Exploring school neighborhood food environment of Norwegian adolescents

Master thesis within Public Health Nutrition

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The work presented in this master thesis was carried out during a full academic year in 2011 and 2012 at the Department of Nutrition, University of Oslo, and was part of HEIA II, a follow-up of those pupils from the original HEIA-study.

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Summary

Background: Adolescent overweight and obesity rates are increasing in Norway. Adolescents spend a lot of time at school and the school neighborhood food environment could affect adolescents’ dietary behavior and development of overweight and obesity. Access to unhealthy foods at school can contribute to a high intake of unhealthy food items and beverages during the school day. The availability of food sales outlets in the school neighborhoods is one environmental determinant that may be of great importance for adolescents’ dietary behavior. One of the first steps when investigating a neighborhood food environment is to obtain descriptive data of the presence of food sales outlets and the availability of food items. The knowledge of the neighborhood food environment and the effect on dietary habits are inconclusive and based on research from countries where the food environments may not be representative for Norway. Consequently, there is a need for research from Norwegian school neighborhood food environments. An instrument for investigating adolescents’ food environment by measuring availability and linear shelf space of food items in food sales outlets in school neighborhoods was developed and evaluated within a research project in Oslo in 2009. This thesis is the continuation of that previous research.

Objective: To describe the availability (if food is present or not) and accessibility (measured in linear shelf space or number of varieties) of food items in food sales outlets around primary and lower secondary schools in eastern Norway, and to explore variation by the schools socio-economic position and possible associations with schools’ mean frequency of the intake per week of selected food items by 7th grade pupils.

Design: Cross sectional data from the HEIA-study (involving primary schools) collected in May 2009 and from HEIA II (involving lower secondary schools) are analyzed in this thesis to answer the objectives and aims.

Methods and sample: There were 37 primary schools and 36 lower secondary schools in the samples. Food sales outlets were identified in the neighborhoods of the schools by using internet-based map services and by physically checking the neighborhood on the day of data collection. An observational form designed for direct observation of food sales outlets was used to measure availability and accessibility of 16 food items and beverages. Descriptive data and comparative data between the two types of schools are presented. Data to determine socio-economic position of each school were collected by questionnaire from 37 and 32 principals from the primary- and lower secondary schools, respectively. Social disparities in the food
environment and its food sales outlets were investigated in the sample. Data on the adolescents’ diet were collected by questionnaire from 945 7th graders (primary school). Associations between the school mean frequency of the intake per week of seven selected food items and both the number of food sales outlets in the school neighborhood and the accessibility of the seven selected food items were analyzed by One-way ANOVA and correlation analyses.

**Results:** Food sales outlets were found around 25 (68%) of the primary schools and 28 (78%) of the lower secondary schools. The number of outlets in each school neighborhood was at its highest nine but with a mean of 1.6 and 1.8 (no significant difference) in primary- and lower secondary schools. The total number of outlets around each school type (primary- vs. lower secondary schools) was similar (60/65). The food sales outlets were supermarkets, kiosks and gas stations with a frequency of occurrence in the mentioned order. Across all types of food sales outlets, the most available food items were those defined as unhealthy. The accessibility of soft drinks with sugar was significantly higher, and another nine food items of the 13 investigated was non-significantly higher, in the neighborhoods of lower secondary schools compared to primary schools. Schools of lower socio-economic position (both primary- and lower secondary schools) had non-significantly higher number of food sales outlets in the neighborhood, higher accessibility of the majority of the food items and in addition a trend of more kiosks and fewer supermarkets, compared to schools of higher socio-economic position. There was a significant lower school mean frequency of raw vegetables intake per week in schools with more than one food sales outlet in the neighborhood compared to school neighborhoods with only one or no food sales outlet. This pattern was also found as a borderline significant negative correlation between school mean frequency of raw vegetables intake per week and the accessibility in the school neighborhoods.

**Conclusions:** Food sales outlets were present in approximately three quarters of the school neighborhoods but the number of food sales outlets in each school neighborhood varied and there were no clear difference between primary- and lower secondary schools. The accessibility of soft drinks with sugar was significantly higher, and another nine food items of the 13 investigated was non-significantly higher, in the neighborhoods of lower secondary schools compared to primary schools. Non-significant school neighborhood disparities related to socio-economic position was present. The food environment and its food sales outlets in Norwegian school neighborhoods need to be investigated more as a potential environmental factor that may affect dietary behavior and body weight of adolescents. Future studies should investigate adolescents’ use of food sales outlets and/or store size adjusted analyses with ratio of healthy/unhealthy food items as well as social disparities in this.
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Clarifications of terms

Accessibility: Describe how easily customers in stores seeking specific food items could obtain them, as measured by the length of shelf space displaying those items or the number of varieties.

Adolescents*: 10-18 years of age.

Availability: Describes whether food items were present or not.

Food sales outlet: Generic name for all outlets selling foods.

Gas station: Apart from fuel, usually have a small outlet with a limited selection of food items including some dairy products, bread, simple meat products and ready to eat food. Gas stations have walk-up counters without conveyor belt.

The HEIA-project: An intervention study in Norwegian primary schools with the main goal to achieve healthy weight development among adolescents’ through healthy dietary habits and physical activity.

HEIA II: A follow-up of the individuals from the HEIA-study now enrolled in lower secondary school.

Kiosk: Have walk-up counters without conveyor belt and focuses on ready to eat food items. Traditionally a large part of the assortment is of unhealthy nature such as energy dense food, with a large proportion of sugar and fat.

Lower secondary school: (Ungdomsskole in Norwegian) Schools with enrolled pupils at the age of 13-16 years.

Overweight: Body mass index greater than or equal to 25

Obesity: Body mass index greater than or equal to 30

Primary school: (Barneskole in Norwegian) Schools with enrolled pupils at the age of 6-13 years.

School neighborhood: Neighborhood was defined as within 500 meter radius from schools.

Vegetarian snack: Convenient types of vegetables possible to eat straight from the package without the need of cutting or slicing (baby carrots, cherry tomatoes or sugar snap peas).
Supermarket: Having check out counters with conveyor belt. Offering a wide variety of food and household merchandise, stocking fresh meat, having a wide selection of dairy products, and normally the biggest type of outlets in the area.

Socio-economic position: Based on the amount of pupils from low income families.

WHO: World Health Organization
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1 Introduction

This thesis has its origin from the Health In Adolescent (HEIA) study which had the overall goal to design, implement and evaluate a comprehensive intervention program to promote healthy weight development among young adolescents (11 to 13-years-olds). The HEIA study was a 20 month, primary school-based randomized controlled intervention trial including 37 schools from seven counties in the south-eastern region of Norway (12 intervention schools and 25 control schools) and was conducted in 2007-2009.

The HEIA II project is a follow-up of the same individuals from the original HEIA-study, now advanced to lower secondary school (15-years-olds). This thesis was part of HEIA II and its author was one of the four field workers who physically visited all schools and collected the data during a four week period in the autumn of 2011.

