such as a higher consumption of unhealthy nutrition and a lower frequency of exercise [5].

The association between sociodemographic status and BMI in adolescence has been found to be dynamic, as it differs between settings and has changed over time [6, 7]. During recent decades, food and drinks that are high in calories and low in nutrition have become more accessible [8]. Furthermore, the need for physically demanding work and transportation has declined [9]. These changes might have been main drivers of the association between sociodemographic status and BMI over recent decades [6]. However, the association between adolescent sociodemographic status and health outcomes including OWOB have been found complex, and in need of further elucidation[10].

Traditionally, objective measures such as income, education, and occupation are used to explore the association between sociodemographic status and BMI. These measures are usually not yet accomplished by adolescents. Another measure, namely, subjective social status (SSS), has been found to be related to both physiological and psychological parameters [11]. Moreover, SSS has also been found to reveal information not captured by objective sociodemographic measures [12].

Adolescence is one of the critical time points for the individual health trajectory, as OWOB has a high risk of continuing into adulthood [2], and many health-related habits are established during adolescence [10]. Furthermore, behavior in this age group is unlike that of children and adults, amongst others, as a result of a rapid development of the central nervous system, and also a late maturation of the prefrontal cortex of the brain [10, 13]. As the pre-frontal cortex is the location for risk assessment, planning, organization and delay of pleasure, the adolescent brain is hypersensitive to reward such as the anticipation of food, money, drugs, and social interactions [13-16]. Accordingly, behavior in this group should be studied separately from other age-groups, and a broader pattern of covariations of unhealthy behaviors should also be explored. If these behaviors are revealed as parts of the complicated behavioral patterns that connect increasing sociodemographic status to decreasing BMI, we could gain a more comprehensive understanding of this association.

The aims of this study were to investigate the possible relationship between SSS and BMI in adolescents at two different time points and to determine whether the association was mediated by

77 health-related behaviors in cross-sectional samples of 15–16-year-old adolescents. By using a
78 Structural Equation Model (SEM), we analyzed whether unhealthy nutrition, unhealthy habits, and
79 lower amount of exercise mediate the association between sociodemographic status and BMI.

