

**“THE INFLUENCE OF INDIVIDUAL, FAMILIAL AND  
NEIGHBORHOOD FOOD ENVIRONMENTAL FACTORS ON  
DIETARY BEHAVIORS OF ADOLESCENTS AND SOCIOECONOMIC  
DIFFERENCES- A CROSS-SECTIONAL STUDY”**

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## Summary

**Background:** The consumption of soft drinks and unhealthy snacks is associated with obesity and other adverse health effects in both children and adolescents. Dietary behaviors established during adolescence often persist into adulthood, thus making early interventions particularly important. Identifying potential determinants of dietary behavior at multiple levels is important to inform such interventions aimed at promoting healthy dietary behavior. In addition, unhealthy dietary behaviors are more prevalent among socioeconomically disadvantaged groups compared to their advantaged counterparts. Exploring differences in dietary behaviors and their determinants by socio-economic position, and assessing potential differences in determinants between different socioeconomic groups can inform efforts aimed at addressing socioeconomic differences in dietary behaviors.

**Aim:** The study aimed to explore differences by parental education in the intake of soft drinks and snacks, and their potential determinants, among Norwegian adolescents. The study also explored the association of potential multilevel determinants with these dietary behaviors. Moderation effects of parental education in the association between the dietary behaviors and their determinants was also explored.

**Methods:** A cross-sectional study among 808 7<sup>th</sup> graders was conducted in 28 schools in Oslo; data was collected by using an electronic questionnaire. Parental educational level was used as an indicator of socioeconomic position. Socio-economic differences in the dietary behaviors and in their potential multilevel determinants were assessed using chi-squared test and ANOVA. Multivariate logistic regression was used to identify the association of potential determinants with the dietary behaviors. Moderation effects by parental education were tested. When interactions were detected, multivariate logistic regression was conducted after stratifying the sample by parental educational subgroup. No significant clustering effect was found at the school level, hence multilevel analyses were not conducted.

**Results:** Adolescents with high parental education had a lower consumption of both soft drink and unhealthy snacks compared to those with medium and low education. There was a significant association between most of the included determinants (self-efficacy, parental modelling for soft drink, parental norms, parental rules, perceived accessibility of soft drink at home, perceived accessibility of grocery and fast-food stores, frequency of food purchase and distance to neighborhood fast food stores) and parental education. Perceived paternal modeling,

perceived accessibility at home and frequency of food purchase were positively associated with both dietary behaviors among adolescents after adjusting for relevant confounders. Perceived accessibility of fast-food stores was additionally associated with the consumption of unhealthy snacks. No interaction was found between predictors of soft drink consumption and parental education. There was a significant interaction by parental education in the association between perceived accessibility of snacks at home, perceived neighborhood accessibility of fast-food stores and frequency of food purchase and the consumption of snacks. However, differences in the associations between parental educational groups were in general not large.

**Conclusion:** The results highlight the importance of the home food environment for both dietary behaviors. Results also indicate that the perceived neighborhood accessibility of fast-food stores can influence the intake of snacks. Targeting the determinants identified in this study will be beneficial for improving dietary behaviors in all groups, but can also help in alleviating social inequalities in the behaviors, as these factors are likely to mediate inequalities in the behaviors. There is a need for more studies to explore the moderating effects of parental education.

**Key words:** Dietary behaviors, determinants, socioeconomic position, parental educational level, moderation, adolescents, Oslo.

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## **ABBREVIATION**

**ANOVA:** Analysis of Variance

**BMI:** Body Mass Index

**CCA:** Cronbach's Coefficient Alpha

**CI:** Confidence Interval

**ESSENS:** Environmental determinants of health behavior among adolescents

**FFQ:** Food Frequency Questionnaire

**HBSC:** Health Behavior in School age Children

**HEIA:** Health In Adolescents

**HELENA:** Healthy Lifestyle in Europe by Nutrition in Adolescence

**ICC:** Intra-class Correlation Coefficient

**IBM:** International Business Machines Corporation

**NCDs:** Non-Communicable Diseases

**NIPH:** Norwegian Institute of Public Health

**NSD:** The Norwegian Centre for Research Data

**OB:** Obesity

**OR:** Odds Ratio

**OW:** Overweight

**SCT:** Social Cognitive Theory

**SEP:** Socioeconomic position

**SPSS:** Statistical Package for the Social Sciences

**TACKLE:** Tackling Socioeconomic differences in weight development among youth

**TSD:** Tjenester (Service) for Sensitive Data

**WHO:** World Health Organization

## **1.0 BACKGROUND**

### **1.1 Overweight and Obesity among adolescents as a public health concern**

Overweight (OW) and Obesity (OB) have emerged as a major public health threat globally. The worldwide prevalence of OW/OB have almost tripled in the last four decades(1). The World Health Organization (WHO) reports that more than 340 million children and adolescents between the age 5-19 were found to be obese in 2016 (1) . The prevalence of OW/OB among Norwegian adolescents varies between 11%- 21% depending on different age and gender (2, 3). Norway was facing marked increment in the prevalence of adolescents OW/OB during the last decades (4, 5). Even though the prevalence appears to have reached a plateau, it is still too high (6-8). Obese children and adolescents are more likely to suffer from obesity in their adulthood as the probability increases by five times than those of non-obese children (9). Obesity is related with morbidity across an individual's lifetime (10, 11). The risk of premature onset of chronic illnesses increases with increased BMI in adulthood (1). Childhood obesity is associated with an increased risk of diabetes and cardiovascular disease later in life (1, 11-13). Studies also show that OW in adolescence is positively associated with mortality in adulthood (11). Dietary behaviors are among the energy balance-related behaviors associated with OW and OB(14). It is therefore essential to address dietary behaviors to combat OW and OB and formulate effective strategies to promote healthy behaviors.

### **1.2 Dietary behaviors**

A healthy diet is needed to prevent and protect from various Non-Communicable Diseases (NCDs) and obesity (15). Lower consumption of micronutrients may cause deficiency diseases whereas excess consumption of macronutrients may lead to obesity (16). A healthy diet consists of varied diet including foods which are high in fiber such as fruits and vegetables, whole grains and reducing the amount of foods that contain high sugar, salt and saturated fats (17).

Dietary behavior starts at birth and continues throughout life. The eating and living behavior of childhood shape health for lifetime. Thus, food habits adopted during early life can have impacts on dietary behavior in adulthood. (18-20) The world health organization recognized

dietary habit as one of the major factors in determining excessive body adiposity (15). Increased body fat is associated with the frequent intake of energy dense foods (15, 21).

Adolescence is the period of marked changes in lifestyle including the establishment of dietary behaviors that may persist into adulthood (22). Studies indicate that adolescents are engaged in unhealthy dietary practices with the evidence showing consumption of foods that are high in fats, sugar and salt and low in fruits, vegetables, whole grains and calcium (23). Globally, several studies have shown that many adolescents fail to balance the dietary requirements from various food groups (24-26). Dietary recommendations were not met by many adolescents in Europe as they were found to consume more meat, fats and sweets and less milk, fruits and vegetables than is recommended (27). These findings underline the need of improving dietary habits of adolescents.

The latest dietary survey (Ungkost 3) conducted in Norway suggested that dietary intakes among Norwegian children and adolescents are largely in line with recommendations (28). Despite showing positive trends in food habits in recent studies, high intake of foods with added sugar and saturated fats is still a challenge for a significant proportion of Norwegian adolescents (28-30). These findings highlight the need of more directed and focused interventions which target the determinants that influence dietary behaviors and help in bridging the gaps of social inequalities (30). Thus, exploring the determinants of dietary behaviors is vital.

### **1.2.1 Consumption of sugar sweetened drinks**

Sugar sweetened beverages are high in energy but low in nutrients. Thus, energy dense beverages are more likely to replace more nutritional diet or compliment additional food intake that may contribute to high energy intake and overweight.(31) Several health outcomes like weight gain, obesity, dental erosion have been directly associated with high consumption of sugar sweetened beverages (32-35). Soft drink consumption has also been found to be inversely proportional with the intakes of nutrients rich diet such as milk and calcium (31). WHO recommended that the total energy intake from free sugar should be less than 10 % (15, 36).

The consumption of sugar sweetened drinks has increased among school age children and has contributed to higher calorie counts among youth (37, 38). A study showed that free sugar

contributed 18% energy intake in Norwegian adolescents and 30% of total added sugar intake is from soft drink consumption (39). Despite several efforts which have been carried out in the reduction of consumption, Norwegian adolescents reported high intakes of sugar in the form of various sugar sweetened beverages (40). The Tromso study, from 2019, showed that 61% of males and 32 % of females consumed sugar-sweetened beverage daily. Though these findings suggest the decreasing trend in the intakes of soft drink while comparing with the finding of a previous study, the consumption of sugar-sweetened drinks is still high (40). The HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study identified sugar-sweetened beverages as the most frequently consumed beverage after water and contributes as the major source of energy in the body among Norwegian adolescents (41).

### **1.2.2 Consumption of unhealthy snacks**

Unhealthy snacks (e.g., sweets, chocolates, sweet bakeries, chips etc.) are most likely to be high in fat and sugar, which can be considered as a major contributor to weight gain and obesity (36, 42, 43). Unhealthy snacks could displace micronutrient rich foods in the daily diet and limit the intake of essential nutrients and dietary fiber (39). A study from Norway showed that, as the intake of foods containing added sugar increased, the intake of most nutrients including fruits and vegetables decreased (39).

The consumption of unhealthy snacks is associated with obesity and other cardiovascular diseases in both children and adolescents (44). Despite having several interventions focusing on dietary behaviors, management of obesity is limited unless the excessive consumption of sweets and salty snacks is reduced (45). WHO recommends limiting the intake of prepackaged snacks which are basically prepared on trans- fats and contain high amounts of sugar (e.g. doughnuts, cakes, pies, cookies, biscuits and wafers) (15).

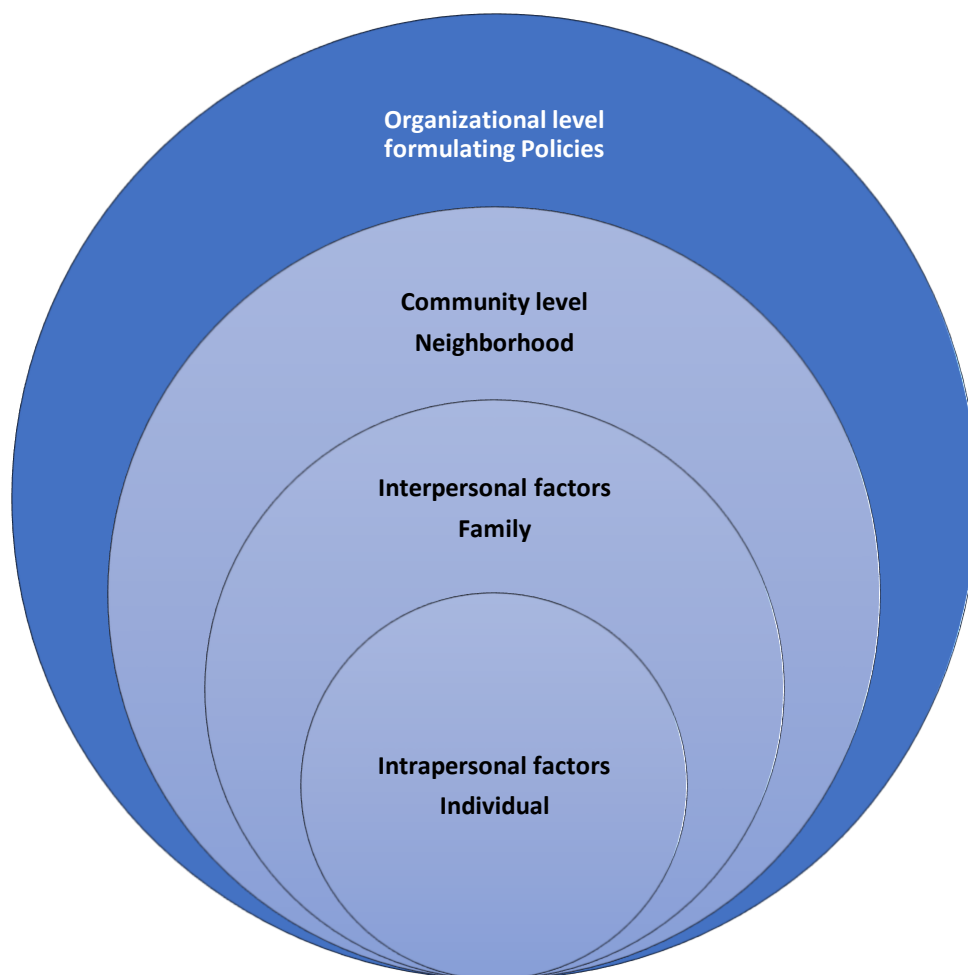
Consumption of snacks has increased significantly over recent decades in different settings (46, 47). A high consumption of snacks containing added sugar has also been documented among Norwegian adolescents (39). Some studies from Norway have looked at the consumption of unhealthy snacks among adolescents, and showed average intakes of 4.5 times per week for different types of snacks (48, 49).

### **1.3 Theoretical perspectives**

A theoretical framework is essential to identify and understand the factors influencing human behaviors. A wide range of theories and conceptual models have been developed to illustrate

the mechanisms that influence health behavior. Most widely used theories for example the theory of planned behavior, the social cognitive theory (SCT) and the social -ecological model are adopted to formulate hypothesis and to explore how different factors impact human behavior. (50) Several studies have discussed the role of theories in shaping food habits. Social-cognitive determinants were the most extensively studied variables during the past decades while more recent studies are increasingly focused on exploring the environmental determinants of dietary behavior, taking into greater consideration the social ecological model. (14) The importance of theories and conceptual framework is even more in the studies of health behavior as they explain behavior and suggest ways to achieve desired behavior (51).