Both individual and environmental determinants affect the dietary behavior of adolescents. Most research on dietary behavior has been done with focus on individual determinants. There are some research on environmental determinants and the neighborhood food environment but none are from Norway. It is important to understand not only the individual determinants of dietary behavior but also the environmental determinants, such as food availability.
2 Background

2.1 Prevalence of overweight and its health problems

Excess bodyweight is a major public health concern increasing worldwide with substantial variation between nations. Between 1980 and 2008, mean body mass index increased by 0.4 kg/m\(^2\) per decade for men and by 0.5 kg/m\(^2\) for women. In 2008, an estimated 1.46 billion adults worldwide had body mass index of 25 kg/m\(^2\) or greater [1]. Lifestyle start to develop early in life and increased body mass index is also seen among adolescents in the world [2]. Once relatively rare, the presence of significant excess body weight now affects more than a quarter of all children in developed countries [3, 4]. It is also appearing at a dramatic rate among children in populations undergoing rapid urbanization and exposure to Western forms of food supply [5, 6]. In Europe, one of the most serious public health challenges have become overweight and obesity and in the Northern and Western part of Europe, about one fifth of adolescents are considered overweight or obese [7, 8].

Overweight and obesity in adolescence have impact on both psychological and physiological health [9], and are among the leading risk factors for developing chronic lifestyle related diseases, as for example diabetes type 2 [8, 10] or coronary heart disease [11]. The chronic non-communicable diseases such as diabetes and cardiovascular disease are the leading cause of death among adults worldwide [12] having comprised 60% of all deaths in 2005. Also adolescents’ overweight and obesity are associated with increased morbidity and mortality related to these chronic diseases in adulthood [13, 14]. According to estimations by WHO, about 60% of overweight or obese adolescents will remain overweight or obese in adulthood [8]. Unhealthy lifestyle behaviors, such as poor diets and a lack of physical activity, have the tendency of tracking from childhood into adulthood [15, 16]. Overweight or obese adolescents have increased risk of being overweight or obese as adults [2, 14, 17].

A limited amount of research has been performed on children/adolescent overweight and obesity in Norway. Research that have been published between the year 2005-2012 on both self reported and objective data, have found a prevalence of overweight ranging from 9.2-21.2% and obesity from 1.3-4.7% [18-22]. The prevalence of overweight and obesity was also found to have increased significantly from 1993-2000 [18]. And also in a longer time perspective, the last three decades, there is support from research of a significant increase of the overweight and obesity in children [21], similar to that in other Northern and Western European countries.
2.2 Determinants of adolescents’ dietary behavior

Adolescence is a critical period in shaping dietary behavior and making the basis for weight and body mass index later in life [23]. Causes of adolescents’ overweight and obesity are not yet completely understood, but significant changes in energy intake and energy expenditure among adolescents the last decades are believed to have contributed to the increasing prevalence of adolescent overweight and obesity [9]. The dietary behavior regarding soft drinks with sugar and the intake of fruit and vegetables which might displace more energy-dense snacks are often presented as important food items that may have associations to adolescents weight development [24, 25]. The dietary behavior has impact on energy intake and may be affected by individual and environmental determinants [9, 23]. Both individual and environmental determinants, including home environment and school environment, have therefore been suggested to play a role in development of adolescent overweight and obesity [9, 23].

The research on adolescents’ dietary behavior have previously been predominantly focused on individual determinants [26-29], including factors such as taste preferences, nutrition knowledge, personal attitudes and intentions [30]. Individual factors have been found to describe only little of the variation in the dietary behavior and energy intake, and individual factors are not alone able to explain the high prevalence of adolescent overweight and obesity [31, 32]. As a consequence of the weaknesses of individual factors to describe the high prevalence of overweight and obesity, there has been a shift in research on determinants of dietary behavior and body mass index towards a focus on environmental determinants [28] and greater attention is now being given to the causes of weight gain in a child's environment.

The interest in environments role in shaping dietary behavior of adolescents is increasing, due to the fact that environmental factors have been shown to affect adolescents’ diet [29, 33-35]. Home environment and school environment are the environments that have been suggested to have the largest impact on adolescents’ dietary behavior [29]. Family and home environment are the most important environments in shaping food behavior in childhood and early adolescence [10, 23]. As children grow up, environments outside home gradually become more important [10, 23]. Schools and school neighborhoods have been viewed upon as important setting for improving the physical availability of healthy foods for adolescents [30]. School food environments have the potential of being highly influential on adolescents’ diet [36].
Compared to adults, adolescents may be more restricted to areas in the home or school neighborhood to which they can walk or bike. Adolescents spend a lot of time at school and consume a substantial portion of their daily energy intake at school [37]. Therefore, youths may be particularly captive to environmental opportunities around their home and school. Access to unhealthy foods at school has been shown to contribute to a high intake of unhealthy food items and beverages during the school day [38, 39]. The availability of food sales outlets in school neighborhoods may be of great importance for adolescents’ dietary behavior, especially when adolescents are growing older, have more money and to a larger extent are using the food sales outlets [40].

2.3 Food environment, food sales outlets and dietary habits

The neighborhood food environment and whether people in general have access to healthy food is often seen as a potentially important contributor to a healthy diet. Policy documents in many countries suggest that lack of access to healthy foods in certain areas is one explanation for inequalities in diet and in health [41, 42]. A food environment that involves different food sales outlets where people buy food, will to a large degree influence the types of food and beverages that are available, and any barriers or opportunities for the consumption of a healthy diet [43]. Local food environments have been shown to be an independent predictor of individuals’ food choice and diet quality in developed countries [44, 45]. A typically unhealthy food item is soft drink with sugar which has been seen to be consumed more frequent in school neighborhoods that have more unhealthy types of outlets [46].

Published research from Norway on food sales outlets and links to dietary behavior or health is absent. However, internationally there are a growing number of studies that have explored links between the local food retail environment, and dietary habits or overweight/obesity but with inconclusive results [30, 47-50]. For example, a number of studies based in regions of the USA found that better supermarket access was associated with increased fruit and vegetable intake [51], and dietary quality [52-54], and reduced levels of overweight/obesity [54-61]. In contrast, higher intakes of fruit and vegetables were also seen in a study sample with better access to large, non-chain grocery stores [62], and smaller food stores [63, 64], while a shorter distance to fruit and vegetables stores was associated with healthier body mass index [61]. To further emphasize the inconsistent research, some studies report better access to supermarkets [65, 66], convenience stores [57, 59, 60], and small grocery stores [58, 66] was associated with increased levels of overweight/obesity, while no significant links were
found between supermarket proximity and fruit and vegetable intake [62], or between small grocers, convenience stores, and body mass index [55].