80 **2. Materials and Methods**

81 *2.1 Protocol and subjects*

82   Tenth-grade students (15–16 years old) in lower secondary schools in the district of Oppland,
83 Norway, answered a cross-sectional survey in the period April–June 2002 and April–May 2017. The
84 district of Oppland is predominantly rural and is one of 18 districts in Norway, with a total
85 population of 183,000 in 2002 and 189,000 in 2017. It includes several towns, two of which had
86 populations between 25–30,000 during this period. The survey contained questions on the perceived
87 economic status of the family, nutrition, leisure-time sports, cigarette smoking, snuff-use, alcohol
88 drinking, and current weight and height. The questionnaires used in 2002 and 2017 were both piloted
89 among 10th-grade students [17]. In 2002, the Norwegian Institute of Public Health conducted the
90 study; in 2017, our research team conducted the study in collaboration with the County Governor of
91 Oppland. Participation was voluntary, and we obtained written consent from students above the age
92 of 16 years and from the parents of students younger than 16 years. The survey was carried out in all
93 46 schools in Oppland in 2002 and in 43 schools (excluding three private schools, accounting for 24
94 students) in 2017. In 2017, the same three pediatric nurses were present in all school classes to assist
95 and answer questions while completing the survey. A total of 1,877 students completed the survey
96 in 2002 and 1,793 in 2017. The study sample used in the SEM analyses comprised 1,596 participants
97 (77%) in 2002 and 1,534 participants in 2017 (69%) due to lack of parental consent and missing data
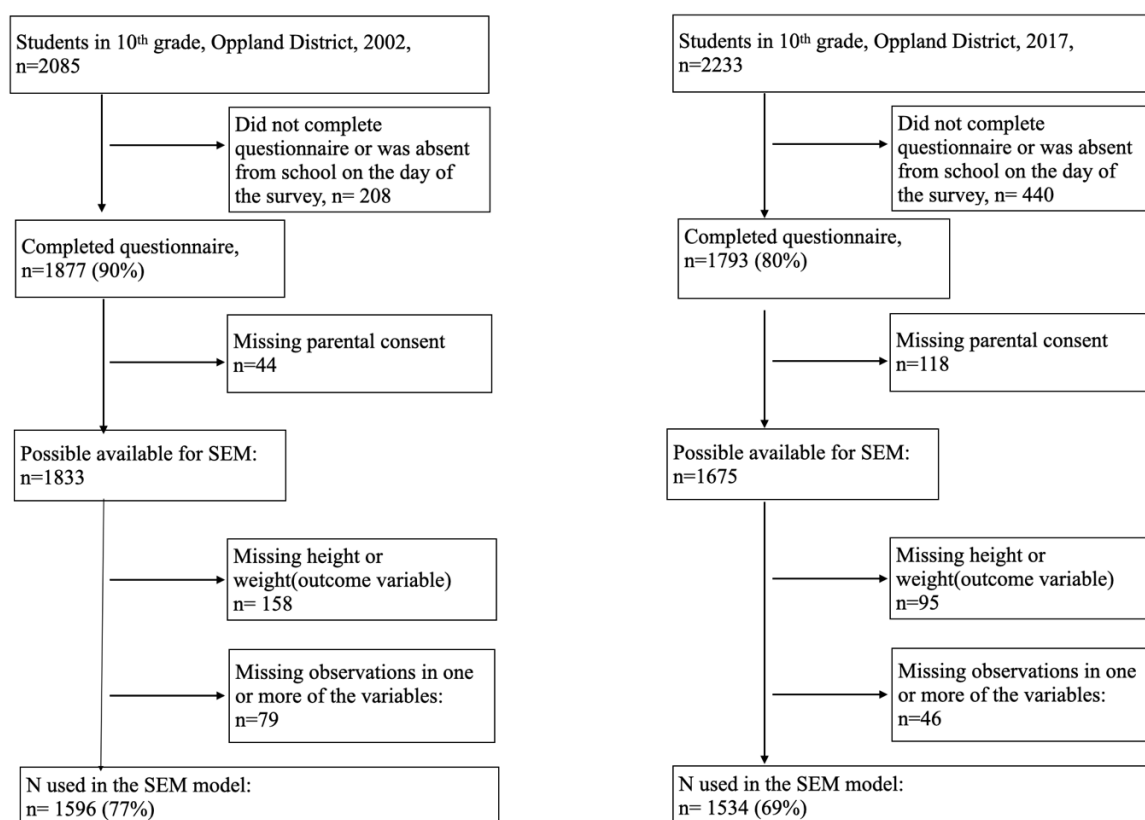98 on one or more of the variables (Figure 1).

99

Figure 1. Flowchart for the SEMs.

The Regional Committee for Medical Research Ethics Southeast approved this project (2017 project number: 2016/1755).

Outcome variables

Based on self-reported weight (to the nearest kg) and height (to the nearest centimeter), we calculated the participants' BMI (kg/m^2).

Exposure variable (SSS)

All participants were asked about their perceived economic situation in the family in comparison to other families. This question had four categories: poor, average, good, and very good.

2.2 Statistical analyses

We addressed missing observations by listwise deletion, meaning that we excluded cases with one or more missing observations. We describe the participants by year of survey (2002 and 2017) in Table 1.

Next, we estimated the association between SSS and BMI using linear regression models. The average family economy was used as the reference group (Table 2). As we did not find an association between the exposure and the outcome in the 2002 model, we did not build a model containing the indirect associations or a latent variable for this timepoint.

123   We calculated the Spearman's rank-order correlation coefficients with corresponding p-values
124   between all variables included in our SEMs (Table 3).
125
126   *2.2.1 SEM analyses*
127   Our a priori hypothesis was that the association between SSS and BMI was mediated by health-
128   related behaviors. We investigated covariation between variables in our dataset by exploring the
129   following latent variables: a diet high in sugar (consumption of cakes and candy, sugar-sweetened
130   carbonated soda, lemonade and energy drinks), level of exercise (hours of leisure-time workout,
131   member of sports team and screen time), and unhealthy behavior (cigarette smoking, snuff use,
132   alcohol drinking, and frequency of brushing teeth). Table 1 displays the variables used in the models,
133   and all variables explored are shown in Table A.1. We also ran the models using BMI z-score as the
134   outcome variable to determine whether the results were different when adjusting for gender and age.