### 1.3.1 Social ecological model



*Figure 1 Social ecological model*

The social ecological model (Figure 1) helps to understand the dynamic interrelationship between individual, community and environment and how these multiple level factors

influence behavior. The influence of all levels are equally important in this model (52). It focuses on the principle of changing environment and provides guidance for the adaptation of healthy behavior (53).

The social ecological model focuses on integrating multiple theories and ensures the involvement of both individual and environmental factors in the development of approaches that are used on studying health behaviors (52). The model is divided into five levels: intrapersonal, interpersonal, organizational, community and public policy (51, 52). Intrapersonal level includes the personal attributes that influence the behavior of the individual, such as knowledge, attitudes, skill, values and beliefs which could influence the performance. Interpersonal level consists of interrelationship and role identity within the family and friends, social support and exposure that could influence the ways of behaving. Community level involves social norms and values, standards, neighborhood networks that assist in perceiving the behavior among individuals, groups and society. Organization plays an important role in establishing the healthy behavior. Formulation of rules and regulation, developing policies and strategies, arranging necessary infrastructures and amenities and facilitating the adoption of recommended guidelines are focused in organizational level. Finally public policy level targets on formulating and implementing standard policies and strategies from the government or municipalities that initiate healthy eating behavior. Cheap and easy access of healthy food and imposing high tax for unhealthy food could also support nutrition intervention. (51, 52, 54)

The variables used in the study can interact within and across the level that could affect the strength and direction of relationship (55). A socio-ecological and multilevel approaches are recommended for studies relating to dietary behavior (56).

### **1.3.2 Social cognitive theory**

Social cognitive theory (SCT) highlights the interaction between the individual and their environment also known as reciprocal determinism (57). Human behavior is the outcome of personal, behavioral and environmental influences that interact with each other. Public health promotion and health activities can be viewed as an illustration of socio-cognitive model where environmental and social factors that are believed to influence health behaviors are controlled to achieve the desired outcomes. The key concepts of SCT are grouped into five categories psychological determinants of behavior, observational learning, environmental determinants of behavior, self-regulation, and moral disengagement (57). These source of influence may not be

of equal strength neither all occur simultaneously but the causation relationship is well established (58).

Individual level psychological determinants can be further categorized as outcome expectation, self-efficacy and collective efficacy (57). The behavior of an individual is not only the results of objective reality but is also based on beliefs and perceptions towards the outcome of behavior. Social cognitive theory is most widely known for self-efficacy and its concepts has been integrated in several other theories and models. (57) Self-efficacy can be defined as the person's beliefs towards his own ability to influence events that affects their living behavior. (59) Self-efficacy has been identified as one of the most important individual determinant of behavior (58). The second concept is central to SCT that emphasizes the human capacity of observational learning. Observational learning is govern by four processes of attention, retention, production and motivation. (57) Albert Bandura has analyzed modeling as one of the learning process through informal observation of human behaviors (60). Environmental determinants of behavior are included in SCT to describe the influences of environmental factor on behavior. The basic approach of environmental determinants is incentive motivation and facilitation in which rewards and punishment are used as well as new structures and resources are developed to modify and achieve the desired behaviors.(57) Accessibility of healthy food outlets can be one example of facilitation of healthy dietary behavior. Fourth constructs of SCT, self-regulation is based on the skill of controlling own's behavior through self-monitoring, goal-setting, feedback, self-reward, self-instruction and enlistment of social support (57). The last categories of SCT, moral disengagement mechanisms allow people to violate moral standards of self-regulation.

The social cognitive theory is broad and describes the influences of multiple factors in human behavior (58). This master thesis looks into behaviors that can potentially be explained by the three first key concepts in the theory: psychological determinants of behavior, like self-efficacy; observational learning, like parental modeling; and environmental determinants of behavior, like perceived accessibility of food at home.

The TACKLE study was based on the social-ecological model, that includes individual, interpersonal, community and environmental factors influencing dietary behaviors, mainly in the home and neighborhood environment. In this master thesis the focus was on the influence of individual, familial and neighborhood determinants of dietary behavior. For example, among individual determinants of dietary behavior, self-efficacy can be placed in the intrapersonal

level of the social ecological model. Parental modelling fits in the interpersonal level and perceived accessibility of food outlets in the neighborhood can be placed in the community level of the social ecological model. However, Banduras social cognitive theory has also been considered in this master thesis to understand and explain the influence of both cognitive and environmental determinants of dietary behavior.

#### **1.4 Determinants of dietary behavior: Intrapersonal, Interpersonal, Neighborhood**

Determinants are used to define the causal relationship between variables whereas the term “correlate” is often used to describe the statistical association or correlations between measured variables and outcome behavior (61). Those factors that influence dietary behavior and demonstrate reproducible association can be defined as determinants of dietary behavior (61). In this thesis, the term determinants is used when exploring factors associated with dietary behaviors since it is assumed that the associations are causal.

Dietary behavior is the product of multiple factors influencing human behavior (20). In order to develop policies, programs or interventions aimed at promoting healthy eating behavior, it is crucial to identify and understand the multiple determinants that influence dietary behavior. The use of theories and conceptual frameworks in order to understand and classify determinants is important in this regard.

##### **1.4.1 Individual determinants (Intrapersonal level)**

Research related to behaviors and health psychology was predominately focused on individual determinants of dietary behaviors where nutritional knowledge, taste preferences, attitudes, and intention were found to influence dietary behavior (20, 62). Evidence also suggests that increased food knowledge and intention were significantly associated with healthy dietary behaviors (14, 63). Taste preference plays important role in determining the food choices (22). Positive attitudes and higher self-efficacy were found to be associated with higher consumption of healthy foods and lower consumption of unhealthy foods (62).

Another individual determinant of dietary behavior is self-efficacy, which is defined as the individual’s beliefs on self-ability to achieve desired behavior or action (64). Dietary self - efficacy refers to the individual’s ability to choose healthy foods and follow healthy dietary habits confronting possible barriers (23). Self-efficacy prompts the initiation, adherence and continuation of healthy behaviors (23). A high level of self-efficacy is essential for making



healthy food choices among adolescents which is mostly associated with reduction in consumption of foods high in fats, sugar and salt (22). Self-efficacy has been identified as an important correlate of dietary behaviors among adolescents (49, 65). Individual determinants have explained relatively large variance in dietary behavior. However, the influence of determinants at other levels cannot be ignored. It is therefore important to study other determinants in addition to individual determinants. (62)

#### **1.4.2 Family Determinants (Interpersonal)**

The consumption of soft drink has been found to be significantly correlated with its easy accessibility and availability at home. Similarly, availability and accessibility of soft drinks and fast food at home, food rules of permissiveness and discouragement, parental modelling have been found to be modifiable determinants at family level previously identified in the literature (65-68). Parental influence is significantly associated with the consumption of snacks, sugar sweetened beverages, fruits and vegetables among adolescents(14, 69) Literature also shows an association between poor dietary habits associated and more permissive parenting style (70). Parents here could play authoritative role in setting limits of sugar sweetened beverages by shaping both physical and social environment of their children (70). Parents as the gatekeepers of dietary activities in many families are responsible for the accessibility and availability of food in the home. On the other side, with increasing age the exposure of the adolescence changes from home to school environment and peer influences (14).

Family environment and the parental role is highly influential in the establishment of dietary behavior of children and adolescents (71). Albert Bandura has analyzed modeling as one of the teaching learning process through informal observation of human behaviors(72). Literature shows a positive association between the high intake of sweets and fats in children and negative parental modeling and easy availability of soft drink at home (73).

#### **1.4.3 Neighborhood Determinants**

Food environment comprises any possible opportunities to obtain food and is most likely to impact health (74, 75). Food environment influences the choices of food and its consumption (76). The availability and accessibility of food outlets is considered influential in determining dietary behavior (77). Availability refers to the presence of stores in the surrounding whereas

accessibility refers to the ease of getting food in terms of location, distance and travel time (78).

Adolescents growing towards autonomy are more likely to be influenced by the neighborhood food environment (49, 79). Better understanding of factors influencing adolescents food choices and eating behaviors is essential to develop effective nutritional policies and intervention (80).

The research on children's diet and food environment is extensive. However, there are limited studies looking at broader neighborhood environmental factor with the potential to influence dietary behavior (74, 77). Limited and varied measures used to illustrate food environmental factors leads to inconsistency in findings (74, 78). Therefore the evidence for the association between food environmental factors and dietary behavior is moderate (74). Evidence suggests that neighborhood environmental factors did not show consistent associations with the consumption of soft drink and fast food intake (79). The reviews suggest the need of well-designed research with validated measures to address the inconsistency in findings (74, 78, 79). More studies to explore the neighborhood level determinants of dietary behaviors among youth have been called for (68).

### **1.5 Socioeconomic differences in dietary behavior**

Social inequalities in health are an ongoing problem worldwide (81-83). Prevalence of overweight is higher among socioeconomically disadvantaged groups compared to their advantaged counterparts (84, 85). Despite being a welfare state, Nordic countries experience large social disparities in health (83, 86, 87). Socioeconomic differences in health stems from several factors, and diet is one of the most common risk factors for major health problems (88-90).

Socioeconomic gradients in dietary behaviors have been documented in several studies as evidenced by systematic reviews (68, 91). People with low socioeconomic status are more likely to not meet dietary recommendations compared to those with a higher socioeconomic status (92). Studies shows that children with low socio-economic status are more likely to exhibit unhealthy food habits (91, 93). Children and adolescents with a low socioeconomic background are more likely to develop obesity. That is related to the fact that they are more

likely to consume sugar sweetened drinks and foods high fat, refined sugar, and to have a lower intake of fruits and vegetables. (65, 68, 88, 91, 93, 94)

In Norway, people with higher education and high income are most likely to eat healthier diets compared to lower socioeconomic groups (95). A higher consumption of soft drinks and fast food has been documented among Norwegian adolescents with lower socio-economic backgrounds (88).

### **1.6 Socioeconomic differences in determinants of dietary behavior**

Associations between determinants of dietary behaviors and socioeconomic position have been documented in the literature (94, 96). Among intrapersonal variables, self-efficacy and children's nutrition knowledge were found to be consistently positively associated with socioeconomic position in most studies included in a systematic review (91). Similarly, different environmental exposures related to the socioeconomic level of the individual/family may contribute to the development of personal food choices (91). Accordingly, availability and accessibility of food at home and parental food intake were consistently associated with the socioeconomic status of the family according to a systematic review of the literature (91). Higher availability of healthy foods in high socioeconomic families such as fruits and vegetables and less availability of junk food and soft drinks than in low socioeconomic families may contribute to differences in dietary behavior between socioeconomic groups (94). Evidence also shows that parents of high socioeconomic position (SEP) were more likely to model healthy dietary behaviors compared to those with a lower socioeconomic position (96, 97). Home food environmental factors are consistently associated with SEP however there is not enough research to conclude which dietary predictors differs by SEP (91). Furthermore, the association between neighborhood food environment and socioeconomic position has been less explored (91, 96), suggesting a gap in existing literature. Exploring these associations between the determinants and SEP is important as it can indicate factors that can potentially mediate/explain socioeconomic differences in the behaviors.

Another possibility is that the associations between dietary behaviors and some of these determinants can be moderated by SEP; i.e. the strength or direction of the association between the determinant and dietary behavior can differ by SEP (for example, the determinant can be associated with the dietary behavior in one SEP group but not the other) (94). Exploring such differences is important as it can help to tailor interventions to specific groups.

Studies exploring such moderation effects indicate that the consumption of snacks among adolescents was positively associated with peer snack consumption only in low socioeconomic groups (91, 98). Higher availability of non-core food and sweetened drinks at home was positively associated with higher consumption of sweetened drink in low socioeconomic groups, whereas no any association was found among middle and high socioeconomic groups when moderated by occupation and employment. (94). Perceived availability of fruits and vegetables in restaurants was positively associated with lower consumption of fruits and vegetables in low affluence groups but not in high affluence families. (91). It has also been suggested that adolescents from low SEP can be more likely to be influenced by the availability of fast-food stores in the neighborhood which may contribute in higher intakes of unhealthy snacks and soft drinks (91, 94, 99).

The relationship between dietary behavior and socioeconomic position has been well investigated. However, studies looking at the association between SEP and determinants of dietary behaviors have namely focused on the individual and interpersonal level, in particular in a Norwegian context. Few studies have also looked at the moderating effect of SEP in the association between determinants and dietary behaviors, and most of these studies did not include determinants at different levels of the social ecological model. While some studies showed a stronger association between food environments and dietary behavior in lower socioeconomic groups, evidence for socioeconomic inequalities in association between environmental determinants and dietary behavior is not clear (100), and thus requires further exploration.

Improving the dietary behavior of adolescents from low socioeconomic population could help in minimizing social inequalities (101). More research is needed to assess multilevel determinants of dietary behaviors, to assess whether there is an association between these determinants and parental education among adolescents in Norway, and to explore whether the association between these determinants and dietary behavior varies by parental educational level.

### **1.7 Indicators of socioeconomic position among adolescents**

Level of educational achievement, professional or occupational status and income are commonly used indicators to measure the socioeconomic status of a person (102). For adolescents, parental socioeconomic position is often used as the indicator of socioeconomic

position, however, it has also been suggested to add additional measures of SEP that are easy to respond by adolescents. (103)

**Parental Education:** Education is considered a good indicator of socioeconomic status and the strongest predictor of good health compared to other indicators (104). Education is also associated with entry into the job market and with income (105). Education is the socioeconomic indicator which shows most consistent associations with dietary behavior. (91, 106). Parental capacity to access, interpret and execute health information can be determined by the level of education attained by parents (91). Health related behavior is socioeconomically influenced by education and the knowledge gained through education could make people more receptive to health information and enable its implementation efficiently. (106, 107).