Evidence from outside the USA about associations between neighborhood food environments and diet or obesity is also mixed. A New Zealand study found no association between fruit and vegetable intakes and better access to food stores, but living near a convenience store was negatively associated with vegetable intake [67], while a study in Australia found that supermarket density was not associated with fruit and vegetable intake [68]. In Japan there were no greater intakes of fruit and vegetables with better access to fruit and vegetable stores, grocery stores or supermarkets [69]. Several UK studies have found no links between supermarket proximity and fruit and vegetable intake [70] or levels of obesity [71], however a recent study across the Republic of Ireland did find a link between nearness to a supermarket and better diet [72]. All these above mentioned research on different types of food sales outlets and links to health, shows that there is not yet full consensus on which configuration of the type of food sales outlets that are healthy and optimum to have in a food environment. However, supermarkets, as compared to other food sales outlets, tend to offer the greatest variety of high-quality products at the lowest cost [63, 73-77] and are sometimes referred to as the type of food sales outlet that are easiest to make healthy choices in.

Socio-economic status is believed to influence the food environment and research have shown that minority communities and lower income areas tend to have a less healthy food retail setting in both the general food environment [45, 78-80] and school neighborhoods [81, 82]. In the USA public secondary schools minority groups are particularly likely to be in schools that are surrounded by convenience stores, restaurants, snack stores and other stores usually considered as unhealthy ones [81]. Similar findings have been seen in lower income school neighborhoods which have more fast food restaurants and convenience stores compared to higher income school neighborhoods [82].

2.4 Measuring neighborhood food environments

Measurements of different components of food environments have been done with a range of tools and methods [83]. Measuring physical food environments and the food outlets is a relatively new research field [44]. Some research has been carried out on how to measure physical food environments and food outlets, but no guidance on measurement of food environments exists [34]. Different instruments have been used for investigating physical food environments. Paper-based instruments have been used in combination with observation
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[44]. Paper-based instruments may be a food item and beverage check list; a market basket of food items; inventory or reporting of all food items and beverages within an area; or interviews carried out based on a list of food environment questions [44]. Analytic measurement tools have also been used, such as sales analysis, nutrient analysis, menu analysis or geographic analysis [44]. Geographic analysis, by using for example Geographical Information Systems (GIS) technology, is the overall most frequently used food environment assessment tool, together with interview/questionnaire and market basket [44]. Research shows that measuring shelf space of different food items can be used to characterize the healthfulness of the food environment [84, 85].

When writing this thesis six published articles of studies which involve components of measuring shelf space or counting number of varieties to assess the availability and accessibility of different food items in different food environments were identified [63, 84-88]. Those six studies were all from the USA, none of them exclusively investigated the school food environment but one involved both adults and youths. Cheadle et al. were one of the first to investigate the availability of healthy food items within a neighborhood and measured shelf space occupied by low-fat and high-fiber products of meat, milk and bread [87]. The study reported significant correlations between the availability of healthful products in stores and the reported healthfulness of individuals’ diets [87]. Bodor et al. measured fruit and vegetable by shelf space and number of varieties and they found that greater fresh vegetable availability within 100 meter of a residence was a positive predictor of vegetable intake; each additional meter of shelf space was associated with 0.35 servings per day of increased intake. However, the study failed to find the same result for fruits [63]. Caldwell et al. were also focusing on vegetables and fruits but in addition involved an intervention. The intervention had greater effect in the areas with greater accessibility of relevant foods as measured by shelf space and number of varieties. Conclusions were thus that interventions should consider focusing on increasing access to fresh fruits and vegetables in target communities [86]. Rose et al. measured fruits, vegetables and in addition energy-dense snacks, and found that a 100-meter increase in shelf space of energy dense foods within 1 kilometer of a respondent’s household was associated with an additional 0.1 BMI points, thus suggesting that the availability of energy-dense snack foods plays a role in weight status [88]. The study also recommended that interventions, which seeks to improve the neighborhood food environments, might need to focus on more than just increasing access to healthy foods [88]. Farley et al. measured shelf space devoted to fruit, vegetables, carbonated beverages,
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salty snacks, cookies and pastries and candy [85]. The study also presented the ratio of the shelf length of healthy items to shelf length of unhealthy food items which were discussed as an easy method of summarizing the store contents and categorize the store type [85]. One study measured fruit, vegetable and alcohol, but their objective was to develop and test an observational tool for objective measurements of in-store availability, hence only reported interobserver reliability and no results from food availability or accessibility [84].

The Nutrition Environment Measures Study (NEMS) [76] developed and evaluated nutrition environment measures for retail stores, and an observational form that investigated food items in food sales outlets. This observational form was used as a basis in 2009, when the Kaja Marie Kigen in her master thesis [89] and within the HEIA-study (HEalth in Adolescents) [90], developed an observational form for investigating adolescents’ food environment by measuring the availability and shelf space of food items and beverages in food sales outlets in school neighborhoods. The form was found to have a high inter-rater and test-retest reliability [89] and was used for data collection in HEIA in May 2009 and in HEIA II in September 2011.

2.5 Summary of background

Adolescent overweight and obesity rates are increasing in Norway. Environmental factors have been found to be associated with dietary behavior of adolescents and people in general. Adolescents spend a lot of time at school, and the food environment in the school neighborhood may be important influences to adolescents’ dietary behavior and body weight. Measuring shelf space of different food items can be used by researchers to characterize the healthfulness of the food environment. Identified published research in which food environments were investigated by measurement of shelf space are all from the USA and none from Norway. There is a need to describe food sales outlets in Norwegian school neighborhood food environments to obtain descriptive information which can assist in identifying potential intervention points for healthier food environments. The completed HEIA-study and the master student Kaja Marie Kigen have already initiated the work of investigating the Norwegian school neighborhood food environments and the work needs to continue.
3 Main objective and research questions

3.1 Overall aim
The overall aim of this thesis is to describe the availability and accessibility of food items in food sales outlets around primary and lower secondary schools in eastern Norway, and to explore variation in the availability and accessibility by the schools socio-economic position and possible associations with school mean frequency of the intake per week of selected food items per week by 7th grade pupils.

3.2 Specific research questions
The following specific research questions will be addressed:

1. Are there food sales outlets within a 500 meter radius from the included schools, and if so, how many and what kind of outlets are they?

2. Are there more food sales outlets present in school neighborhoods around lower secondary schools compared to primary schools?

3. Do the availability and accessibility of different food items and beverages in the food sales outlets vary?

4. Is there higher accessibility of different food items around primary schools compared to lower secondary schools?

5. Is there higher accessibility of different food items around schools of lower socio-economic position compared to schools of higher socio-economic position?

6. Is the school mean frequency of the intake per week of selected food items higher in primary schools with food sales outlets compared to those neighborhoods without food sales outlets?

7. Does school mean frequency of the intake per week of selected food items correlate with accessibility of these food items in the neighborhoods of primary schools?
4 Methods and sample

This thesis is conducted within a research group at the University of Oslo. The research group is responsible for the projects HEIA and HEIA II which both have generated data that are analyzed in this thesis to answer the objective and aims.