135   We built the model with standardized estimates and performed the process in two steps:
136
137   *1)   Latent variables*
138   We used confirmatory factor analyses to build the measurement model, i.e., the part of the model
139   that builds the latent variable [18]. It explored how well the variables fit within the latent variables.
140   We removed variables that did not correlate to the latent variable, had factor loadings <0.4, produced
141   impossible cases (the presence of non-possible values), or resulted in a poor model fit when included.
142   We only used latent variables that included three or more observed variables (19) (page 201). The
143   variables cigarette smoking, snuff use, and alcohol drinking fit these criteria and were used as a latent
144   variable. We marked the latent variables by circles and the observed variables by squares (Figure 2).
145
146   *2)   Structural model*
147   To explore the hypothesized direct and indirect effects, we built structural models estimating
148   the associations among latent and observed variables [18]. We defined the direct association as the
149   path between SSS and BMI. The indirect associations were the paths connecting the SSS and BMI
150   through the variables describing health-related behavior (Figure 2). The mediated proportion of the
151   indirect effect is calculated from the indirect effect/total effect (direct + indirect effect).
152
153   *3)   Model fit*
154   We decided a priori to test the goodness of fit of both models using Comparative Fit Index (CFI),
155   Root Mean Square Error of Approximation (RMSEA), Chi-square, and standardized Root Mean
156   Square Residual (SRMR) as indicators [19](pp. 268-278). We did not perform any post hoc
157   modification of the model.
158

159   We compared the excluded and included cases to explore whether the missing observations
160   were missing at random (Table A.2).

161

162   We performed the SEM analyses in R version 3.6.1 (2019-07-05) -- "Action of the Toes":R
163 Foundation for Statistical Computing, 2017, www.R-project.org, using the libraries lavaan [20],
164 semPlot [21], and semTools [22]. As we used ordinal data, we explored the model parameters by the
165 preferred estimator diagonally weighted least squares, including variance-adjusted robust mean and
166 standard errors [19](pp. 257-259). For all other analyses, except the SEM analyses, we used STATA
167 15.0 software (STATA, College Station, TX, United States: StataCorp, 2017).

168 **3. Results**

169   The mean age (SD) of the participants was 15.9 years (0.3) in 2002 and 15.8 years (0.3) in 2017
170 (Table 1). The proportion of boys was 51.3% in 2002 and 47.8% in 2017. The mean BMI increased from
171 21.1 in 2002 (95% confidence interval (CI) 21.0–21.2) to 21.4 (95% CI 21.3–21.6) in 2017. The
172 distribution of the main exposure variable (SSS) and all observed variables are displayed in Table 1.
173

Table 1. Characteristics of tenth-grade students (15–16-year-old) in lower secondary schools in the district of Oppland, Norway.

	2002 N = 1596	2017 N = 1534
Boys	818 (51.3%)	734 (47.8%)
Age; years, mean (SD[a])	15.9 (0.3)	15.8 (0.3)
Weight; kg, mean (SD)	62.4 (11.1)	63.5 (11.4)
Height; cm, mean (SD)	171.6 (8.5)	171.9 (8.6)
BMI[b]; mean (SD)	21.1 (3.0)	21.4 (3.1)
SSS[c]		
Poor	57 (3.6)	62 (4.0)
Average	620 (38.9)	469 (30.6)
Good	842 (52.8)	832 (54.2)
Very good	77 (4.8)	171 (10.7)
Sodas[d]		
Seldom/never	169 (10.6.)	437 (28.5)
1–6 glasses weekly	837 (52.4)	893 (58.2)
1 glass daily	234 (14.7)	111 (7.2)
2–3 glasses daily	235(14.7)	70 (4.6)
≥4 glasses daily	121 (7.6)	23 (1.5)
Smoking[e]		
Never	993 (62.2)	1336 (87.1)
Used to, but quit	151 (9.5)	92 (6.0)
Occasionally	236 (14.8)	97 (6.3)
Daily	216 (13.5)	9 (0.6)
Snuff[f]		
Never	1337 (83.8)	1310 (85.4)
Used to, but quit	78 (4.9)	89 (5.8)
Occasionally	142 (8.9)	75 (4.9)
Daily	39 (2.4)	60 (3.9)
Alcohol [g]		
No	209 (13.0)	650 (42.4)
Yes	1397 (87.0)	884 (57.6)
Exercise[h]		
0	150 (9.4)	149 (9.7)
1–2	362 (22.7)	346 (22.6)
3–4	417 (26.1)	308 (20.1)
5–7	362 (22.7)	352 (22.9)
8–10	190 (11.9)	227 (14.8)
≥11	115 (7.2)	152 (9.9)

Data are presented as n (%) unless indicated otherwise.