## **1.8. Objectives of the study**

### **1.8.1 General Objectives:**

To explore individual, familial and neighborhood determinants of soft drink and snack intake among adolescents, and explore whether this association differs by parental education.

### **1.8.2 Specific objectives:**

- To explore whether soft drink and unhealthy snack consumption varies by parental education among Norwegian adolescents
- To explore whether there is an association between the multilevel determinants and parental education.
- To identify the association between factors at the individual, family and neighborhood food environmental level and the consumption of soft drinks and unhealthy snacks by adolescents.
- To explore whether parental education moderates the association between the determinants and the intake of soft drink and snack.

## **2.0 METHODS (SUBJECTS AND DESIGN)**

### **2.1 Study design**

In this master thesis, data from a sub-project of the Tackling Socioeconomic Differences in Weight Development among Youth (TACKLE study), a cross-sectional school-based study, was used.

## **2.2 The TACKLE study**

The TACKLE study was a school-based study, one of the main aims of which was to investigate multilevel determinants of different lifestyle behaviors including dietary behaviors among adolescents, and to assess factors explaining socioeconomic differences in these behaviors. The study was divided into qualitative and quantitative parts and included multiple research group members.

The quantitative component of the study, from which data for this thesis has been used, is a cross-sectional study conducted among 7<sup>th</sup> graders of 28 schools in Oslo, and will be described further below.

## **2.3 Pretest and test-retest**

The recruitment of schools for pretest and test-retest was based on school registers from municipalities close to Oslo (Bærum, Drammen and Asker). For the pretest, the first school we contacted in Bærum consented to participate in the study. The questionnaire was pre-tested among a sample of 28 adolescents followed by a cognitive interview among 10 adolescents. Participants were 7<sup>th</sup> graders and the pretest was conducted in October 2019. Modifications were made to the questionnaire, which was then test-retested. Eleven schools were invited to participate in the test-retest, and 3 accepted the invitation. All 157 7<sup>th</sup>-graders attending these schools were invited, and 90 consented to participate (57% response rate). Of these, 82 (91%) participants participated in both test and retest (November-December 2019).

## **2.4 Sample and sampling method**

A total of registered 94 primary school based in Oslo municipality were invited to participate in the main study. Target participants were students of 7<sup>th</sup> grade from all schools in Oslo. Prior to the invitation, schools were assessed for eligibility and special schools and schools with few students in the 7<sup>th</sup> grade were excluded. The schools were recruited via invitation letter, emails and calls.

Of the invited schools, 28 consented to participation. A total of 1540 students from these schools were invited to participate. Written informed consent from a parent or legal guardian was obtained for 939 (63%) of these students. A total of 898 students (58%) participated in the study.

The study was approved by The Norwegian Centre for Research Data (NSD).

## **2.5 Data Collection**

The data collection was conducted at respective schools during school hours. Data collection was conducted at two different time-points, due to Covid-19. From February-April 2020, 11 schools participated, and from September-November 2020, 17 schools participated.

The students answered an internet-based questionnaire (Nettskjema) over a period of approximately 45-60 minutes. Questions were mainly related to dietary behavior, and the determinants of these behaviors.

The students answered the questionnaire on an iPad in their classroom, or were taken to a computer room in groups. Test personnel from UiO and teachers from the respective schools were present to answer questions, resolve technical issues and ensure that the students replied independently from each other.

## **2.6 Ethical consideration**

The project obtained approval from The Norwegian Centre for Research Data (NSD) before starting the study. Invitation to schools was sent to get consent from principals. Written informed consent from the parents was taken for the participation of adolescents. Verbal assent was taken from the students after providing information about what participation involves and clearly stating that the participation was voluntary. Anonymity and confidentiality were ensured and data were directly collected into a secure data storage facility (TSD), where they were also stored. Access to data was through TSD during analysis.

## **2.7 Development of questionnaire**

The questionnaire used in the study was developed by researchers in the TACKLE study, after a review of the literature. Most measures were taken from or adopted/modified from previous measures with evidence of validity and reliability.

The questionnaire of the TACKLE study included questions regarding sociodemographic characteristics, dietary behaviors, physical activity, sedentary behavior as well as multilevel determinants of these behaviors. In this thesis, questions on socio-demographic characteristics, dietary behaviors and determinants at multiple levels were used. These variables are further described below.

## **2.8 Variables**

Socio-demographic characteristics used in this master thesis were age, gender, ethnicity and parental educational level. The dietary behaviors studied were the intake of unhealthy snacks and carbonated soft drinks with sugar. Determinants of dietary behaviors at individual, familial and neighborhood level are identified in intrapersonal (self-efficacy), interpersonal (parental modeling, parental norms and parental rules) and perceived environmental determinants levels (perceived accessibility of food at home, perceived accessibility of neighborhood stores, distance to neighborhood stores and frequency of food purchase).

### **2.8.1 Socio-demographic characteristics**

The information related to gender, age, ethnicity was used to assess sociodemographic characteristics of the participants. A single question with two answer options; girl and boy were asked to identify the gender of the participants. The age of the adolescents was measured by asking the year and month of birth. The adolescents were also asked if their mother and father were born in Norway or another country. Those having both parents born in a country other than Norway were defined as ethnic minorities (108).

### **2.8.2 Socioeconomic background (Parental educational level)**

The students' socioeconomic background was based on parental educational level. Parental educational level was assessed to identify the socioeconomic position of the participants. The information of parental education was obtained from the parental informed consent form where parents were asked to answer questions regarding their level of education.



“What is the highest formal education of this guardian?” The education variable was divided into six levels (1: No education/ has not completed primary school, 2: primary school/lower secondary school, 3: upper secondary school, 4: Vocational school, 5: University-/college (up to 4 years), 6: University/college (more than 4 years). These six categories were merged into lower (1-4), medium (5) and higher (6) educational levels where the highest educated parent determined the parental education level of the family; if only one parent reported education, that information was used. The three levels of SEP were chosen based on the known gradient in health inequalities (Dahl et al., 2014).

### **2.8.3 Dietary behaviors**

#### ***2.8.3.1 Soft drinks with sugar consumption***

In this study the consumption of sugar sweetened soft drinks refers to the intake of carbonated drinks with sugar (e.g., coca cola). Intake of these drinks was measured through two questions concerning frequency and amount of consumption during weekdays and one question for amount of consumption during weekends. The question measuring frequency of consumption on weekdays was; “On weekdays (Monday to Friday), how often do you drink carbonated soft drinks with sugar (e.g., Cola, Solo)?”

Participants were asked about the frequency of soft drink intake in weekdays and allowed to answer between never/seldom to every weekday. They were further asked to specify the amount of drinks they consume on a day. “On weekdays: On a day that you drink soft drinks with added sugar, how many glasses, cans or bottles do you usually drink on such a day”? To make the measurement easier, the amount of drinks in glasses (0.25L), cans (0,33L) and bottles (0.5L) were also provided, including picture illustrations.

For weekend days, adolescents were asked to answer the number of glasses, cans or bottles that they usually drink on Saturdays and Sundays. “In the weekend’s days, how many glasses, cans or bottles of soft drinks with added sugar do you usually drink in total on Saturdays and Sunday?” This question has five answer categories starting from none to 5 glasses or more.

The consumption of soft drink in both weekdays and weekends days were combined to compute a total weekly consumption of sugar sweetened soft drinks.

The questions regarding soft drink consumption were adopted from a previous study (109). The test-retest study showed an ICC of 0.65 for the weekly consumption measure. Since the variable was highly skewed, a binary variable was computed using the sample median intake. The cut-off for these categories were  $\leq 1$  liter per week for low consumption and  $>1$  liter for high consumption.

### ***Unhealthy snacks consumption***

In this study the consumption of unhealthy snacks refers to the intake of sweets, chocolate, cake, muffins, sweet cookies, and salty snacks. Consumption of unhealthy snacks was assessed through four questions on frequency of snacks consumption; “How often do you usually eat chocolate or candy?”, “How often do you usually eat buns or muffins?”, How often do you usually eat sweet cookies? (safari cookies, bixit cookies)”, “How often do you usually eat salty snacks? (e.g., chips, popcorn and other)” All these questions had seven answer categories from never/rarely to two times or more per day. The response on the questions related to intake of unhealthy snacks were further combined to obtain one variable of total snacks consumption. The variable was dichotomized to times per week based on the distribution of the variable. The cut-off for these categories were  $\leq 3$  times/week for low consumption and  $> 3$  times/week for high consumption. The questions regarding the consumption of snacks was adopted from the HEIA study and further modified after the test-retest study.(110)

## **2.8.4 Determinants of dietary behavior**

### ***Intrapersonal level***

#### ***2.8.4.1 Self-efficacy***

Self-efficacy for healthy eating was assessed using a four item likert-type scale. The participants were asked to answer how strongly they agreed or disagreed with each statement. The statement began with: “Whenever I can choose what I want to eat”; and follows the statement that are supposed to assess self-efficacy as: “I find it difficult to choose low-fat foods (e.g. fruit rather than chips or “low fat” milk rather than “full cream” milk), “I find it easy to choose a healthy snack when I eat in between meals (e.g. fruit or reduced-fat yoghurt)”, “I believe I have the knowledge and ability to choose/prepare healthy snacks”, “I find it difficult to choose healthy meals/snacks when I am with friends”. The question had five answer categories ranging from strongly agree to strongly disagree

with a neutral midpoint. Reverse coding was done for negative statements (i.e 1 and 4) in order to maintain the accurate scoring. The total score was summed up to compute the self-efficacy score. A high score represents a high self-efficacy for healthy eating. The scale assessing self- efficacy was originally developed based on concepts from Bandura’s social cognitive theory (111). Self-efficacy scale on the TACKLE study were adopted from Dewar et al. 2012 (111) and further modified as per the objectives of the study. The test-retest study after modifying the questions shows ICC of 0.61 in average for all four items.

### ***Interpersonal Level***

#### ***2.8.4.2 Parental Modeling***

Parental modelling was assessed using a single item scale where the adolescents were asked to answer how much agreed or disagreed with the statement applies for both mother and father separately. “My mother drinks fizzy drinks with added sugar several times a week”, “My father drinks fizzy drinks with added sugar several times a week”, “my mother eats fatty or sweet snacks several times a week”, “My father eats fatty or sweet snacks several times a week” The answer had five answer categories on a 5-point scale from 1(strongly agree) to 5 (strongly disagree) with a neutral midpoint. Four different variables were created for assessing parental modelling. The test- retest study showed ICC of >0.65 for 3 out of 4 constructs. One construct showed ICC 0.38 and 59 % agreement. The questions regarding parental modelling were modified from a validation study. (112)

#### ***2.8.4.3 Parental norms***

Parental norms were measured by asking adolescents to answer in what extent do they agree or disagree with the given statement that applies for father and mother separately. “My mother thinks I should eat healthy”, “My mother is a healthy eater”, “My father thinks I should eat healthy”, “My father is a healthy eater.” The answer had five answer categories on a 5-point scale from 1 (strongly agree) to 5 (strongly disagree) with a neutral midpoint. The test- retest study showed acceptable percentage agreement (70% and 81%) and ICC=0.40 respectively for these variables. The questions regarding parental norms were adopted from a study related to the role of social norms in adolescents eating and activity behaviors. (113)

#### ***2.8.4.4 Parental rules***

Parental rules related to the consumption of sugar-sweetened soft drinks and unhealthy snacks were assessed by asking adolescents to rate on what extent the given statement applies to their parents. All statement begins with “My parents have clear rules for”. The response option has 5 categories with score ranging from 5 (very true) to (not at all). A high score indicates high prohibitive rules, meaning strict parental rules regarding the consumption of sugar sweetened soft drinks and unhealthy snacks. Parental rules for intake of soft drink were assessed by using a single statement “My parents have clear rules for how much soft drinks with added sugar (e.g. fizzy drinks, fruit squash, cordials etc) I can drink. Parental rules for intake of unhealthy snacks were assessed through 2 statements “My parents have clear ruler for how much sweets (chocolate, ice cream, cookies, cake, buns etc.) I can eat”, “My parents have clear rules for how much salty snack (chips, salty peanuts etc.) I can eat”.

The questions on parental rules related to consumption soft drink with sugar and unhealthy snacks were adopted and modified from the Family processes study (114). The initial validation studies were conducted by assessing internal reliability (Cronbach’s alphas 0.77/0.82) and test-retest reliability (ICC 0.74/0.74) (114). The questionnaires assessing parental rules were further validated by the researchers of the TACKLE study doing test-retest survey with ICC of 0.67 for soft drinks, and 0.60-0.72 for unhealthy snacks.

#### ***Perceived environmental determinants***

##### ***2.8.4.5 Food accessibility at home***

Food accessibility at home were measured using a multi-item Likert-type scale by asking the 7<sup>th</sup> graders to answer to what extent they agreed or disagreed with the different statement related to their access of soft drinks and unhealthy snacks at their homes. The answer has 5 option categories with scores ranges from completely agree (5) to completely disagree (1). A high score indicates the higher accessibility of both soft drinks and unhealthy snacks at homes. All statements begin with “At home”. Accessibility of soft drinks was measured using a scale with 3 items “We usually have soft drinks for dinner at weekend days”, “There are usually soft drinks available”, “we usually have soft drinks for dinner at week days”. Accessibility of unhealthy snacks at home was assessed using a scale with two items: “I have almost always had easy access to sweet and salty snacks”, “We usually have sweet

and salty snacks (e.g sjokolade, godteri, is, potetgull, muffins, boller) available” . The questions for soft drink was adopted from family processes study (114); the question for unhealthy snacks was adopted from a study by Benarroch et al. (112) The results of test retest showed ICC of 0.67 and 0.76 for accessibility of soft drink with sugar and snack respectively.