4.1 The HEIA project

The HEIA (HEalth In Adolescents) project was an intervention study implemented between the years 2007-2009. The main goal of the HEIA intervention was to achieve healthy weight development among adolescents in 6th and 7th grade, corresponding to adolescents at the age of 11-13 years, by promoting healthy diet and physical activity. The intervention is not part of this thesis and thus not further described. The project included 37 primary schools from seven counties in the south-eastern region of Norway (12 intervention schools and 25 control schools). All 6th graders (class of 2007) and their parents/legal guardians were invited to participate. Evaluation and data collection was conducted at three different time points (baseline measures in September 2007, follow-up 1 in May 2008 and follow-up 2 in May 2009). Data collection consisted of multiple questionnaires directed at pupils, parents, principals or school nurses. In addition anthropometric measurements of pupils were taken and observational tools for school, school area and the food sales outlets in the school neighborhood were used. The instrument for investigating food sales outlets in the school neighborhoods used in follow-up 2 in the year 2009 is the focus of this thesis (described later).

4.2 The HEIA II project

The work of this master thesis were done within the HEIA II project, which is a follow-up of the individuals from the original HEIA project, now advanced from primary school to the 10th grade in lower secondary school, corresponding to adolescents at the age of 14-15 years. The design of the data collection was identical with the follow-up 2 in the original HEIA project, but anthropometric measurements had to be omitted. However, the relevant parts of the data collection for this thesis were all done with the same method and instruments as in the original HEIA project.
4.3 Sample

The target group of this thesis is food sales outlets in neighborhoods surrounding primary schools (HEIA project) and lower secondary schools (HEIA II project). In the HEIA-project, the school neighborhood was defined to a radius of 500 meter, because this area is expected to be reachable by pupils during a lunch break or during transport to or from school [89, 91]. The investigated primary schools did not allow pupils to leave school during the school day [89], but in lower secondary schools this was allowed in some of the schools (data not shown). However, the food sales outlets in the school neighborhood were available before and after school, since the pupils mostly lived in walking distance from the schools. Recruitment of schools to the original HEIA project was conducted by the research team in 2007. Primary schools in the counties near Oslo were invited to participate. This area was chosen because schools within these counties are easily reachable by car. The schools located in the largest communities and towns in all the counties were chosen, and the schools were supposed to have a minimum of 40 pupils in the 6th grade by the time of recruitment. A total of 177 primary schools were invited to participate in the original HEIA project, of which 37 schools (21%) from seven different counties (Akershus, Buskerud, Hedmark, Oppland, Telemark, Vestfold and Østfold), agreed to participate. In HEIA II, all pupils had moved to a total number of 39 lower secondary schools. Those pupils and schools were invited to participate and in 36 (92%) of the schools, pupils agreed to participate and those schools were included.

4.3.1 Identification of food sales outlets

The identification of food sales outlets were done with the same method in both the original HEIA project and the HEIA II project. A map of each school neighborhood was created to get an overview of the number and types of food sales outlets within the school neighborhood. Different sources were used for creating the maps. Maps on the internet pages of local authorities were used for recognizing and restricting the neighborhood of each school. These maps were printed out in several specimens. Several different map services on the internet (www.finn.no, www.1881.no, www.maps.google.no, www.gulesider.no) were used for locating food sales outlets within a radius of 500 meters. The food sales outlets located within each school neighborhood were marked on the printed maps. Each food sales outlet in a school neighborhood was numbered, and the full name and address were written on a sheet of paper that was stapled to the map. On the day of the visit, field workers checked the school neighborhood for any missed food sales outlets, and in some cases concluded that the food sales outlet had closed or did not exist anymore.
Methods and sample

Supermarket was defined as stores offering a wide variety of food and household merchandise, stocking fresh meat, having a wide selection of dairy products, having check out counters with conveyor belt and normally the biggest type of outlets in the area. Observed supermarket chains were Bunnpris, Coop, Ica, Joker, Meny, Kiwi, Rimi, Rema 1000 and Spar. Gas stations, apart from fuel, usually have a small outlet with a limited selection of food items including some dairy products, bread, simple meat products and ready to eat food. Gas stations have walk-up counters without conveyor belt. Observed chains of gas stations were Shell, Statoil and YX. Kiosks have the least variety of food/drinks and are usually smallest in size. Kiosks also have walk-up counters without conveyor belt and focuses on ready to eat food items and traditionally a large part of the assortment is of unhealthy nature and energy dense food, with a large proportion of sugar and fat. Observed chains of kiosks were 7-eleven, Narvesen and Mix, as well as independent/non-chain kiosks.

4.4 Data collections

Data collections relevant for this thesis have been conducted at three different time points. All food sales outlets were investigated one time in the original HEIA project (follow-up 2 in 2009) and one time in HEIA II (2011). The school principal questionnaire was used twice in the original HEIA project (baseline in 2007 and follow-up 2 in 2009) and one time in HEIA II (2011). The Internet based student questionnaire, directed to all school children, was used in both the original HEIA project and HEIA II, but only data from follow-up 2 (original HEIA project) is analyzed, because data from HEIA II was not ready on time for this thesis.

In the original HEIA project there were a total of 14 field workers in three teams, who collected the data whereas in HEIA II there were a total of four field workers who collected the data. Field workers were trained within the research group to ensure standardized data collections. When field workers entered a food sales outlet, the manager of the outlet was contacted. A short oral description of the project and the observation method was given and an information letter (appendix 1) was handed out. It was up to the manager to give permission for the data collection in his/her food sales outlet.

4.4.1 The instrument for investigating food sales outlets (appendix 2)

The observational form is designed to investigate physical food environment, in terms of availability and accessibility of different food items and beverages in food sales outlets in Norwegian school neighborhoods. The investigated products were chosen based on having a size which made it likely to be consumed at the time of purchase. The term *availability*
describes whether food items were present or not, and *accessibility* describe how easily customers in stores seeking specific food items could obtain them, as measured by the length of shelf space displaying those items or number of varieties.

The observational form originates from a form developed by Glanz et al. [76], and further developed to the purpose and Norwegian context by Kigen in 2009 [89]. The first page contains basic information about the outlet, and categorizes it into one of five different types; kiosks, gas stations, restaurant/café, supermarkets, specialized stores (as bakery, fruit and vegetable outlets) (appendix 2). Sixteen different food items and beverages are included in the observational form; sweet and salty biscuits; chocolate and sweets; sweet bakery products; unsweetened bakery products; unsweetened bakery products with mixed grain; vegetarian snack; fresh fruits; fresh vegetables; savory snacks; soft drinks with sugar; soft drinks without sugar; still and sparkling water; juice and fruit drinks; light ice tea; flavored milk; flavored milk with less sugar and fat. In this thesis the investigated food items are grouped into three categories, first *unhealthy* food items (chocolate and sweets, soft drinks with sugar, savory snacks, sweet and salty biscuits, sweet bakery products, flavored milk) due to high energy density with a large proportion of simple sugars, fats, salt and low content of micronutrients and fibers. Secondly, *semi healthy* food items (juice and fruit drinks, unsweetened bakery products, flavored milk with less sugar and fat, light ice tea, soft drinks without sugar) being slightly better alternative than the unhealthy category but still containing some unhealthy components like simple sugars or artificial sweeteners (which is not recommended as the first choice by Norwegian authorities [92]), low in micronutrients and fibers. Third category, *healthy* (unsweetened bakery products with mixed grain, still and sparkling water, vegetarian snack, fresh fruit, fresh vegetables) which have low energy density, high micronutrient density, high fiber, mostly natural and unprocessed food items recommended by the Norwegian authorities [92]. The three categories simplifies the presentation and discussion of the data.