[a]SD= Standard deviation

[b]BMI= Body Mass Index

[c]SSS= Subjective Social Status, i.e., perceived family economy

[d]Consumption of Sugar-sweetened carbonated sodas

[e]Cigarette smoking

[f]Use of snuff

[g]Ever drunk alcohol

[h]Hours of weekly leisure-time work-out

174

175   BMI had an approximately normal distribution (skewness and kurtosis 1.21 and 2.81 for 2002,
176   1.14 and 2.44 in 2017.

177   The results from the crude linear regression models are displayed in Table 2.

178

Table 2. Crude association between SSS[a] and BMI[b] in 15–16-year-old adolescents.

SSS[a]	2002	2017
Poor	1.23 (0.42,2.03)	0.03 (-0.80,0.85)
Average	0 (Reference)	0 (Reference)
Good	0.04 (-0.27, 0.34)	-0.48 (-0.84, -0.13)
Very good	0.17 (-0.53, 0.87)	-0.58 (-1.13, -0.04)

Data collected in the District of Oppland, Norway.
[a]SSS=subjective social status, i.e., perceived family economy
[b]BMI = Body Mass Index. Data are presented as the regression coefficient (95% confidence interval).

179

180   Table 3 presents a correlation matrix between all measured variables used in the SEM analysis.
181   The highest correlations were between snuff use and cigarette smoking (0.68) and snuff and ever tried
182   alcohol (0.32).

183

Table 3. Spearman's correlation coefficient (rho) for the included variables in the SEM for the 2017 survey, N=1534[a].

	BMI[b]	SSS[c]	Soda[d]	Smoking [e]	Snuff [f]	Alcohol [g]
BMI[b]						
SSS[c]	-0.06*					
Soda[d]	-0.03	-0.02				
Smoking [e]	0.05	-0.08**	0.13***			
Snuff [f]	0.04	-0.06*	0.13***	0.68***		
Alcohol [g]	0.05	-0.08**	0.15***	0.31***	0.32***	
Exercise[h]	-0.05	0.15***	-0.06*	-0.09***	-0.07**	-0.07**

[a] Study performed among 15–16-year-old adolescents in the District of Oppland, Norway
[b]BMI= Body Mass Index
[c] SSS= Subjective Social Status, i.e., perceived family economy. Coded as poor–very good (4 categories)
[d]Sugar-sweetened carbonated sodas. Coded as never–≥4 glasses daily (5 categories)
[e]Cigarette smoking. Coded as no–daily (4 categories)
[f]Snuff-use. Coded as no–daily (4 categories).
[g]Ever tried alcohol. Coded as no/yes (2 categories)
[h] Hours of weekly leisure-time work-out. Coded as 0–≥11 hours weekly
*$p \leq 0.05$; **$p < 0.01$; ***$p < 0.001$

184

185   We constructed a latent variable covering unhealthy behavior. We coded all the observed
186   variables so that an increasing value indicated a higher use or consumption. We included the
187   consumption of sugar-sweetened carbonated sodas and hours of leisure-time weekly work out as
188   mediating variables.