#### ***2.8.4.6 Perceived accessibility of neighborhood stores***

Perceived accessibility of three types of neighborhood stores (grocery stores; kiosks and gas stations; fast food places) was assessed by asking adolescents to what extent do they agreed or disagreed with the different statement related to their access of neighborhood stores. The answer option has 5 option categories with scores ranges from completely agree (5) to completely disagree (1). A high score indicates the higher accessibility of neighborhood stores. Statement are as follows: “There are grocery stores (e.g., Kiwi, Rema 1000) within easy walking distance from my home”, “There are stores (kiosks, gas stations) are within easy walking distance from my home”, “There are fast food places (McDonalds, kebab) within easy walking distance from my home”. These questions were modified from a previous study. (115) These questions were modified questions based on results of the test-retest study.

#### **2.8.4.7 Distance to neighborhood stores**

Perceived travel time to nearest neighborhood stores was assessed by asking the adolescents how long it takes to walk from home to the nearest stores. The question has 6 categories answer options ranging from 1-5 minutes, 6-10 minutes, 11-20 minutes, 21-30 minutes, 31 minutes or more and don’t know. Since the frequency for some response categories were too few, further recoding into three categories was made as follows: 1-5 minutes, 6-10 minutes and 11 minutes or more. Different questions were used to assess information for different types of stores: grocery stores (Kiwi, Rema), Kiosks (7 eleven, Narvesen) and fast-food restaurant (McDonalds). These questions were modified from a scoring protocol of NEWS-Y (Neighborhood Environment Walkability scale for youth) (116).

#### ***2.8.4.8 Frequency of food purchase***

Frequency of food purchase was measured by asking adolescents to answer how often do they visit neighborhood stores to buy food and drink. The question has 7 categories answer

option ranging from: never, once in two weeks, one times in a week, two times in week, three times in a week, 4-5 times in a week, 6 or more times in a week. The seven categories were further recoded to three categories due to a low number of participants in some categories: never or once in two week, one to two times in a week, and three or more than three times in a week. The test retest showed ICC of 0.69 for frequency of food purchase. The questions related to frequency of food purchase were modified from the ESSENS study. (117)

## **2.9 Statistical Analysis**

Descriptive statistics were conducted to find mean and confidence intervals for continuous variables and percentage distributions for categorical variables. SEP differences in the dietary behaviors and corresponding determinants were assessed using chi-squared test and ANOVA (Tuckey Post hoc test was conducted to identify where the differences lie in between the parental educational groups). Univariate regression and thereafter multivariate logistic regression were used to explore the association of different determinants with the dietary behaviors. Factors found to be significant at the 0.05 level in univariate analyses were included in multivariate models. To assess the moderating effect of education in the association between the determinants and the dietary behaviors, interactions were checked for. When significant interaction effects were detected, associations within each educational subgroup were separately explored for the specific determinants.

Since the recruitment in this study was at the school level, we checked for clustering effect at the school level. Less than 4% of the total variation in the outcome variables was at the school level, thus multilevel analyses were not conducted. IBM SPSS statistics 27 was used to conduct the statistical analysis (IBM Corporation, 2015).

### 3.0 RESULTS

#### 3.1 Sample

The Demographic characteristics of the sample are presented in table 1. The mean age of the participants was 12.4 (*SD*: 0.3) years. Of the 808 participants included in the analyses, 54.6% were girls. Ethnic minorities (those with two parents born outside of Norway) represented 28.7% of the sample. The distribution of highest parental educational level was as follows; 25.5% with low education, 22.5% with medium education, and 52% with high parental educational level.

**Table 1 Sociodemographic characteristics of the sample**

	Parental education				P- value
	Total N=808 (100%)	Low N=206 (25.5%)	Medium N=182 (22.5%)	High N=420 (52%)	
Age (years) mean (SD)	12.4 (0.3)	12.3 (0.3)	12.4 (0.4)	12.4 (0.3)	<b>0.013<sup>a</sup></b>
<b>Gender</b>					0.247 <sup>b</sup>
<b>Male</b>	367 (45.4)	99 (48.1)	89 (48.9)	179 (42.6)	
<b>Female</b>	441 (54.6)	107 (51.9)	93 (51.1)	241 (57.4)	
<b>Ethnicity n %</b>					<b>&lt;0.001<sup>b</sup></b>
<b>Ethnic Norwegian</b>	564 (71.3)	71 (35.7)	134 (74.9)	359 (86.9)	
<b>Ethnic minority</b>	227 (28.7)	128 (64.3)	45 (25.1)	54 (13.1)	

n varies slightly due to missing data

<sup>a</sup> Anova test

<sup>b</sup> Chi-square test

Bold value represents significant differences.

#### 3.2 Association of dietary behaviors with parental educational level

Among those with high parental educational level, 63.6% had a low consumption of soft drink; the respective percentages among those with low and medium education were 42.7 % and 44.0 % respectively. Among those with high parental education level, 56.9% had a low consumption of unhealthy snacks; the respective percentages among those with low and medium were 43.7%

and 51.1% respectively. There were significant differences in the consumption of soft drink ( $p < 0.001$ ) and unhealthy snacks ( $p = 0.003$ ) by parental educational groups (Table 2.).

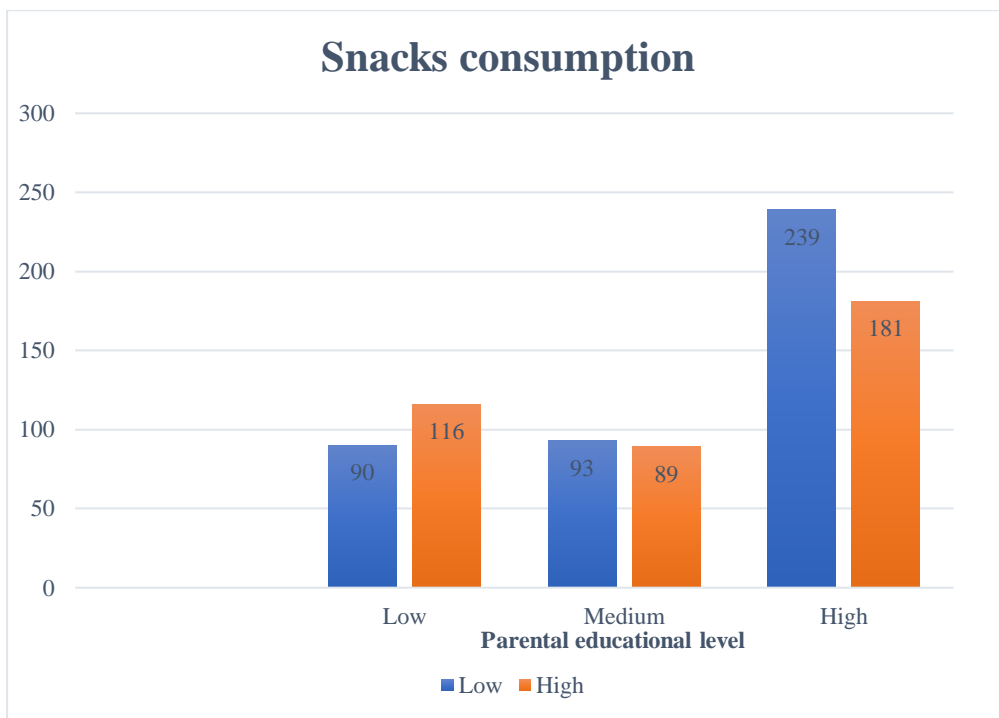
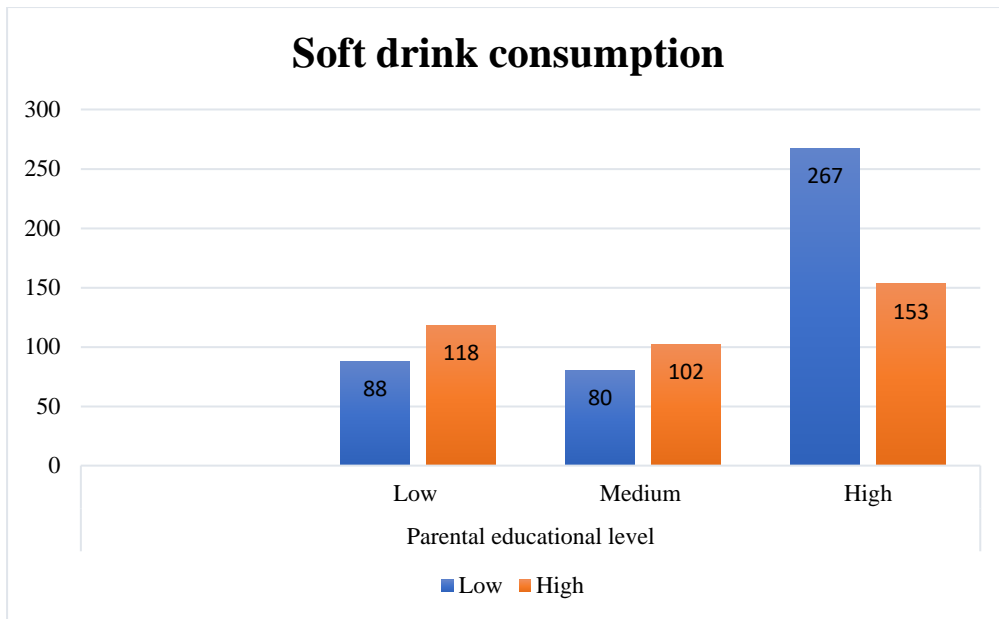
**Table 2. Association of dietary behaviors with parental educational level**

		Total N (%)	Parental education			P- value
			Low	Medium	High	
<b>Soft drink</b>						
	Low	435 (53.8)	88 (42.7)	80 (44.0)	267 (63.6)	<b>&lt;0.001<sup>a</sup></b>
	High	373 (46.2)	118 (57.3)	102 (56.0)	153 (36.4)	
<b>Unhealthy snacks</b>						
	Low	422 (52.2)	90 (43.7)	93 (51.1)	239 (57)	<b>0.003<sup>a</sup></b>
	High	386 (47.8)	116 (56.3)	89(48.9)	181 (43)	

<sup>a</sup> Chi-square test

Bold value represents significant differences





**Figure 2 Association of dietary behavior with parental education**

### **3.3 Association of determinants of dietary behaviors with parental educational level**

Descriptive statistics for self-efficacy for healthy eating, perceived parental modelling, perceived parental rules, parental norms, perceived home accessibility, perceived accessibility

of neighborhood stores, frequency of food purchase and distance to neighborhood stores are presented in table 3.

### **3.3.1 Self-efficacy for healthy eating**

The total mean score of self-efficacy for healthy eating was 3.67 (95% *CI*: 3.61 to 3.73), for total parental educational level. There were significant differences of self-efficacy for healthy eating between parental educational level ( $P=0.013$ ) with mean scores of 3.52 (95% *CI*: 3.40 to 3.64) for low, 3.68 (95% *CI* 3.56-3.79) for medium and 3.74 (95% *CI* 3.66-3.83) for high educational groups. The significant difference in self-efficacy for healthy eating was between the low and high parental educational group, according to Tukey post-hoc test.

### **3.3.2 Perceived parental modeling**

Parental modeling of soft drink had mean scores of 1.64 (95% *CI*: 1.58 to 1.70). Parental modeling of snacks had mean score of 1.87 (95% *CI*: 1.81 to 1.93) Parental modeling of soft drinks showed a significant difference ( $p = 0.008$ ) between parental educational level, with mean scores of 1.70 (95% *CI*: 1.57 to 1.82), 1.78 (95% *CI*: 1.63 to 1.92) and 1.55 (95% *CI*: 1.47 to 1.63) for low, medium and high educational level respectively. The significant differences in parental modeling for soft drink was between medium and high parental educational group, according to Tukey post-hoc test.

### **3.3.3 Perceived parental norms**

The 7<sup>th</sup> grader experienced high parental norms for dietary behavior with mean scores of 4.55 (95% *CI*: 4.50 to 4.60). Parental norms showed a significant difference ( $p=0.002$ ) between parental educational groups with mean score of 4.43 (95%*CI*: 4.32 to 4.55), 4.49 (95%*CI*: 4.38 to 4.60) and 4.64 (95% *CI*: 4.57 to 4.70) for low, medium and high educational groups respectively. The significant difference in parental norms was between the low and high parental educational group, according to Tukey post-hoc test.

### **3.3.4 Perceived parental rules**

The mean score for perceived parental rules for soft drink and unhealthy snacks for the total sample was 3.61 (95% *CI*: 3.53 to 3.69) and 3.68 (95% *CI*: 3.60 to 3.75), respectively. There was a significant difference between parental educational level in rules related to unhealthy snack consumption ( $p = 0.028$ ), where adolescents from parents with high education

experienced more permissive rules (*mean: 3.76, 95% CI: 3.676 to 3.86*) compared to low parental education (*mean: 3.53, 95% CI: 3.37 to 3.68*) and medium (*mean 3.65, 95% CI: 3.49 to 3.81*). The significant difference in parental rules for snacks was between the low and high parental educational group, according to Tukey post-hoc test.