For some of the food items and beverages, the field workers measured meters of shelf space (biscuits, chocolate and sweets, savory snacks, soft drinks with sugar, soft drinks without sugar, and still and sparkling water). For other food items and beverages, the field workers counted the number of available sorts within each product category (sweet bakery products, unsweetened bakery products, unsweetened bakery products with mixed grain, fresh fruit, fresh vegetables, juice and fruit drinks, and flavored milk). Three food items were only checked for the availability (vegetarian snack, light ice tea and flavored milk with less sugar.
and fat). The field workers were also asked to rate if the fruit and vegetables section looked appetizing.

Finally, the field workers used a checklist at the end of the form to record typically occurring food items and drinks available within arm’s reach in one random cash register queue of the outlet (sugar free gum, sugar free pastilles, chocolate, other sweets, vegetables, fruit, nuts, still and sparkling water, soft drink with sugar, soft drinks without sugar, other food items). When presenting results on the availability around the cash registers, only supermarkets are included, due to being the most interesting type of food sales outlet in this situation and with best potential to minimize exposure of unhealthy options in favor of healthy ones.

In Norwegian food sales outlets, soft drinks with sugar, soft drinks without sugar and still and sparkling water are usually offered and displayed in three different ways. Ordinary shelf space (refrigerators included), loading pallets (800x600 millimeter) with 48 bottles with the volume of 1,25 liter or 1,5 liter, or plastic crates (400x300 millimeter) of 10 or 24 bottles (depending on volume) with a volume of 0.33 to 1.5 liter. On the observation form these were recorded as the number of loading pallets, the number of crates and the linear shelf space in meters. In the analysis these three variables (the number of loading pallets, number of crates and shelf space) were aggregated to total linear shelf space by multiplying the total number of loading pallets and crates with its long side and added to the measured shelf space.

4.4.2 Principal questionnaire

The principal questionnaire was in this thesis used to find out if pupils were allowed to leave the school during the school day and to determine the socio-economic position of the schools.

The school principal or another person in the school administration was requested to complete a questionnaire on school environment. The questionnaire consisted of 75 questions on school environment. In one of the questions, the principal was asked if pupils were allowed to leave the school on breaks during the school day. There were three answer alternatives; yes, some of the pupils or no. In another question, the principal was asked to assess the amount of pupils coming from families with low income. There were six categories ranging from less than 5% to more than 40% of the pupils. This question was used to determine the socio-economic position of the school. The categorical variable was recoded into a dichotomous variable with a cut of at 10 %, meaning that schools with 10% or more pupils from low income families, were defined as schools of lower socio-economic position -and vice versa. Principals were
Methods and sample

asked to return the questionnaire in a pre stamped envelop. If the research group had not received the questionnaire within three weeks, the principal was reminded by e-mail.

In the following two sections of text the procedure of determining socio-economic position will be described. Two flow diagrams (appendix 3 and 4) are available for support.

At baseline (2007) in the original HEIA-project, involving primary schools, the research group received 35 principal questionnaires from the 37 included schools of which five had missing data on the question about the amount of pupils coming from low income families. In follow-up 2 (2009) all 37 primary schools delivered the principal questionnaire, of which two had missing data on the particular question. One school had missing data at both time points which meant that it should be possible to get an indication of the socio-economic position of 36 of the 37 investigated primary schools. For 13 of those schools, the answer had the same category at both times, seven schools answered the question about socio-economic position in only one of those two occasions (baseline and follow-up 2). In addition 16 schools answered in different categories in baseline (2007) compared to follow-up 2 (2009). Of those 16 schools, 11 had answered categories which both led to the same category of either lower or higher socio-economic status after. The remaining five schools (of which one didn’t have food sales outlets) had given answers resulting in different categories even after dichotomization and due to this difficulty those five schools were excluded from analyses regarding socio-economic position. A total of 24 primary schools (of which eight did not have food sales outlets) were in this thesis defined as schools of higher socio-economic position and seven schools (of which two did not have food sales outlets) as schools of lower socio-economic position.

In the HEIA II project, involving lower secondary schools, the research group received 32 principal questionnaires from the 36 included schools. One questionnaire was not possible to determine its origin, three questionnaires had missing data and it was then possible to get an indication of the socio-economic position in 28 lower secondary schools. A total of 15 lower secondary schools (of which five did not have food sales outlets) were in this thesis defined as schools of higher socio-economic position and 13 schools (of which two did not have food sales outlets) as schools of lower socio-economic position.
4.4.3 The internet based student questionnaire

The individuals in the included primary schools completed an internet based questionnaire during the school hours. The questionnaire consisted of 121 questions, amongst others on dietary behavior.

In this thesis data from eight of the 121 questions were used. Seven of those eight questions investigate the frequency of intake per week of six food items and one beverage (fruit, raw vegetables, chocolate and sweets, savory snacks, sweet bakery products, sweet and salty biscuits and soft drinks with sugar). The eighth and last question that was used from the internet based student questionnaire was about the amount of soft drinks usually consumed. The recoding and aggregation of those variables will now be described.

The questions on the six food items were formulated as the following example on fruit (translated from Norwegian to English): How often do you usually eat fruit? For fruit and raw vegetables there were eight answer categories (1: never/seldom (0), 2: less then one time per week (0.5), 3: one-two times per week (1.5), 4: three-four times per week (3.5), 5: five-six times per week (5.5), 6: one time per day (7), 7: twice per day (14), 8: three times per day (21). Recodings into times/week in parenthesis).

For chocolate and sweets, savory snacks, sweet bakery products and sweet and salty biscuits there were seven answer categories (1: never/seldom (0), 2: less then one time per week (0.5), 3: one-two times per week (1.5), 4: three-four times per week (3.5), 5: five-six times per week (5.5), 6: one time per day (7), 7: twice or more per day (14). Recodings into times/week in parenthesis).

The question on the frequency of intake per week of soft drinks with sugar was formulated as following (translated from Norwegian to English): On WEEKDAYS (Monday-Friday) how often do you usually drink soft drinks with sugar? There were six answer categories (1: never/seldom (0.0), 2: one day (0.2), 3: two days (0.4), 4: three days (0.6), 5: four days (0.8), 6: every day (1.0). Recodings into times/day in parenthesis.) Next step was to use data from the following question (translated from Norwegian to English): When you drink soft drinks with sugar, how much do you usually drink? (1/2 liter = 3 glasses) There were four answer categories (1: one glass (1.67), 2: two glasses (3.33), 3: three glasses (5.00), 4: four glasses or more (4=6.67). Recodings into volume in dl/time in parenthesis). With the data from those two previously described variables on soft drinks with sugar, a new variable was created that
stated the volume in deciliter ingested each weekday by multiplying the number of times soft drinks with sugar were ingested each day with the volume usually ingested each time in deciliters. This new variable was then multiplied with the number of five to obtain the final variable: intake of soft drinks with sugar per school week (five days, Monday-Friday) in deciliters.