189

190   Figure 2 displays our hypothesis, i.e., that the association between SSS and BMI was mediated
191   by health-related behaviors. The model revealed a good fit with a CFI of 0.99, RMSEA of 0.046 (95%
192   CI 0.03–0.06), and SRMR of 0.04. The chi-square test for the model was significant at *p*<0.001.
193
194   Figure 2 shows the model, which explained 2% of the variance in adolescent BMI in 2017.
195   We found a significant association between SSS and BMI (standardized ß -0.05 (95% CI (-0.10, -
196   0.001)), indicating that the BMI decreased by 0.05 standard deviations (0.05 x 3.1 = 0.16 BMI units) for
197   each one-category increase in SSS (i.e. from average to good perceived family economy) (Figure 2).
198   This association was partially mediated by the latent variable unhealthy behavior (standardized
199   ß -0.009, (95% CI -0.002, -0.04) and hours of weekly leisure-time workout (standardized ß -0.013, (95%
200   CI -0.02, -0.004)) (Figure 2). Thus, a higher SSS category was associated with a lower BMI through
201   both the direct and mediated pathways. Unhealthy behavior mediated 15.3% of the total effect, and
202   the hours of weekly workout mediated 20.6% of the total effect.
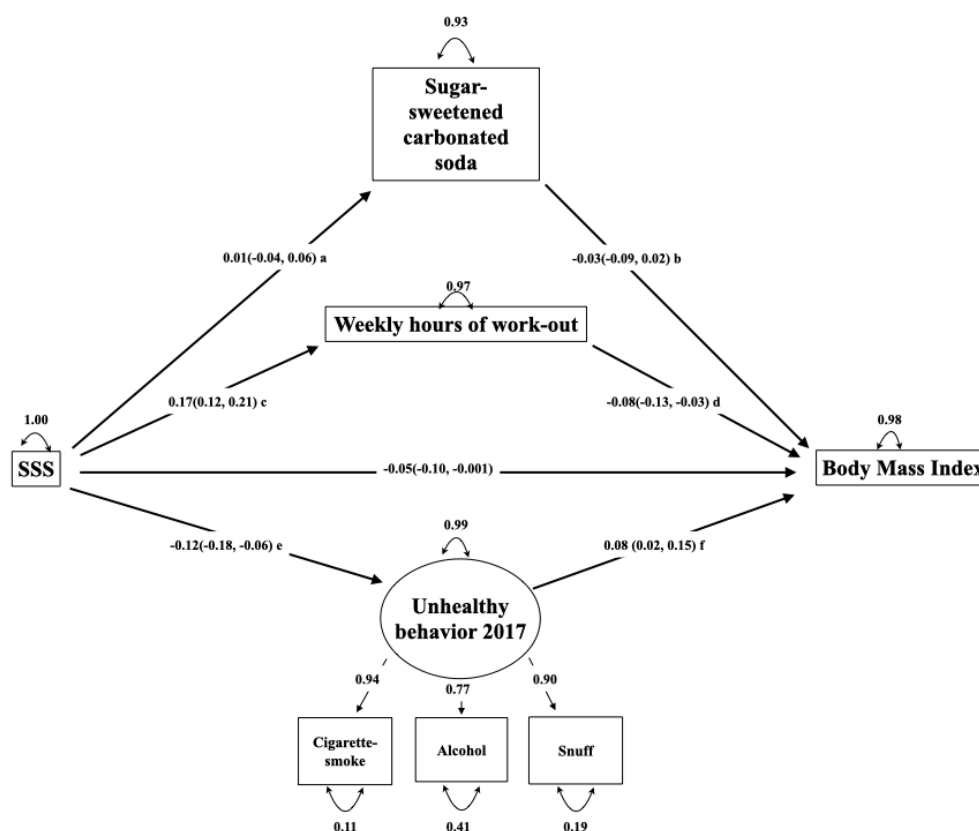203

Figure 2. SEM for the 2017 survey including the latent variable.

Numbers on straight arrows in the structural model indicate standardized β with 95% confidence intervals. Numbers on straight arrows in the measurement model indicate standardized regression coefficients between the latent variable and the observed variable. Numbers on top of curved arrows indicate unexplained variance. The rectangles indicate observed variables. The circle indicates a latent variable. Letters a, b, c, and d indicate parts of the indirect pathways with standardized β with 95% confidence intervals. The indirect pathways from SSS to body mass index:

a*b= mediated by consumption of sugar-sweetened carbonated sodas = 0.001 (0.007, -0.001).

c*d= mediated by weekly hours of workout -0.013 (-0.02, -0.004) Mediated effect: 20.6%.

e*f = mediated by unhealthy behavior -0.009 (-0.002, -0.04) Mediated effect: 15.3%.