### **3.3.5 Perceived accessibility of food at home**

The mean score of accessibility of soft drink for the total sample was 2.00 (95% CI: 1.94 to 2.00), and unhealthy snacks was 2.64 (95% CI: 2.56 to 2.72). There were significant differences of accessibility of soft drinks between parental educational groups ( $P < 0.001$ ) with mean score of 2.12 (95% CI: 1.98 to 2.25) for low, 2.20 (95% CI: 2.0 to 2.31) for medium and 1.86 (95% CI: 1.78 to 1.94) for high educational level. There was no significant difference in the accessibility of snacks at home by parental education.

### **3.3.6 Perceived accessibility of neighborhood stores**

The perceived accessibility of neighborhood stores was higher for grocery stores (kiwi, Rema) than for kiosks, gas station and fast-food places. The mean scores of accessibility of grocery stores (e.g. kiwi, Rema) was 4.62 (95% CI: 4.55 to 4.68), accessibility of stores (kiosks, gas station) was 3.96 (95% CI: 3.88 to 4.05) and fast food place was 3.50 (95% CI: 3.40 to 3.59). There were significant differences in the perceived accessibility of grocery stores ( $p$  value: 0.052) and fast-food places ( $p$  value: 0.009) between parental educational groups.

The mean scores for perceived accessibility of grocery stores were 4.53 (95% CI: 4.39 to 4.67) for low, 4.53 (95% CI: 4.38 to 4.67) for medium and 4.69 (95% CI: 4.61 to 4.78) for high educational groups. The mean scores for fast food places were 3.69 (95% CI: 3.50 to 3.88) for low, 3.53 (95% CI: 3.31 to 3.74) for medium and 3.39 (95% CI: 3.25 to 3.53) for high educational groups. The significant difference in perceived accessibility of neighborhood stores (fast food places) was between low and high parental educational groups, according to Tukey post-hoc test.

### **3.3.7 Frequency of food purchase**

Adolescents with parents with high educational background reported a lower frequency food purchase in a week compared to those from medium and low educational background. Majority (57.6%) of adolescents with high parental education has never been for food purchase or has been once in a two week, while only 29.5% of adolescents from low and 42.2% from medium parental educational level reported the same.

Adolescents from parents with low educational level had higher frequency of purchase. 27.5% adolescents from low parental educational groups had purchased food 3 or more times in a week. However only about 11 % each from both medium and high educational groups had higher number of purchases in a week. There were significant differences in the frequency of food purchase between parental educational groups. (P value: <0.001)

### **3.3.8 Perceived distance to neighborhood stores**

40.1% of adolescents with high parental education thought that it takes more than 10 minutes to reach to the nearest kiosks. The respective percentages for those with low and medium parental education were 38.4% and 37.6%.

Grocery stores were perceived as the nearest neighborhood stores by the majority of participants. More than 51 percent adolescents thought grocery stores were within 1-5 minutes distance whereas 54.6%, 45.3% and 53.5 % of participants were from low, medium and high parental educational level respectively.

A high percentage of the participants had perceived that fast food restaurants were located within more than 10 minutes of distance (61.8% adolescents were from high parental educational level, 56.9% and 49% from medium and low educational level respectively).

There were significant differences in the perceived distance to neighborhood fast food restaurant between parental educational groups (p value: 0.005) (such differences were not found for distance to nearest kiosks and grocery stores).

### **Table 3 Association of determinants of dietary behaviors with parental educational level**

<b>Determinants of dietary behavior</b>	<b>Total</b>	<b>Low</b>	<b>Medium</b>	<b>High</b>	<b>P value<sup>a</sup></b>
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	
<b>Self-efficacy</b>	3.67 (3.61, 3.73)	3.52 (3.40, 3.64)	3.68 (3.56, 3.79)	3.74 (3.66, 3.83)	<b>0.013</b>
<b>Parental modeling</b>					
• Soft drink	1.64 (1.58,1.70)	1.70 (1.57,1.82)	1.78 (1.63, 1.92)	1.55 (1.47, 1.63)	<b>0.008</b>
• Snacks	1.87 (1.81,1.93)	1.84 (1.72, 1.97)	2.00 (1.87, 2.13)	1.83 (1.74, 1.92)	0.089
<b>Total Parental norms</b>	4.55 (4.50, 4.60)	4.43 (4.32, 4.55)	4.49 (4.38, 4.60)	4.64 (4.57, 4.70)	<b>0.002</b>
<b>Parental rules</b>					
• <b>Soft drink</b>	3.61 (3.53, 3.69)	3.49(3.32, 3.66)	3.56 (3.40, 3.74)	3.69 (3.59, 3.79)	<b>0.104</b>
• <b>Snacks</b>	3.68 (3.60, 3.75)	3.53 (3.37, 3.68)	3.65 (3.49, 3.38)	3.76 (3.67, 3.86)	<b>0.018</b>
<b>Perceived food accessibility at home</b>					
• Soft drinks	2.00 (1.94, 2.00)	2.12 (1.98, 2.25)	2.20 (2.06, 2.31)	1.86 (1.78, 1.94)	<b>&lt;0.001</b>
• Sweet and salty snacks	2.64 (2.56, 2.72)	2.64 (2.48, 2.79)	2.60 (2.43, 2.77)	2.66 (2.54, 2.77)	0.870
<b>Perceived accessibility of neighborhood stores</b>					
• Grocery Stores	4.6 (4.55, 4.68)	4.53 (4.39, 4.67)	4.53 (4.38, 4.68)	4.69 (4.61, 4.78)	<b>0.052</b>
• Stores(kiosk, gas station)	3.96 (3.88, 4.05)	3.84 (3.65, 4.02)	4.03 (3.85, 4.02)	4.00 (3.88, 4.11)	0.236
• Fast food	3.50 (3.40, 3.59)	3.69 (3.50,3.88)	3.53 (3.31, 3.74)	3.39 (3.25, 3.53)	<b>0.009</b>

	Parental education			Total N	P value <sup>b</sup>
	Low	Medium	High		
<b>Frequency of food purchase</b>					
Never or Once in two week	29.5%	42.2%	57.6%	374 (47.0%)	<b>&lt;0.001</b>
1-2 times in a week or more	43.0%	46.1%	31.3%	299 (37.6%)	
3 times or more in a week	27.5%	11.7%	11.1%	122 (15.3%)	
Total	100%	100%	100%	100%	

### Distance to Neighborhood stores

<b>Kiosks</b>	1-5 minutes	35.0%	28.7%	31.0%	253 (31.5%)	0.524
	6-10 minutes	26.6%	33.7%	28.9%	236 (29.4%)	
	11 minutes or more	38.4%	37.6%	40.1%	314 (39.1%)	
<b>Grocery stores</b>	1-5 minutes	54.6%	45.3%	53.5%	418 (51.9%)	0.234
	6- 10 minutes	30.7%	38.7%	34.6%	278 (34.5%)	
	11 minutes or more	14.6%	16.0%	11.9%	109 (13.5%)	
<b>Fast food restaurant</b>	1-5 minutes	19.8%	10.5%	10.7%	104(13.0%)	<b>0.005</b>
	6-10 minutes	31.2%	32.6%	27.4%	237 (29.6%)	
	11 minutes or more	49.0%	56.9%	61.8%	461 (57.5%)	

<sup>a</sup> Anova test

<sup>b</sup> Chi-squared test

Bold value represents significant differences

### 3.4 Association between determinants and dietary behaviors

Self-efficacy for healthy eating, perceived parental modeling, perceived parental rules perceived accessibility of food at home and frequency of food purchase were significantly associated with both soft drink with sugar and unhealthy snacks consumption ( $p < 0.05$ ) in the univariate regression analyses (Table 4). Parental norms and perceived accessibility of

neighborhood stores (kiosks) were significantly associated with soft drink intake. Perceived accessibility of neighborhood stores (fast food places) and distance to fast food were significantly associated with snacks consumption.

Results of multivariate regression analyses are presented in table 5. Perceived paternal modeling and perceived accessibility of soft drink at home were significantly positively associated with soft drink intake ( $p < 0.05$ ) with odds ratio of 1.33 (95% CI: 1.07 to 1.65) and 1.78 (95% CI: 1.43 to 2.20) respectively. As the total scores for the parental modeling increases by one, the odds of high sugar sweetened beverages consumption increase by 33%. For every one unit increase in the accessibility of sugar sweetened beverages at home, the odds of high sugar sweetened beverages intake increased by 78 %.

The odds ratio for frequency of food purchase indicates that compared to adolescents who purchase more (3 or more times in a week), adolescents who have less (never or once in two week) frequency of purchase were less likely to have a high intake of soft drink with sugar OR= 0.49 (95% CI: 0.29, 0.80).

Perceived accessibility of snacks at home, perceived accessibility of neighborhood fast food stores and frequency of food purchase were significantly associated with unhealthy snacks intake ( $p < 0.05$ ). For every one unit increase in the accessibility of unhealthy snacks at home, the odds of high unhealthy snacks intake increase by 60 % (odds ratio: 1.60, 95% CI: 1.39-1.86). As the total score for perceived accessibility of neighborhood fast food stores increases by one, the odds of high unhealthy snacks consumption increase by 16% (odds: 1.16, 95% CI: 1.04, 1.30). Adolescents who have less (never or once in two week) frequency of purchase were less likely to have high intake of snacks compared to adolescents who purchased more (3 or more times in a week). (OR= 0.34, 95% CI: 0.21,0.56). Parental modeling of snacks shows borderline significant association with snacks consumption OR=1.16 (95% CI 0.97, 1.39).

**Table 4 Determinants of soft drink and snack intake: Univariate regression**

Dietary behavior	Determinants			
		OR	95 %CI	P value
<b>Soft drink</b>				
	Self-efficacy	0.69	0.59, 0.81	<0.001
	Parental modeling	1.82	1.53, 2.17	<0.001

Parental norms	0.63	0.50,0.78	<b>&lt;0.001</b>
Parental rules	0.76	0.68, 0.87	<b>&lt;0.001</b>
Perceived Accessibility of soft drinks	2.19	1.83, 2.60	<b>&lt;0.001</b>
Accessibility of neighborhood stores			
Stores Grocery (Kiwi, Rema)	0.87	0.75, 1.00	0.061
Stores (Kiosks, gas stations)	0.89	0.79, 0.99	<b>0.034</b>
Fast food places	1.06	0.96, 1.17	0.227
Frequency of food purchase			
<i>Never or once in two week</i>	0.39	0.26, 0.60	<b>&lt;0.001</b>
<i>1-2 times in a week</i>	0.82	0.54, 1.26	0.365
Reference category: 3 times or more in a week			
Distance to neighborhood stores			
Kiosks	1.00	0.72, 1.40	0.98
<i>1-5 minutes</i>	1.22	0.87, 1.71	0.25
<i>6-10 minutes</i>			
Grocery	0.88	0.58, 1.34	0.55
<i>1- 5 minutes</i>	0.90	0.58, 1.40	0.65
<i>6-10 minutes</i>			
Fast food restaurant	1.01	0.66, 1.55	0.96
<i>1-5 minutes</i>	1.18	0.86, 1.61	0.31
<i>6-10 minutes</i>			
Reference category: 11 minutes or more			
<b>Unhealthy snacks</b>			
Self-efficacy	0.85	0.73, 1.00	<b>0.053</b>



Parental modeling	1.35	1.15, 1.58	<b>&lt;0.001</b>
Parental norms	0.87	0.71, 1.06	0.182
Parental rules	0.75	0.66, 0.86	<b>&lt;0.001</b>
Home accessibility of snacks	1.68	1.48, 1.92	<b>&lt;0.001</b>
Accessibility of neighborhood stores			
<i>Stores Kiwi, Rema)</i>	1.00	0.87, 1.16	0.989
<i>Stores (Kiosks, gas stations)</i>	1.03	0.93, 1.16	0.540
<i>Fast food places</i>	1.19	1.08, 1.32	<b>&lt;0.001</b>
<i>Frequency of food purchase</i>			
<i>Never or once in two weeks</i>	0.30	0.19, 0.46	<b>&lt;0.001</b>
<i>1-2 times in a week</i>	0.44	0.28, 0.68	<b>&lt;0.001</b>
Reference category: 3 times or more in a week			
<sup>a</sup> Perceived distance to neighborhood stores			
Kiosks	1.06	0.76, 1.47	0.739
<i>1-5 minutes</i>	1.06	0.76, 1.49	0.729
<i>6-10 minutes</i>			
Grocery	1.36	0.89, 2.08	0.158
<i>1- 5 minutes</i>	1.09	0.70, 1.70	0.695
<i>6-10 minutes</i>			
Fast food restaurant	1.91	1.24, 2.94	<b>0.003</b>
<i>1-5 minutes</i>	1.33	0.97, 1.82	<b>0.078</b>
<i>6-10 minutes</i>			
<sup>a</sup> Reference category: 11 minutes or more			

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\*Univariate regression.

OR=odds ratio, CI: Confidence interval.  
 Bold values represent significant differences (p<0.05).

**Table 5 Determinants of soft drink and snack intake: Multivariate regression**

<b>Dietary behavior</b>			
	<b>OR</b>	<b>95 %CI</b>	<b>P value*</b>
<b>Soft drink</b>			
Self-efficacy	0.88	0.72, 1.07	0.191
Perceived Parental modeling	1.33	1.07, 1.65	<b>0.009</b>
Perceived Parental Norms	0.82	0.64, 1.05	0.119
Perceived Parental rules	0.89	0.77, 1.04	0.139
Home accessibility of soft drink	1.78	1.43, 2.20	<b>&lt;0.001</b>
Perceived Accessibility of neighborhood stores			
Stores (Kiosks, gas stations)	0.91	0.80, 1.04	0.153
<sup>a</sup> Frequency of food purchase			
Never or once in two weeks	0.49	0.29, 0.80	<b>0.005</b>
1-2 times in a week	0.82	0.50, 1.34	0.425
<sup>a</sup> Reference category: 3 times or more in a week			
<b>Unhealthy snacks</b>			
Self-efficacy	0.99	0.82, 1.19	0.932
Parental modeling	1.16	0.97, 1.39	0.098
Parental rules	0.92	0.78, 1.08	0.302
Home accessibility of snacks	1.60	1.39, 1.86	<b>&lt;0.001</b>
Accessibility of neighborhood fast food places	1.16	1.04, 1.30	<b>0.007</b>

<sup>a</sup> Frequency of food purchase

<i>Never or once in two week</i>	0.34	0.21, 0.56	<b>&lt;0.001</b>
<i>1-2 times in a week</i>	0.48	0.29, 0.78	<b>0.003</b>

<sup>a</sup> Reference category: 3 times or more in a week

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\*Multivariate regression.