The total number of pupils in each school varied and a mean for each school were calculated for each of those variables just described, and those variables (school mean frequency of the intake per week) were then used in the analyses.

The sample available for analysis regarding the school mean frequency of the intake per week of selected food items was limited down to 25 primary schools. This since dietary data from lower secondary schools not were available for analysis during this thesis and in addition, only control schools could be used due to some of the investigated food items were targeted in the intervention which could have introduced a systematic bias in the data.

4.5 Statistical analysis

The statistical program SPSS 18.0 was used for all the statistical analyses. Descriptive statistics were used for getting an overview of the data collected from included food sales outlets and for determining the median and the 25th and 75th percentiles. The Kolmogorov-Smirnov Test of Normality and histograms were used to assess whether the variables were normally distributed. When data were not normal distributed non-parametric statistical tests were used such as Kruskal-Wallis test and Mann-Whitney U tests when testing for significant difference between groups.

One-way ANOVA between groups analysis and correlation analyses with Pearson’s correlation coefficient were used to explore the association between the school neighborhood food environment and the schools mean frequency of the intake per week of seven selected food items.
5 Results

5.1 Food sales outlets in school neighborhoods

A total number of 131 food sales outlets were identified in the investigated school neighborhoods, of which 63 and 69 were in neighborhoods of primary schools and lower secondary schools, respectively. Six outlets were excluded from further analysis, of which three did not give permission for observation, two lacked personnel with authority to give clearance for the observation, and one bakery due to being the only one found and thus proven very rare in the investigated school neighborhoods. Included type of outlets were supermarkets, gas stations and kiosks since these were the most frequent occurring type of food sales outlets around the investigated schools and most likely to be used by pupils.

Table 1 presents the numbers and percentages of school neighborhoods with or without food sales outlets as well as the distribution of supermarkets, gas stations and kiosks between primary and lower secondary schools. Food sales outlets were found around 25 (68%) of the investigated primary schools and 28 (78%) of the lower secondary schools (before exclusion it was 29 lower secondary schools with food sales outlets). One food sales outlet was located within 500 meters from two schools, and therefore in the analyses, considered as two cases when comparing schools, and one case when comparing food sales outlets. This gave data from a total of 125 food sales outlets, 60 outlets from primary school neighborhoods and 65 from lower secondary school neighborhoods.

| Table 1: Overview of the investigated food sales outlets in the school neighborhoods* |
|---------------------------------|-----------------|-----------------|
|                                 | Primary school | Lower secondary school |
| **School overview**             |                |                  |
| Number of schools with food sales outlets present in neighborhood | 25 (68%) | 28* (78%) |
| Number of schools without food sales outlets present in neighborhood | 12 (32%) | 8b (22%) |
| **Total of schools**            | 37 (100%) | 36 (100%) |
| **Type of observed food sales outlets** |                |                  |
| Supermarkets                    | 34 (57%) | 41 (63%) |
| Kiosks                          | 17 (28%) | 16 (25%) |
| Gas stations                    | 9 (15%) | 8 (12%) |
| **Total of food sales outlets** | 60 (100%) | 65 (100%) |

*Neighborhood was defined as within 500 meter radius from schools

* Were 29 before exclusion of those outlets which did not permit observation

b Were seven before the school with one excluded food sales outlet in the neighborhood were added to
Results

Highest number of outlets in a single school neighborhood was nine, of which six were kiosks, two supermarkets and one gas station (figure 1). Second highest number of outlets in a single school neighborhood was seven. The mean number of food sales outlets in each neighborhood was 1.6 and 1.8 in primary and lower secondary schools, no significant difference (data not shown). More than one food sales outlet in the neighborhood had 41% of all the primary schools and 52% of all the lower secondary schools (60% and 68% of those schools that had food sales outlets in the neighborhood) (data not shown).

The most frequently occurring type of outlet in all school neighborhoods were supermarkets which were found in 62% of the neighborhoods to all primary schools and 75% to all lower secondary schools (92% and 96% of those schools that had food sales outlets in the neighborhood) (data not shown). More than one supermarket was found in 22% of the neighborhoods to all primary schools and 28% to all lower secondary schools (32% and 36% of those schools that had food sales outlets in the neighborhood) (data not shown). The second most occurring type of outlet was kiosks which were found in 28% of all the neighborhoods to both primary schools and lower secondary schools (40% and 36% of those schools that had food sales outlets in the neighborhood) (data not shown), and there were more than one kiosk in 8% of all the neighborhoods around both primary schools and lower secondary schools (12% and 11% of those schools that had food sales outlets in the neighborhood) (data not shown). Gas stations were the third most occurring type of outlets and were found in 28% of all the neighborhoods to primary schools and 22% to lower secondary schools (40% and 29% of those schools that had food sales outlets in the neighborhood) (data not shown), but never more than one gas station in each neighborhood.
Figure 1: Number of food sales outlets in each investigated neighborhood of primary schools (A) and lower secondary schools (B) in south-eastern Norway, sorted from highest to lowest number of outlets.
( Neighborhood was defined as within 500 meter radius from schools )
Results

5.2 Availability of different food items

5.2.1 Availability in food sales outlets

The availability of 16 different food items and beverages by type of food sales outlet is presented in table 2. Five of the 16 investigated food items (chocolate and sweets, soft drinks with sugar, juice and fruit drinks, soft drinks without sugar and still and sparkling water) were available in all investigated food sales outlets. The six food items, considered unhealthy in this thesis (chocolate and sweets, soft drinks with sugar, savory snacks, sweet and salty biscuits, sweet bakery products and flavored milk), were available in all supermarkets and all gas stations but not in every kiosk. Supermarkets had 100% availability of 12 (75%) of the 16 investigated food items, while corresponding figures in gas stations and kiosks were 9 (56%) and 5 (31%). Supermarkets had four food items, considered healthy or semi healthy (flavored milk with less sugar and fat, light ice tea, unsweetened bakery products with mixed grain and vegetarian snack) that were not available in all supermarkets (64%, 73%, 99%, 97%). One of those four food items (light ice tea) had a non-significant higher availability in gas stations (76%) than supermarkets (73%). Gas stations had seven food items that were not available in all gas stations, all considered semi healthy or healthy. Kiosks had 11 food items that were not available in all kiosks, both unhealthy, semi healthy and healthy food items.