When comparing the included and excluded observations due to the use of listwise deletion, we found only minor differences between them (Table 5) (Appendix). We additionally ran the model using BMI z-score as an outcome and found only minor differences (data not shown).

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221 **4. Discussion**

222 *Main results*

223 In a repeated cross-sectional survey in 15–16-year-old Norwegians, we studied how SSS affects

224 BMI through health-related behavior. We found an association between SSS and BMI in 2017 but not

225 in 2002. In 2017, this association was mediated by exercise and unhealthy behavior.

226

227 *The association between SSS and BMI in 2002 and 2017.*

228 The use of SSS seems adequate to depict adolescent sociodemographic status, as adolescents

229 have not yet finished their education towards achievement of occupation and income. Furthermore,

230 SSS and objectively measured socioeconomic status have been found to be moderately connected

231 [11]. SSS has been found to reveal unique aspects of the association between sociodemographic status

232 and health outcomes [11]. This measure has successfully been used in other studies exploring

233 subjective perception of family economic status and BMI in adolescents, subjective perception of rank

234 within a school hierarchy and obesity in adolescents, and perceived rank within society and body fat

235 distribution in female Caucasian adults [11, 23, 24]. Accordingly, the observed association between

236 several nuances of OWOB and SSS seems robust.

237 We found a significant association between SSS and BMI in 2017 but not in 2002, which may

238 reflect a time trend for this association in our setting. A shift in the association is described in several

239 reviews among child- and adolescent populations in developed countries: A review published in

240 1989 found that 26% of the studies revealed an association between higher sociodemographic status

241 and obesity [25]. A review published in 2008 found that the positive association between

242 sociodemographic status and OWOB had almost disappeared [26]. Finally, a review from 2015 found

243 that higher weight was associated with lower sociodemographic status [27]. This development is

244 further supported by a longitudinal study from the same time period in the UK [7].

245 The finding of different social patterns of OWOB can be put in context through the

246 epidemiological transition, describing predominating patterns of morbidity and mortality, including

247 OWOB [6, 28]. Population groups with more resources gain access to more food first, and thus,

248 OWOB can be a sign of wealth [6]. Subsequently, the "western" lifestyle and living standards are

249 achievable for the less economically privileged, thus increasing access to unhealthy food and

250 possibilities for overfeeding as well as facilitating a less physically active lifestyle. Hence, a higher

251 prevalence of OWOB will be found in the lower-income groups, possibly connected to cheaper

252 energy-dense foods [6, 29].

253

254 *Unhealthy behaviors in adolescents*

255 We found a correlation between cigarette smoking, snuff-use and alcohol-drinking in

256 adolescents. Our finding is in line with a study that revealed adolescent health-related behavior as a

257 continuum from preventive health behaviors to unhealthy behaviors [30]. The co-variation of the

258 unhealthy behaviors in adolescents seen in our study has been described as an age-typical pattern of

259 behavior which is possibly influenced by an immature cognitive control system [13]. Thus, it seems

260 reasonable to address behavior in adolescents separately from other age-groups.

261 Besides our finding of a direct association between SSS and BMI in 2017, our SEM explored three

262 indirect associations between these variables. First, we found that more exercise mediated the

263 negative association between SSS and BMI. Our finding is in line with an earlier review in European
264 children and adolescents [31]. Second, we did not reveal any association for SSS and BMI mediated
265 by consumption of sugar-sweetened carbonated sodas, which is inconsistent with previous research
266 [32, 33]. This insignificant finding may partly be influenced by that the sales figures for sugar-
267 sweetened carbonated soda in the last decade have declined by about 20 %. Simultaneously, the
268 numbers for sugar-free carbonated sodas have inclined and reached comparable numbers with sugar-
269 sweetened carbonated sodas [34]. Thus, there is a possibility that sugar-sweetened soda has lost its
270 position as a main driver of the obesity epidemic. The decrease in consumption of sugar-sweetened
271 carbonated soda is also revealed in our data (Table 1). Another possibility is the use of a non-validated
272 nutrition record in the surveys in our study. Third, we found that cigarette smoking, snuff use and
273 alcohol drinking are highly correlated and that the latent variable that included those habits mediated
274 the association between SSS and BMI in 2017. The associations between these behaviors and
275 sociodemographic status have earlier been found diverging, as use of nicotine products like cigarette
276 smoking and snuff use have been found associated to lower sociodemographic status, while alcohol
277 drinking has shown a more complex pattern related to higher sociodemographic status in some
278 countries in Europe [35-38]. Another systematic review of cigarette smoking, unhealthy nutrition,
279 alcohol consumption and less exercise in adolescents and adults found that these behaviors tended
280 to cluster with lower sociodemographic status and also with younger age[39].