OR=odds ratio, CI: Confidence interval.

Bold values represent significant differences (p<0.05).

Models are adjusted for Age, gender, ethnicity, data collection time pre and post corona and parental education.

### **3.5 Interactions by parental education in the association between determinants and dietary behaviors**

No significant interactions by parental education were detected for the association between different determinants and soft drink intake.

Significant interactions by parental education were obtained in the association between accessibility of snacks at home (for medium vs. high education) interaction p= 0,046, accessibility of fast-food stores (for medium vs. high education) interaction p=0.023, and frequency of food purchase (for low vs. high education) interaction p= 0.022 and the intake of snacks. Stratified analysis showed that the OR (CI) for the association between accessibility of snacks at home and the intake of snacks was 1.40 (1.02, 1.91) for those with medium parental education and 1.79 (1.47, 2.19) for those high parental education. The OR (CI) for the association between the perceived accessibility of fast-food stores and the intake of snacks was 1.44 (1.13, 1.82) for those with medium education and 1.10 (0.94, 1.28) for those with high parental education. The OR (CI) for the association between the frequency of food purchase (never or once in two weeks vs 3 or more times per week) and the intake of snacks was 0.17 (0.07, 0.42) for those with low parental education and 0.55 (0.27, 1.13) for those with high parental education (Table 6).

**Table 6 Predictors of snack intake in different parental educational groups: multivariate regression**

Dietary behavior	Low parental education		
	OR	95% CI	P value*
<b>Unhealthy snacks</b>			
Home accessibility of snacks	1.70	1.22, 2.37	<b>0.002</b>
Neighborhood accessibility (fast food places)	1.07	0.85, 1.35	0.553
<sup>b</sup> Frequency of food purchase			
<i>Never or once in two weeks</i>	0.17	0.07, 0.42	<b>&lt;0.001</b>
<i>1-2 times in a week</i>	0.26	0.11, 0.61	0.002
<i>Reference category: 3 times or more in a week</i>			
<b>Medium parental education</b>			
Home accessibility of snacks	1.40	1.02, 1.91	<b>0.037</b>
Accessibility of neighborhood stores (fast food)	1.44	1.13, 1.82	<b>0.003</b>
Frequency of food purchase			
<i>Never or once in two week</i>	0.47	0.14, 1.58	0.223
<i>1-2 times in a week</i>	0.80	0.25, 2.55	0.705
<i>Reference category: 3 times or more in a week</i>			
<b>High Parental Education</b>			

Home accessibility of snacks	1.79	1.47, 2.19	<b>&lt;0.001</b>
Neighborhood accessibility of snacks (fast food)	1.10	0.94, 1.28	0.233
Frequency of food purchase			
<i>Never or once in two weeks</i>	0.55	0.27, 1.13	0.105
<i>1-2 times in a week</i>	0.68	0.32, 1.46	0.327
Reference category: 3 times or more in a week			

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\*Multivariate regression

OR= odds ratio, CI: Confidence interval.

Bold values represent significant differences (p<0.05).

All models are adjusted for Age, gender, ethnicity and data collection time pre and post corona. Parental modeling was also included.

## **4.0 DISCUSSION**

This chapter will discuss the study sample, methods and results of study.

### **4.1 Methodological considerations**

Before proceeding towards the discussion of results, it is important to reflect upon the methodological strengths and weaknesses of the study as results can be highly influenced by methodological context of the study.

#### **4.1.1 Study sample**

The study population in the Tackle study was 7<sup>th</sup> graders in Oslo. Out of 94 invited, 28 school (30%) consented to participate. A total of 1540 students from these school were invited to participate, where 898 students (58%) participated in the study. Participants with missing data on educational level and were excluded from the analyses. Thus we ended up with 808 number of participants. The sample of the TACKLE study was from a specific geographic location, Oslo, therefore the results cannot be generalized to the rest of the country.

#### **4.1.2 Participation rate school**

The participation rate of the school in the TACKLE study was 30%, which can be considered a rather low participation rate. The rate is slightly better when compared to another school based survey from Norway among a similar age group where only 21% of the invited school participated in the study (118). Similar school participation rates have also been reported in other settings such as Australia (94). There can be several reasons for non-participation from schools, including an increase in invitation in research projects. The few schools that provided a reason for non-participation provided the following reasons: participating in other projects, challenges with 7<sup>th</sup> grade and lack of capacity. Other schools did not provide a reason for non-participation, and it is possible that it is the more motivated schools who ended up participating in the study.

#### **4.1.3 Participation rate students**

Among 1540 students invited to participate, parental consent was received from 939 (63%) students. A total of 898 students (58%) participated in the study. Student participation rate can be considered relatively high when relating with similar cross-sectional school-based studies. Similar studies conducted in other countries had lower participation rate varying from 33% to 47% (94, 119). A cross-sectional study from Norway has also documented 39% participation rate among the school adolescents (114). However, there was 64% participation rate in another Norwegian study, conducted in Norway (117).

The majority (52%) of sample had at least one parent with high education (university education of more than 4 years), suggesting an overrepresentation of parents with higher education compared to the educational attainment data reported by the Municipality of Oslo (120). Previous studies have shown that there can be an under-representation of low educated participants in epidemiological studies (94, 121). Those more interested in issues related to diet and physical activity might be more likely to participate in such surveys, also referred as self-selection bias (122).

#### **4.1.4 Study design**

The TACKLE study used a cross-sectional study design. This type of study design is carried out at a single point in time, and therefore suitable for limited time frame of master thesis. A cross-sectional design was considered appropriate to this study since the objectives were to explore determinants at multiple level. Despite being well suited for the purpose of this master study, a cross-sectional study design can have some limitations. It is difficult to determine the causal relationship between exposure and outcome. (123, 124)

#### **4.1.5 Instrument/ Measurements**

Data were collected through a web-based questionnaire. A web based questionnaire has been found to result in higher response rates compared to paper based questionnaires. (125). A questionnaire is a good means of getting information from a large sample (126). Being relatively inexpensive and easy to administer makes food frequency questionnaires popular among dietary survey (127). Most of the questions in the TACKLE study were adopted and modified as per Norwegian requirements from previously validated dietary questionnaires. The

questions were further pre-tested and test-retested in the current project, which is a strength of the study.

Self-reported data are however subject to bias due to misreporting intentionally or unintentionally. It relies on the adolescents' ability to correctly recall and report the dietary activities and other factors. In addition, socially desirable response bias is a common limitation of self-reported measures.(96)

Parental education level was obtained from the parental consent form, which potentially led to more accurate results than asking the adolescents about their parental education, and also resulted in a low percentage of missing data on parental education.

### **Data collection period**

Due to school closures related to covid-19 restrictions, the data collection was conducted in two periods, two months apart. Assessment of whether there was an association between the period of data collection and the intake of soft drink or snacks was done and no statistically significant difference was found. All analyses were adjusted for data collection period.

## **4.2 Discussion of results**

### **4.2.1 Association of dietary behaviors with parental educational level**

Findings of this study indicate that there were significant differences in the consumption of soft drink and unhealthy snacks by parental educational groups.

#### **Socioeconomic differences in soft drink consumption**

The study demonstrates a correlation between dietary behavior and socioeconomic position. Results in the present study found that the 7<sup>th</sup> graders from the high parental educational groups had a lower intake of soft drink compared to the 7<sup>th</sup> graders in the low and medium parental educational group. Despite having a positive trend in the reduction of soft drink consumption (30), a socioeconomic gradient is still prevalent in the dietary behavior of adolescents (128, 129). Similar findings were documented in one longitudinal study after 20 months where adolescents with a low parental education had higher consumption of soft drink (129). Another study from Norway reported that children from families with high educational level consume soft drink less frequently than those children from lower educational level (88, 128). A similar



cross-sectional study looking for socio-economic differences in dietary behavior reported high intakes of sugar-sweetened soft drink in adolescents from low educated parents (88). On the contrary, a school-based study having family affluence scale (FAS) as a socioeconomic indicator found no association between SES and soft drink and snack consumption among Norwegian adolescents (130). These differences in findings might be due to differences in the measures of SEP. The use of varied SEP indicators indicates different pathways of influence. (131). The strength of association for different variables differs for different SEP indicators (132). Therefore, several studies have recommended the use of multiple indicators of SEP (103, 131-133).

### **Socioeconomic differences in unhealthy snacks consumption**

The study demonstrates adolescents from low parental educational level had higher intakes of unhealthy snacks than those of high parental educational level. This finding is consistent with a similar dietary study from Norway (88). However, another study from Norway showed no significant association of parental education with snacks consumption. (48). In a study conducted in the Netherlands, it was reported that the children from medium socioeconomic status had higher consumption of snacks ( $B=1.22$ , 95% CI 0.22, 2.20) versus high socioeconomic status. However, the study shows no significant difference in snack consumption among children with low and high SEP. (134) The variation in findings may indicate the need of using robust measures of socioeconomic position. Parental education as an indicator of socioeconomic position has showed most consistent associations with dietary behaviors in several studies.(91) Differences between studies could also be due to differences in the specific types of snacks included in the studies.

#### **4.2.2 Association of determinants of dietary behaviors with parental educational level**

Results from the present study indicated that different multilevel determinants of dietary behaviors are associated with parental education.

Self-efficacy from interpersonal level was associated with parental educational level. This finding was consistent with the findings of a systematic review (91). In addition, a study exploring socioeconomic variations in adolescents' dietary behavior reported lower level of self-efficacy for reducing unhealthy food in adolescents from mothers with low education (119).

4 out of 7 home food environmental factors were associated with parental education. Parental modeling for soft drink, parental norms, parental rules for snacks and perceived accessibility of soft drink at home from household level showed significant differences by parental educational level. The findings of a systematic review show a positive association between parental modeling and education (91). In a study conducted in Belgium, an association was found between parental education and parental modeling. Mothers with a higher educational level demonstrate better parental food practices.(135). Similar to our findings, a study conducted among 11-year-old children in Netherlands has also reported the association between parental modeling, home availability of soft drink and maternal education. While no environmental determinants for snacks consumption were found to be associated with maternal education (134). Parental modeling for snacks and perceived accessibility of snacks at home showed no association with parental educational level in our study.

In contrast to our findings, a cross-sectional survey conducted among adolescents in Norway has reported parental rules for soft drink consumption is positively associated with parental education (136). The study has also reported accessibility of soft drink is inversely associated with parental education, which is in accordance with our findings.(136)

3 out of 7 neighborhood food environmental factors were associated with parental education. Perceived accessibility of neighborhood grocery stores and fast-food stores, frequency of food purchase and distance to fast food restaurants from community level were significantly associated with parental education. Finding of a systematic review looking for the association between dietary predictors and socioeconomic position shows no consistent associations between neighborhood factors and parental education (91).

The possible explanation for these inconsistencies could be the use of varied measures of determinants at the neighborhood level. We have measured perceived accessibility of neighborhood stores and perceived distance to neighborhood stores rather than availability of neighborhood stores. Availability only refers if stores are physically present in the neighborhood or not, whereas distance measure the tentative duration required to reach the stores. Furthermore, accessibility refers to the features that facilitate the access of neighborhood stores.

The findings of our study shows higher perceived accessibility of neighborhood grocery stores among adolescents with high parental education. While a higher perceived accessibility of

neighborhood fast food stores was found among those with parents with lower education. These findings are in line with a study exploring the association between neighborhood deprivation and neighborhood food environment conducted in Oslo. Neighborhood SEP has been found to be associated with neighborhood food environmental factor such as presence of grocery stores and restaurants (137).

A lower perceived distance to neighborhood fast food stores was found among those with parents with lower education. In this regard, objective mapping of the food environment in Oslo was done in the TACKLE study, and preliminary results (not published) indicate a higher prevalence of fast food stores in lower income neighborhoods.

The frequency of food purchase was found to be higher among adolescents with low parental education, who also reported having a higher amount of money for food purchase (results not shown). A study conducted among youth, aged 10-14 in Baltimore has also reported the higher expenditure of money is associated with higher frequency of purchase among low income families (138). Another study from New Zealand have found positive association between amounts of daily food money and food purchase (139). A study conducted in Australia has reported education being a socioeconomic indicator is weakly to moderately associated with food purchasing behavior (132). To the best of our knowledge, not many studies have investigated the association between frequency of food purchase and parental education.

Due to the limited literature related to the association between neighborhood level food environment and parental education, it is difficult to compare our findings with the existing literature. Even though several of the potential determinants explored in the current study did not show statistically significant associations with the included dietary behaviors, for some of the determinants a pattern towards a positive or negative association was apparent. In addition, some of the factors, and in particular the neighborhood environmental factors are more likely to become more important as the adolescents grow older and start using the neighborhood environment more. Thus, it is important to explore the socioeconomic differences in these determinants, as these differences can mediate differences in dietary behaviors.

#### **4.2.3 Determinants of soft drink and snack intake**

The study uses a social ecological framework to identify multilevel predictors of soft drink and unhealthy snacks consumption. The social ecological model helps the researcher to conceptualize how the multi-level determinants influence dietary behavior (114).