| Table 2 Availability of food items and beverages measured in the proportion and percent of the investigated food sales outlets having the particular food item available |
|---------------------------------|-----------------|-----------------|-----------------|
|                                 | Supermarkets    | Gas stations    | Kiosks          |
| Unhealthy                       |                 |                 |                 |
| Chocolate and sweets*           | 75/75 (100%)    | 17/17 (100%)    | 33/33 (100%)    |
| Soft drinks with sugar*         | 75/75 (100%)    | 17/17 (100%)    | 33/33 (100%)    |
| Savory snacks                   | 75/75 (100%)    | 17/17 (100%)    | 27/33 (82%)     |
| Sweet and salty biscuits        | 75/75 (100%)    | 17/17 (100%)    | 11/32* (34%)    |
| Sweet bakery products           | 75/75 (100%)    | 17/17 (100%)    | 19/32* (59%)    |
| Flavored milk                   | 75/75 (100%)    | 17/17 (100%)    | 22/33 (67%)     |
| Overall/total                   | 100%            | 100%            | 74%             |
| Semi healthy                    |                 |                 |                 |
| Juice and fruit drinks*         | 75/75 (100%)    | 17/17 (100%)    | 33/33 (100%)    |
| Unsweetened bakery products     | 75/75 (100%)    | 6/17 (35%)      | 9/32* (28%)     |
| Flavored milk, less sugar and fat| 47/73* (64%)  | 7/17 (41%)      | 2/25* (8%)      |
| Light ice tea*                  | 46/63* (73%)    | 13/17 (76%)     | 18/32* (56%)    |
| Soft drinks without sugar*      | 75/75 (100%)    | 17/17 (100%)    | 33/33 (100%)    |
| Overall/total                   | 87%             | 70%             | 58%             |
| Healthy                         |                 |                 |                 |
| Unsweetened bakery products with mixed grain | 73/74* (99%) | 3/16* (19%) | 4/30* (13%) |
| Still and sparkling water*      | 75/75 (100%)    | 17/17 (100%)    | 33/33 (100%)    |
| Vegetarian snack                | 73/75 (97%)     | 6/17 (35%)      | 1/33 (3%)       |
| Fruit, fresh                    | 75/75 (100%)    | 12/17 (71%)     | 6/33 (18%)      |
| Vegetables, fresh               | 75/75 (100%)    | 6/17 (35%)      | 3/33 (9%)       |
| Overall/total                   | 99%             | 52%             | 29%             |

*Values are number (%) of food sales outlets unless otherwise stated
The overall/total is the mean of the food items within its group
*Were available in all the investigated food sales outlets.
*The only food item in supermarkets which were of lower availability compared to gas stations (not significant)
*Missing data in some of the cases
5.2.2 Availability around the cash registers

The availability of 11 typically occurring food items and beverages next to one randomly chosen cash register were registered in the supermarkets. Almost all supermarkets had sugar free gum and sugar free pastilles available (figure 2). Furthermore, almost 80% of the supermarkets around primary schools had chocolate available, whilst the corresponding percentage in the neighborhoods around lower secondary schools was only 37%. Apart from that, the availability of those nine products differed markedly between supermarkets (data not shown).

![Figure 2](image.png)

Figure 2 Percent of supermarkets which offered different food items to customers in the cash register queue

5.3 Accessibility of different food items

5.3.1 Accessibility by type of food sales outlets

The accessibility of 13 different food items and beverages were investigated in the included food sales outlets (table 3). A Kruskal-Wallis test revealed a statistically significant difference in accessibility levels across the three groups of food sales outlets. Follow-up Mann-Whitney U tests between pairs revealed that all food items had significantly higher accessibility in supermarkets compared to kiosks. Furthermore, 12 of the investigated food items had significantly higher accessibility in supermarkets compared to gas stations. The difference between gas stations and kiosks was not large but seven of the 13 investigated food items had an accessibility which was significantly higher in gas stations compared to kiosks.
Table 3 Accessibility of food items and beverages in the investigated food sales outlets, measured by linear shelf length and number of varieties

<table>
<thead>
<tr>
<th>Measured by shelf length in meters</th>
<th>Supermarkets (S)</th>
<th>Gas stations (G)</th>
<th>Kiosks (K)</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate and sweets</td>
<td>74.4 [60.8, 102.0]</td>
<td>31.3 [27.1, 34.1]</td>
<td>30.9 [25.5, 41.4]</td>
<td>&lt;.001</td>
<td>S&gt;G, K</td>
</tr>
<tr>
<td>Soft drinks with sugar</td>
<td>37.9 [30.4, 53.4]</td>
<td>6.9 [5.6, 10.6]</td>
<td>4.9 [3.0, 7.4]</td>
<td>&lt;.001</td>
<td>S&gt;G&lt;K</td>
</tr>
<tr>
<td>Savory snacks</td>
<td>56.4 [39.5, 79.4]</td>
<td>9.0 [7.2, 11.2]</td>
<td>3.3 [1.0, 8.0]</td>
<td>&lt;.001</td>
<td>S&gt;G&lt;K</td>
</tr>
<tr>
<td>Sweet and salty biscuits</td>
<td>17.2 [14.1, 27.0]</td>
<td>1.5 [1.0, 1.9]</td>
<td>0.0 [0.0, 0.9]</td>
<td>&lt;.001</td>
<td>S&gt;G&lt;K</td>
</tr>
<tr>
<td>Soft drinks without sugar</td>
<td>24.7 [18.0, 31.8]</td>
<td>2.8 [2.1, 4.8]</td>
<td>2.0 [1.3, 2.9]</td>
<td>&lt;.001</td>
<td>S&gt;G&lt;K</td>
</tr>
<tr>
<td>Still and sparkling water</td>
<td>17.4 [11.8, 23.9]</td>
<td>3.0 [2.0, 4.0]</td>
<td>2.4 [1.3, 3.6]</td>
<td>&lt;.001</td>
<td>S&gt;G, K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measured by number of varieties</th>
<th>Supermarkets (S)</th>
<th>Gas stations (G)</th>
<th>Kiosks (K)</th>
<th>p-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet bakery products</td>
<td>19.0 [13.0, 22.0]</td>
<td>8.0 [4.5, 11.5]</td>
<td>2.0 [0.0, 4.2]</td>
<td>&lt;.001</td>
<td>S&gt;G&gt;K</td>
</tr>
<tr>
<td>Flavored milk</td>
<td>6.0 [5.0, 8.0]</td>
<td>4.0 [3.0, 6.0]</td>
<td>1.0 [0.0, 3.7]</td>
<td>&lt;.001</td>
<td>S&gt;G&gt;K</td>
</tr>
<tr>
<td>Juice and fruit drinks</td>
<td>18.0 [13.0, 28.0]</td>
<td>13.0 [7.5, 23.0]</td>
<td>9.0 [5.0, 14.0]</td>
<td>&lt;.001</td>
<td>S&gt;K</td>
</tr>
<tr>
<td>Unsweetened bakery products with mixed grain</td>
<td>3.0 [2.0, 4.0]</td>
<td>0.0 [0.0, 0.0]</td>
<td>0.0 [0.0, 0.0]</td>
<td>&lt;.001</td>
<td>S&gt;G, K</td>
</tr>
<tr>
<td>Fruit</td>
<td>15.0 [13.0, 17.0]</td>
<td>1.0 [0.0, 2.0]</td>
<td>0.0 [0.0, 0.0]</td>
<td>&lt;.001</td>
<td>S&gt;G&gt;K</td>
</tr>
<tr>
<td>Vegetables</td>
<td>22.0 [20.0, 25.0]</td>
<td>0.0 [0.0, 1.0]</td>
<td>0.0 [0.0, 0.0]</td>
<td>&lt;.001</td>
<td>S&gt;G, K</td>
</tr>
</tbody>
</table>