281 We found that hours of exercise mediated 20.6% of the association between SSS and BMI, and
282 that unhealthy behavior mediated an additional 15.3% of this association in adolescents. We interpret
283 this finding as that the SSS is associated with BMI in a manner where SSS influences habits exceeding
284 those directly related to an energy sur-plus. This interpretation is in line with the established
285 perception that sociodemographic status also involves capabilities that surpass obtaining services
286 and goods that promote health [5]. This new information can contribute to our understanding of how
287 SSS influences BMI.

289 *Strengths*

290 The strengths of this study include that the repeated cross-sectional studies reflect a general
291 adolescent population, and the sample sizes are relatively large. The survey was repeated in the
292 same district, at the same time of year, and at the same participant age. Accordingly, the numbers
293 are seemingly comparable.

294 Using SEM analysis allowed us to assess indicators of health-related behavior, including a latent
295 variable of unhealthy behavior as a mediator in the association between SSS and BMI. This method
296 of analyses provides a more comprehensive measurement compared to using the variables as
297 separate indicators. This method also quantifies the measurement errors and unexplained variances
298 and provides a measure of how well the model fits the covariance in the dataset [40]. Further, we
299 used a reflective measurement model when building our latent variable [41](pp. 38-39). Latent
300 variables can be thought of as a hypothetical construct that reflecting a co-variating pattern that is
301 not directly observable, such as personality [41](page 38). Latent variables might represent a structure
302 otherwise observed as a clustering behavior [42].

303   We consider the model-fit to be good, still, we consider the theory behind the model as more
304 important than the model fit in evaluating to what extent the model reflects the hypothesized theory
305 [19](pp. 262-263).
306   We also used a subjective measure of sociodemographic status. Subjective measures of
307 sociodemographic affiliation are validated through the use of the Mac Arthur Scale of Subjective
308 Social Status [43]. These measures have also been found to reveal information not detected by using
309 objective measures of sociodemographic affiliation[12].
310
311 *Limitations*
312   SEM is considered a potentially powerful tool; however, it comes with additional statistical
313 costs [44]. Unlike regression analyses, in SEM, all connected variables are assumed to display a
314 linear association, which does not necessarily reflect reality. Moreover, SEMs are highly dependent
315 on the correct specification of variables and the association between them. This possible source of
316 error grows with the complexity of the SEM and is especially apparent for cross-sectional data,
317 where the use of mediation is debated because causality cannot be addressed.
318   We used self-reported data including weights and heights to calculate BMI and to define
319 overweight and obesity. Although other standard measures include waist circumference and
320 skinfolds, BMI is recommended when conducting research at a population level [45]. Our self-
321 reported data provide a potential risk of random errors and therefore an underestimation of effect
322 sizes and a lower explained variability by our models. This will affect the power to identify
323 associations and consequently increase the likelihood of type 2 errors: In other words, reduce the
324 likelihood of observing existing associations. Last, our initial ambition of including more latent
325 variables might have been achievable if the questionnaire had originally been designed for the
326 purpose of SEM analyses and included a more detailed recall of dietary intake. Our model also lacks
327 a variable displaying sedentary behavior. Thus, the complex field of adolescent behavior and obesity
328 could have been be explored even more extensively than we have accomplished in this study.
329
330 *Implications*
331   Our finding that unhealthy behaviors mediated the association between SSS and BMI implies
332 that prevention should aim at broad interventions targeting attitudes considering healthy behavior.
333 As lower sociodemographic status is a risk factor for increased BMI, it is essential to develop
334 strategies to prevent OWOB and ensure that these strategies do not enhance the social inequalities in
335 health. The overall consequence is that socio-demographic differences should be kept small to
336 maintain normalweight in the majority of the population.