## **Soft drink consumption**

Perceived paternal modeling, perceived accessibility of soft drink at home and frequency of food purchase were significantly positively associated with soft drink consumption among adolescents after adjusting for age, gender, ethnicity, and data collection period (pre and post corona). Adolescents whose parents drink soft drink with sugar several times a week were more likely to consume soft drink. These findings are consistent with a study conducted in 23 states of USA where adolescents were around 3 times more likely to consume soft drinks 5 or more times in a week if their parents are regular consumer of soft drinks. (140). In addition, systematic reviews have also reported a positive association of soft drink intake with parental modeling (66, 70, 79). Perceived accessibility was found as one of the important correlates of soft drink consumption among 11 and 13 year old Norwegian adolescents (129). Results from another Norwegian study also found, in accordance with our results, perceived parental modeling, perceived accessibility at home and frequency of food purchase to be positively associated with soft drink consumption. (49, 141). A cross-sectional survey conducted in eight European countries has found family related factors were significantly associated with soft drink consumption (142).

Although not statistically significant, the results of the present study indicate a trend towards an inverse association between self-efficacy, parental rules and soft drink intake as documented in other studies. A study conducted in Belgium has reported inverse relationship between self-efficacy for healthy eating, and strict parental rules with soft drink consumption (143). Another Norwegian study found that self-efficacy and parental rules to be significantly inversely associated with both soft drink and unhealthy snacks consumption (49). A review study has also reported permissive parental rules positively associated with soft drink consumption (70, 142). However more restrictive dietary behavior may lead to increased preferences for restricted food resulting in unhealthy food consumption (144, 145).

## **Snack consumption**

Parental modeling (borderline significant), perceived accessibility of snacks at home, perceived accessibility of neighborhood fast food stores and frequency of food purchase were significantly associated with the intake of unhealthy snacks.

In relation to parental modeling, maternal modeling was found to be positively associated with sweet snack and high fat snack consumption as reported by two different studies conducted in

Australia and Netherlands.(146, 147). Results from a Norwegian study among adolescents have documented a positive association between perceived home accessibility and snacks' consumption (49). A school based cross-sectional survey conducted among eight school in Netherlands found that higher accessibility of food was associated with higher snacks consumption, which is in accordance with our results (147). These findings, together with our results indicate that the home food environment is an important arena to address in order to reduce unhealthy snacks consumption particularly in this age groups. A review study of family correlates of dietary behavior has also found family and household factors to be significantly associated with adolescents dietary behavior (148).

In relation to neighborhood food environment, two different studies conducted in USA and Canada has reported higher consumption of non-core foods among those having greater access to neighborhood fast food stores (149, 150). Conversely, a study conducted in Canada have reported less consumption of unhealthy foods in children having better accessibility to neighborhood stores.(151). A possible explanation for these inconsistent finding could be the differences in the types of stores. A supermarkets is likely to sell more healthy foods than convenience stores or fast food stores (152). A Norwegian study among adolescents has found the frequency of food purchase as an important correlate of the consumption of snacks and highlights the need of addressing food purchasing behavior using different approaches (49). A cross-sectional study has documented perceived higher accessibility of neighborhood stores was associated with more frequent purchase and unhealthy diet consumption. (153). In this regard, adolescents should be encouraged for healthy purchase and parents here could play role in limiting the purchase of unhealthy foods by reducing unnecessary financial advantages. Studies shows that the food prices were inversely associated with purchase of foods and can influence the consumption of both healthy and unhealthy food. (154). Increasing prices and tax for non-core foods and offering subsidies for healthy choices could also contributes in the reduction of purchasing and consumption of unhealthy foods.

#### **4.2.4 Interactions by parental education in the association between determinants and dietary behaviors**

No significant interactions by parental education were detected for the association between different determinants and soft drink intake. Our findings are inconsistent with a similar moderation study that reported, the association of self-efficacy with girls sweetened drink consumption was stronger among those with low and middle educational level (94). Another

cross-sectional study conducted among Norwegian adolescents has also reported stronger association between parental modeling and soft drink consumption among those with plans of higher education.(155). However, the indicator of socioeconomic position used in that study was adolescents' plan for higher education, hence different from the current study.

A combination of home food environmental factors and neighborhood factors predicted snack consumption and associations were moderated by parental educational level. Accordingly, significant interactions by parental education were obtained in the association between accessibility of snacks at home (for medium vs. high education), accessibility of fast-food stores (for medium vs. high education) and frequency of food purchase (for low vs. high education) and the intake of snacks.

Perceived accessibility of food at home was a predictor of unhealthy snacks consumption in all groups but the association was slightly stronger in those with medium parental education. Stratified analysis shows OR (CI) for the association between accessibility of snacks at home and the intake of snacks was 1.40 (1.02,1.91) and 1.79 (1.47,2.19) for those with medium and high parental education respectively. A previous study looking for socioeconomic differences among 9–13-year adolescents did not find any interaction by maternal education in the association of home accessibility and snacks consumption (94).

A systematic review with meta-analysis investigating the association between the (theory of planned behavior) predictors and healthy dietary behavior found no association was moderated by individual level socioeconomic status (92). The systematic review has only studied theory of planned behavior variables whereas a social ecological framework has been applied in our study exploring multilevel determinants of dietary behavior. Indeed, this is supported by the findings of our own study where no association between a personal level predictor and dietary behavior was moderated by parental education, both for soft drink and snack intake.

Perceived accessibility of neighborhood fast food stores has been identified as a predictor of unhealthy snacks consumption and this association was slightly stronger and significant in those with medium parental education compared to those with high parental education. This findings is also supported by several moderation studies as unhealthy dietary behaviors were found to be associated with neighborhood availability of stores and the association was moderated by socioeconomic position. (99, 156, 157). A study conducted in Hongkong reported positive association between perceived availability of neighborhood stores and fast

food consumption only in low socioeconomic position.(158). A study conducted in Finland had similar findings where adolescents from low socioeconomic background have stronger relationship with availability of neighborhood fast food stores and unhealthy snacks consumption.(157). However, in the current study, this association was detected for those with medium education but not for those with low education.

A systematic review investigating socioeconomic differences in the association between the food environment and dietary behavior however found no clear evidence to support the moderating effect of education in the association between food environment (including availability of foods, access and proximity) and dietary behavior (100). The inconsistent findings may be due to the difficulties in comparing the measures of food environment used in different contexts. Food environment comprises of broad factors; availability, accessibility, distance, proximity, etc and different studies have different assumptions regarding these factors influencing dietary behavior.(100)

Frequency of food purchase from neighborhood food environmental factor has been identified as an important correlate of unhealthy snacks consumption. The association between frequency of food purchase (never or once in two week) and snacks consumption is stronger among adolescents with low parental education compared to those with medium and high parental education. Studies shows people living in low SEP neighborhoods have greater access to both healthy and unhealthy food outlets (159). However, some past studies have also reported that deprived neighborhood have lesser access to grocery stores having healthy food (160). Accessibility of food outlets might influence the purchasing behavior (78, 161), and the type of food outlets available in a neighborhood can influence what type of food is purchased. It can however be argued that the measures frequency of food purchase used in the study haven't specified the types of purchase. It could be both healthy and unhealthy purchase in the any types of food outlets. It is therefore important to observe the purchasing behavior of adolescents and encourage them for healthy purchase particularly in low parental educational groups. No other study looking at the moderating effect of socioeconomic position in the association between food purchase and dietary behavior could be identified.

It is important to view the results of the moderation and subgroup analyses in the present study in view of the limitation in sample size. Checking for interactions and conducting stratified analyses requires a large sample size with planning for such analyses ahead of data collection. Such sample size estimation was not conducted for this purpose in this study. There is a need

for more studies with a larger sample size to further explore moderation effects and conduct stratified analyses by parental education.

In summary, the findings of the present study indicate that several factors influence the dietary behaviors of adolescents, irrespective of their parental educational level. Several of these determinants vary by socioeconomic position. Thus, these factors are likely to mediate social inequalities in dietary behaviors. Thus, targeting these factors will be beneficial for improving dietary behaviors in all groups, but can also help in alleviating social inequalities in the behaviors.

## **5.0 STRENGTH AND LIMITATIONS OF THE STUDY**

The strength of the study includes the relatively large sample size of the study for the overall analyses. The study included multilevel determinants of dietary behavior, thus addressing a gap in existing literature. Variables used in the study had displayed evidence of validity or reliability in previous studies, and pre-testing and test-retesting were done before the actual survey. Despite having several strengths, this study also has some limitations. The data were cross-sectional, limiting the observation of changes over time and restricting causal inferences. There also appeared to be an overrepresentation of children of parents with high education in the present study. Measurements were based on self-reported data among a young population group, potentially leading to issues with reporting accuracy and social desirability.

## **6.0 CONCLUSIONS AND FURTHER IMPLICATION**

The findings of the present study indicate that adolescents with lower parental education had relatively higher consumption of both soft drink and unhealthy snacks than adolescents with medium and high parental educational level. Self-efficacy, perceived parental modeling for soft drinks, parental norms, parental rules, perceived home accessibility of soft drink, perceived neighborhood accessibility of grocery and fast-food stores, frequency of food purchase and distance to neighborhood fast food restaurant were associated with parental education. Perceived paternal modeling, perceived home accessibility and frequency of food purchase were identified as important predictors of soft drink and snack consumption. Results also indicate that the perceived neighborhood accessibility of fast-food stores is associated with the intake of snacks. Targeting the determinants identified in this study can be beneficial for improving dietary behaviors of adolescents in similar settings in general, but can also help in



alleviating social inequalities in the behaviors, as these factors are likely to mediate inequalities in the behaviors. Some moderation effects of parental education in the association between determinants and snack intake were found.

The findings highlight the importance of home food environmental factors for the improvement of dietary behaviors among adolescents. In addition, neighborhood factors are likely to become more important as adolescents grow older and start using their neighborhood more. Future interventions aimed at promoting these dietary behaviors should target parents, by encouraging them to be good role models of healthy eating, as well as limiting the purchase and accessibility of unhealthy foods and drinks both at home and neighborhood. The moderating effects identified should also be taken into consideration and explored further in future studies.

Future research can consider longitudinal studies as it can provide better evidence to draw causality inferences. Further, it is recommended to conduct additional research regarding the mediating roles of determinants in the association between parental education and dietary intake.

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## **LIST OF APPENDICES**

**Appendix 1: Questionnaire – relevant survey items**

**Appendix 2: Ethical approval from Norwegian social science data services**

## Appendix 1: Questionnaire – relevant survey times

### Spørreskjema elever hovedstudie kopi

Takk for at du hjelper oss med å svare på disse spørsmålene om kosthold, fysisk aktivitet og stillesittende atferd.

Det er frivillig å svare på disse spørsmålene, og alle svarene du gir er hemmelige. Ingen på skolen din, eller andre du kjenner får, rar vite hva du har svart.

Spørsmål som er markert med stjerne (\*) er obligatoriske og må svares på før du kan ,gå videre. Hvis du er usikker på hva du skal svare, velg det du tror er mest riktig.

Lykke til!

1. Skolens navn \*;

\_\_\_\_\_

2. ID-nummer, \*

\_\_\_\_\_

3. Er du jente eller gutt, \*

- Jente
- Gutt

4. Hvilket år er du født; \*

2006

2007

2008

2009

Annet år

5. Skriv året du er født \*

Dette elementet vises kun dersm alternativet! «Annet år» er valgt i spørsmålet.

**6. I hvilken måned har du fødselsdag? \***

**8. I hvilket land er moren din født?**

Norge

Annet land

**9. I hvilket land er faren din født?**

Norge

Annet land

NÅ KOMMER NOEN SPØRSMÅL OM HVA DU DRIKKER PÅ HVERDAGER

12.a PÅ HVERDAGER. 1(mandag til og med fredag), hvor ofte drikker du valgte brus MED sukker (f.eks Coca Cola)?

Hvor ofte fra mandag til fredag?

0 Aldri/sjeldent

Q 1 dag

0 2 dager

0 3 dager

0 4 dager

0 5 dager



13a.PA HVERDAGER: Når du drikker brus MED sukker, hvor MANGE glass, brusbokser eller flasker drikker du vanligvis på en slik dag?

Fyll inn antall glass (0,25l), brusbokser (0,33l) eller halvliters flasker som du vanligvis drikker på en hver dag når du drikker brus med sukker. Sett et Kryss for hver linje.

	Ingen	1	2	3	4	5 eller fla-:
Glass(0.25l)	0	0	0	0	0	

Bokser (0.331)

0 0 0 0 0 0

Flasker (0,51)

0 0 0 0 0 0

-

-

14a. I HELGEN: Hvor MANGE glass, brusbokser eller flasker brus MED sukker drikker du vanligvis til sammen på lørdag og søndag?

Legg sammen det du pleier å drikke på lørdager og søndager.

	Ingen	1	2	3	4	5 eller flere
Glass (0,251)	0	0	0	0	0	0
Bokser { 0,33Q	0	0	0	0	0	0
Flasker (0,51)	0	0	0	0	0	0
•• ]						

## KOSTHOLDSVANER

De neste spørsmålene handler om mat og drikke. Vi er klar over at det er forskjell fra dag til dag. Prøv derfor så godt du kan gi et "gjennomsnitt". Der du er usikker, svar det du tror passer best.