337 **5. Conclusions**

338   In this repeated cross-sectional study of 15–16 year old Norwegian adolescents, we found that
339 perceived lower sociodemographic status was a risk factor for increased BMI in adolescents in 2017
340 but not in 2002. This could be due to the epidemiological transition. The association between SSS and
341 BMI in adolescents was mediated through exercise as well as cigarette smoking, snuff-use and alcohol
342 drinking. Our finding contributes to the understanding of the complexity of the association between
343 sociodemographic status and OWOB in adolescents.

363

364   **Appendix A**

Table A.1. Description of the variables explored in the SEM for 15–16-year-old adolescents in the District of Oppland, Norway in 2017.

	Variable type	Categories	Use of variable
SSS= perceived family economy[a]	Ordinal	Poor, average, good, very good	Exposure
BMI[b]	Continuous	-	Outcome
Consumption of cakes and candy	Ordinal	Seldom/never, 1–3 times monthly, 1–3 times weekly, 4–6 times weekly, once-twice daily, ≥ 3 times daily	Not used in the model
Consumption of sugar-sweetened carbonated sodas	Ordinal	Seldom/never, 1–6 glasses weekly,1 glass daily, 2–3 glasses daily and ≥4 glasses daily	Mediator
Consumption of lemonade	Ordinal	Seldom/never, 1–6 glasses weekly, 1 glass daily, 2–3 glasses daily and ≥4 glasses daily	Not used in the model
Consumption of energy drinks	Ordinal	Seldom/never, 1–3 times monthly, Once weekly, glass daily, 2–3 times weekly 4–5 times weekly	Not used in the model
Weekly hours of leisure-time workout	Ordinal	0, 1–2, 3–4, 5–7, 8–10 and ≥11	Mediator
Member of sports team	Nominal	Yes/no	Not used in the model
Daily screen-time on school days	Ordinal	Less than 1 hour, 1–2 hours, 3–5 hours > 5 hours	Not used in the model
Cigarette smoking	Ordinal	Never, have quit, occasionally, daily	In latent variable
Snuff use	Ordinal	Never, have quit, occasionally, daily	In latent variable
Ever tried alcohol	Nominal	No/yes	In latent variable
Frequency of daily toothbrushing	Ordinal	Once daily, Once daily, every second day, < every second day	Not used in the model

[a] SSS= Subjective Social Status
[b] BMI= Body Mass Index

365

366   **Appendix B**

Table A.2. Description of included and missing observations in the SEM for the 2017 survey[a]		
	Included in study **N= 1534**	**Not included in study** **N= 141[c]**
Gender (boys)	818 (47.8%)	76 (54%)
BMI[b]; mean (SD[c])	21.4 (3.1)	20.9 (3.2)
	n=1534	n=95
SSS[d]		
Poor	62 (4.0)	5 (4.0)
Average	469 (30.6)	41 (33.0)
Good	832 (54.2)	65 (52.4)
Very good	171 (11.2)	13 (10.5)
Weekly hours of leisure-time workout		
0	150 (9.4)	18 (13.6)
1–2	362 (22.7)	35 (26.5)
3–4	417 (26.1)	27 (20.5)
5–7	362 (22.7)	27 (20.5)
8–10	190 (11.9)	18 (13.6)
≥11	115 (7.2)	7 (5.3)
Sugar-sweetened carbonated sodas		
Seldom/never	169 (10.6.)	23 (19.7)
1–6 glasses weekly	837 (52.4)	73 (62.4)
1 glass daily	234 (14.7)	9 (7.7)
2–3 glasses daily	235 (14.7)	10 (8.9)
≥4 glasses daily	121 (7.6)	2 (1.7)
Cigarette smoking habits		
Never	993 (62.2)	97 (83.6)
Have quit	151 (9.5)	9 (7.8)
Occasionally	236 (14.8)	8 (6.9)
Daily	216 (13.5)	2 (1.7)

[a]*Data from 15–16-year-old adolescents in the District of Oppland, Norway.*
[b]*BMI= Body Mass Index*
[c]*SD= Standard deviation*
[d]*SSS=Subjective Social Status, explored through perceived family economy*

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