1. Hvor ofte spiser du vanligvis SJOKOLADE OG GODTERI?

- 0 Aidri/sjeldent
- 0 Mindre enn 1 gang i uken
- 0 1-2 ganger per uke
- 0 3-4 ganger per uke
- 0 5-6 ganger per uke
- 0 1 gang per dag
- 0 2 ganger eller mer per dag

2. Hvor ofte spiser du vanligvis BOLLER OG MUIFIFINS?

- Aldri/sjeldent
- Mindre enn 1 gang i uken
- 1-2 ganger per uke
- 3-4 ganger per uke
- 5-6 ganger per uke
- 1 gang per dag
- 2 ganger eller mer per dag

3. Hvor ofte spiser du vanligvis SOTE KJEKS? (f.eks. safari kjeks, bixit kjeks)

- Aldri/ sjeldent
- Mindre enn 1 gang i uken
- 1-2 ganger per uke
- 3-4 ganger per uke
- 5-6 ganger per uke
- 1 gang per dag
- 2 ganger eller mer per dag

Side 11

4. Hvor ofte spiser du vanligvis SALT SNACKS? (f.eks. potetgull, popcorn og lignende)

- Aldri/ sjeldent
- Mindre enn 1 gang i uken
- 1-2 ganger per uke
- 3-4 ganger per uke
- 5-6 ganger per uke
- 1 gang per dag
- 2 ganger eller mer per dag

## NABOLAGET DITT

De neste spørsmålene handler om nabolaget ditt. Et nabolag er området du bor i, og områder som ligger en 15-20 minutters gåavstand fra ditt hjem .

### 2. Butikker og andre offentlige steder i ditt nabolag

Sånn ca. hvor lang tid ville det tatt for deg å gå fra ditt hjem til de t nærme ste stedet som står skrevet nedenfor? Marker tiden det ville tatt deg å gå til hvert sted, selv om det er et sted du ikke vanligvis drar til.

	1-5 minu:ter	6-10 minutter	11-20 minuner	21-30 minu:ter	31 minutta eD:rmer	Ve:tikk e
Kiosk (f.eks. Narve n. 7-eleven)	0	0	0	0	0	0
Matbutikk	0	0	0	0	0	0
Frukt og grønnsaks butikk	0	0	0	0	0	0
Kjøpe senter	0	0	0	0	0	0

Sann ca. hvor lang tid ville det tatt for deg å gå fra ditt hjem til det nærmeste stedet som står skrevet nedenfor? Marker tiden det ville tatt deg å gå til hvert sted, selv om det er et sted du ikke vanligvis drar til.

	1-5 minuter	6-10 minutter	11-20 minutter	21-30 minutter	31 minutter eller mer	Veit ikke
Fast Food steder (f.eks. McDonalds, kebabs jappe)	0	0	0	0	0	0
Cafe	0	0	0	0	0	0
Restaurant	0	0	0	0	0	0

### 3. Butikker og fast food steder i ditt nabolag

Svar på påstandene nedenfor fra helt uenig til helt enig, etter hva som passer best for deg og ditt nabolag

	Helt uenig	Lil, u-nig	Verken enig el/ru>nig	Lin enig	H-ilt e11jg
Det er matbutikker { f.eks. kjwi. Rema 1000) innen enkel gl avstand fra mitt hjem	0	0	0	0	0
Det er butikker (kiosk.et,0 ben sin stasjoner) innen enkelt avstand fra mitt hjem	0	0	0	0	0
Det er fast food steder {f.eks. kebabsjappe, McDonalds) innen enkel avstand fra mitt hjem	0	0	0	0	0

24. Hvor ofte handler du vanligvis mat/drikke i butikker (matbutikk, kiosk,bensinstasjon) rundt skolen din eller nabolaget ditt?

- Aldri
- Annen hver uke
- En gang i uken
- To ganger per uke
- 3 ganger per uke
- 4-5 ganger per uke
- 6 ganger eller mer

25. Hvor mye penger bruker du vanligvis på å kjøpe mat og/eller drikke per uke?

- Jeg bruker ingen penger
- 50 kr eller mindre
- 51-100 kr
- 101-150 kr
- 151-200 kr
- Mer enn 200 kr



12. Hvor uenig eller enig er du i påstandene nedenfor?

Når jeg selv kan velge hva jeg vil spise...

	Verken enig				
	Helt uenig	Litt uenig	eller uenig	Litt enig	Helt enig
...synes jeg det er vanskelig å velge mat med lavt fettinnhold (f.eks. frukt i stedet for potetgull, eller lettmelk i stedet for helmelk)	0	0	0	0	0
...synes jeg det er enkelt å velge et sunt mellommåltid (f.eks. frukt eller lett yoghurt)	0	0	0	0	0
...tror jeg at jeg har kunnskap og ferdigheter til å velge/lage sunn snacks	0	0	0	0	0
...synes jeg det er vanskelig å velge sunne måltider/snacks når jeg er sammen med venner	0	0	0	0	0

13. De neste utsagnene handler om hvilke grenser foreldrene dine setter for inntak av ulike typer mat

Sett et kryss fra "ikke i det hele tatt", til "veldig", etter hva som passer best for deg

	Ikke i det hele tatt 1	2	3	4	Veldig 5
Mine foreldre setter klare grenser for hvor mye sukkerholdig drikke (som brus, saft osv.) jeg får drikke	0	0	0	0	0
Mine foreldre setter klare grenser for hvor mye søtsaker (sjokolade, iskrem, kjeks, kaker, boller osv.) jeg får spise	0	0	0	0	0
Mine foreldre setter klare grenser for hvor mye salt snacks (potetgull, søtne peanøtter osv.) jeg får spise	0	0	0	0	0
Mine foreldre setter klare grenser for hvor mye fast Food jeg får spise	0	0	0	0	0

13. Hvor uenig eller enig er du i følgende påstander (sett ett kryss på hver linje)

Verken enig

	Helt uenig	Litt uenig	eller uenig	Litt enig	Helt enig
Hjemme hos oss har vi vanligvis brus med sukker til middag i helgedager	0	0	0	0	0
Hjemme hos oss er det vanligvis brus med sukker tilgjengelig	0	0	0	0	0
Hjemme hos oss har vi vanligvis brus med sukker til middag på hverdager	0	0	0	0	0

18. Hvor uenig eller enig er du i følgende påstander (sett ett kryss for hver linje)

	Helt uenig	Verken enig			Helt enig
		Litt uenig	eller uenig	Litt enig	
Hjemme hos oss har vi vanligvis søt og salt snacks (f.eks. sjokolade, godteri, is, potetgull, muffins, baller) tilgjengelig	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hjemme hos oss har det nesten alltid vært lett for meg å finne søt og salt snacks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. Hvor uenig eller enig er du i følgende påstander (sett ett kryss for hver linje)

	Helt uenig	Litt uenig	V:eriken enig eller ue11ig	Litt enig	Helt enig
Moren min drikker brus med sukker flere ganger i uken	0	0	0	0	0
Faren min drikker brus med sukker flere ganger i uken	0	0	0	0	0
Moren min spiser fettholdig eller søtsnacks flere ganger i uken	0	0	0	0	0
Faren min spiser fettholdig eller søtsnacks flere ganger i uken	0	0	0	0	0

20. Hvor uenig eller enig er du i følgende påstander (sett ett kryss for hver linje)

	Helt uenig	Litt uenig	V:eriken enig eller ue11ig	Litt enig	Helt enig
Moren min synes at jeg burde spise sunt	0	0	0	0	0
Moren min spiser sunt	0	0	0	0	0
Faren min synes at jeg skal spise sunt	0	0	0	0	0
Faren min spiser sunt	0	0	0	0	0

23. Hvor uenig eller enig er du i følgende påstander om butik hvor du kjøper mat og drikke i nærheten av din skole/ i ditt nabolag:

	Helt uenig	Litt uenig	Værlig eller ue11ig	Litt enig	Helt enig
Det er lett å få tak i et stort og variet utvalg av fersk frukt og grønnsaker som jeg liker	0	0	0	0	0
Det er lett å få tak i et stort og variert utvalg av søt og salt snacks (sjokolade, potetgull, muffins, kjeks eller lignende) som jeg liker	0	0	0	0	0
Det er lett å få tak i et stort utvalg av drikke med sukker som jeg liker	0	0	0	0	0
Det er billigere å kjøpe brus med sukker eller snacks (f.eks. potetgull eller kjeks) enn å kjøpe frukt og grønnsaker	0	0	0	0	0



## NSD sin vurdering

### Prosjekttittel

Tackling socioeconomic differences in weight development among youth

### Referansenummer

675092

### Registrert

22.08.2019 av Mekdes Gebremariam - mekdeskg@uio.no

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### Type prosjekt

Forskerprosjekt

### Prosjektperiode

15.09.2019 - 30.04.2022

### Status

24.09.2019 - Vurdert

### Vurdering (1)

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#### 24.09.2019 - Vurdert

Our assessment is that the processing of personal data in this project will comply with data protection legislation, so long as it is carried out in accordance with what is documented in the Notification Form and attachments, dated 24.09.2019, as well as in correspondence with NSD. Everything is in place for the processing to begin. NOTIFY CHANGES If you intend to make changes to the processing of personal data in this project it may be necessary to notify NSD. This is done by updating the Notification Form. On our website we explain which changes must be notified. Wait until you receive an answer from us before you carry out the changes. TYPE OF DATA AND DURATION The project will be



processing special categories of personal data about health and general categories of personal data until 30.04.2022. Samples 1-3 consist of pupils in the 7th grade in schools in Oslo and neighbouring areas (aged 12-14 years) and the parents/guardians that sign the consent form. Samples 2 and 3 will take part in a pretest and test-retest before the main data collection in which sample 1 will participate. The collected data relating to sample 1 will consist of online survey data, paper-based survey data, data collected using a physical activity monitor/sensor, physical measurements (height, weight, waist circumference and hip circumference) and data from SSB (see list of variables on the page "Additional information").

#### LEGAL BASIS

The project will gain consent from parents/guardians for the processing of personal data relating to their children (12-14 years) who will participate in the project. For pupils in sample 1, one parent/guardian will sign the consent form and give consent for the processing of personal data relating to the child, including linking data from SSB to the collected data. The parent will give their own educational background, and the educational background of the other parent, on the consent form. The parent that signs the form will gain ethical consent from the other parent before providing this information. We find that consent will meet the necessary requirements under art. 4 (11) and 7, in that it will be a freely given, specific, informed and unambiguous statement or action, which will be documented and can be withdrawn. The legal basis for processing general categories and special categories of personal data relating to data subjects in sample 1 is explicit consent given by parents/guardians, cf. the General Data Protection Regulation art. 6.1 a), cf. art. 9.2 a), cf. the Personal Data Act § 10, cf. § 9 (2). The legal basis for processing general categories of personal data relating to data subjects in samples 2 and 3 is consent given by parents/guardians, cf. the General Data Protection Regulation art. 6.1 a).

Third persons The parent that does not sign the consent form will be a third person in this project. It is necessary to collect information about the educational background of both parents in order to achieve the purpose of the project, and it will involve a disproportionate amount of effort to gain signed consent from both parents. All collected data will be anonymised in publications. Our assessment is that the processing meets the requirement of scientific research, cf. the Personal Data Act § 8, and therefore constitutes a task in the public interest. The project will process personal data relating to third persons on the legal basis that processing is necessary for the performance of a task carried out in the public interest, cf. the General Data Protection Regulation art. 6 nr. 1 e), cf. art. 6 nr. 3 b), cf. the Personal Data Act § 8.

#### PRINCIPLES RELATING TO PROCESSING PERSONAL DATA

NSD finds that the planned processing of personal data will be in accordance with the principles under the General Data Protection Regulation regarding: - lawfulness, fairness and transparency (art. 5.1 a), in that data subjects will receive sufficient information about the processing and will give their consent - purpose limitation (art. 5.1 b), in that personal data will be collected for specified, explicit and legitimate purposes, and will not be processed for new, incompatible purposes - data minimisation (art. 5.1 c), in that only personal data which are adequate, relevant and necessary for the purpose of the project will be processed - storage limitation (art. 5.1 e), in that personal data will not be stored for longer than is necessary to fulfil the project's purpose

#### THE RIGHTS OF DATA SUBJECTS

Data subjects in samples 1-3 will have the following rights in this project: transparency (art. 12), information (art. 13), access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), notification (art. 19), data portability (art. 20). Third persons will have the

following rights in this project: transparency (art. 12), information (art. 13), access (art. 15), rectification (art. 16), erasure (art. 17), restriction of processing (art. 18), notification (art. 19) and protest (art. 21). These rights apply so long as the data subject can be identified in the collected data. NSD finds that the information that will be given to parents/guardians about the processing of personal data will meet the legal requirements for form and content, cf. art. 12.1 and art. 13. The parent that signs the form will make information about the project available to the other parent. The information letter will meet the legal requirements for content, cf. art. 14. The pupils themselves will receive information about the project that is easy for them to understand. We remind you that if a data subject contacts you about their rights, the data controller has a duty to reply within a month. FOLLOW YOUR INSTITUTION'S GUIDELINES NSD presupposes that the project will meet the requirements of accuracy (art. 5.1 d), integrity and confidentiality (art. 5.1 f) and security (art. 32) when processing personal data. Collaborators inside the EU/EEA will have access to collected data (in pseudonymised form). NSD presupposes that the processing of personal data by a collaborating institution (i.e. data processor) meets the requirements under the General Data Protection Regulation arts. 28 and 29. We understand that no personal data will be shared outside the EU/EEA. To ensure that these requirements are met you must follow your institution's internal guidelines and/or consult with your institution (i.e. the institution responsible for the project). FOLLOW-UP OF THE PROJECT NSD will follow up the progress of the project underway (every other year) and at the planned end date in order to determine whether the processing of personal data is being carried out in accordance with what is documented. Good luck with the project! Contact person at NSD: Eva J B Payne Data Protection Services for Research: +47 55 58 21 17 (press 1)