Values are Median [25th and 75th percentile] unless otherwise stated

* n varies slightly (73-75)  ** n varies slightly (15-17)  *** n varies slightly (27-33)

* Nonparametric Kruskal-Wallis Test (between the groups Supermarkets, Gas stations and Kiosks)

* Nonparametric Mann-Whitney U tests, the symbol > meaning significant difference

5.3.2 Accessibility by type of school

The median, 25th and 75th percentile of the accessibility for each food item around primary schools compared to lower secondary schools is presented in table 4. The data shows that in the current sample, lower secondary schools had higher accessibility of 10 (77%) of the investigated food items, but only one (soft drinks with sugar) was significantly higher.
Table 4  Accessibility of food items and beverages in the school neighborhoods, measured by total shelf length in meters and number of varieties

<table>
<thead>
<tr>
<th></th>
<th>Primary school (n=25)</th>
<th>Lower secondary school (n=28)</th>
<th>p-valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shelf length in meters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate and sweets</td>
<td>125.0 [67.6, 176.1]</td>
<td>116.2 [81.4, 229.8]</td>
<td>0.47</td>
</tr>
<tr>
<td>Soft drinks with sugar</td>
<td>37.9 [19.0, 70.9]</td>
<td>65.7 [39.1, 98.7]</td>
<td>0.037</td>
</tr>
<tr>
<td>Savory snacks</td>
<td>69.5 [39.7, 106.3]</td>
<td>79.5 [47.7, 147.8]</td>
<td>0.22</td>
</tr>
<tr>
<td>Sweet and salty biscuits</td>
<td>17.9 [14.4, 40.6]</td>
<td>25.4 [15.5, 43.4]</td>
<td>0.28</td>
</tr>
<tr>
<td>Soft drinks without sugar</td>
<td>28.9 [16.4, 44.7]</td>
<td>32.7 [20.8, 58.7]</td>
<td>0.31</td>
</tr>
<tr>
<td>Still and sparkling water</td>
<td>24.9 [11.9, 33.8]</td>
<td>27.8 [13.6, 46.4]</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Number of varieties</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet bakery products</td>
<td>29.0 [18.0, 36.0]</td>
<td>24.5 [16.2, 49.7]</td>
<td>0.94</td>
</tr>
<tr>
<td>Flavored milk</td>
<td>8.0 [5.0, 15.0]</td>
<td>11.5 [6.0, 22.7]</td>
<td>0.07</td>
</tr>
<tr>
<td>Juice and fruit drinks</td>
<td>29.0 [15.0, 55.0]</td>
<td>44.0 [17.5, 80.7]</td>
<td>0.15</td>
</tr>
<tr>
<td>Unsweetened bakery products</td>
<td>12.0 [7.0, 19.2]</td>
<td>10.0 [8.0, 23.0]</td>
<td>0.61</td>
</tr>
<tr>
<td>Unsweetened bakery products with mixed grain</td>
<td>3.5 [3.0, 5.0]</td>
<td>4.0 [3.0, 7.0]</td>
<td>0.27</td>
</tr>
<tr>
<td>Fruit</td>
<td>16.0 [13.5, 27.0]</td>
<td>22.0 [14.0, 34.0]</td>
<td>0.31</td>
</tr>
<tr>
<td>Vegetables</td>
<td>25.0 [19.0, 46.0]</td>
<td>26.0 [22.0, 45.0]</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Values are median [25th and 75th percentile] unless otherwise stated
Neighborhood was defined as within 500 meter radius from schools
a Nonparametric Mann-Whitney U independent samples test

5.3.3  Food sales outlets and accessibility by schools socio-economic position

There was a non-significant pattern of higher number of food sales outlets in lower socio-economic position school neighborhoods (table 5). The mean number of food sales outlets in each school neighborhood (that did have food sales outlets) was 2.0 and 1.7 for higher socio-economic position primary- and lower secondary schools respectively, whilst corresponding result from lower socio-economic position schools were 4.2 and 2.7. In this sample of schools there were also a non-significant greater proportion of supermarkets and a smaller proportion of kiosks around schools with higher socio-economic position compared to lower socio-economic position schools, from both primary- and lower secondary type.

Accessibility of different food items in the investigated school neighborhoods with regard to the schools’ socio-economic position is presented in table 6. Primary schools and lower secondary schools defined as being of lower socio-economic position, had non-significant higher accessibility of 12 (92%) and 11 (85%) of the 13 investigated food items respectively.
Table 5 Frequency of food sales outlets and type of food sales outlets in neighborhoods of primary and lower secondary schools with higher (SEP1) and lower (SEP2) socio-economic position.

<table>
<thead>
<tr>
<th>Type of food sales outlets</th>
<th>Primary School</th>
<th>Lower Secondary school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEP 1*</td>
<td>SEP 2**</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>20 (62%)</td>
<td>8 (38%)</td>
</tr>
<tr>
<td>Kiosks</td>
<td>7 (22%)</td>
<td>9 (43%)</td>
</tr>
<tr>
<td>Gas stations</td>
<td>5 (16%)</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>Total food sales outlets</td>
<td>32 (100%)</td>
<td>21 (100%)</td>
</tr>
<tr>
<td>Mean in each type of school</td>
<td>2.0</td>
<td>4.2</td>
</tr>
</tbody>
</table>

* Higher socio-economic position - schools with >10% of pupils from low income families
** Lower socio-economic position - schools with <10% of pupils from low income families

Non significant higher mean in SEP 2 compared to SEP 1 in both primary and lower secondary schools
(OF the 31 primary schools with determined socio-economic position, 10 had no food sales outlets in the neighborhood)
(OF the 28 lower secondary schools with determined socio-economic position, seven had no food sales outlets in the neighborhood)
(Neighborhood was defined as within 500 meter radius from schools)

Table 6 Differences in accessibility of the investigated food items and beverages in school neighborhoods by socio-economic position (SEP), measured by total shelf length in meters and number of varieties

<table>
<thead>
<tr>
<th>Shelf length in meters</th>
<th>Primary school</th>
<th>Lower secondary school</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate and sweets</td>
<td>110.9 [50.3, 149.8]</td>
<td>215.3 [81.1, 351.4]</td>
<td>0.12</td>
</tr>
<tr>
<td>Soft drinks with sugar</td>
<td>36.3 [14.3, 65.6]</td>
<td>109.8 [24.7, 135.1]</td>
<td>0.19</td>
</tr>
<tr>
<td>Savory snacks</td>
<td>63.1 [36.1, 87.0]</td>
<td>105.6 [40.9, 193.2]</td>
<td>0.22</td>
</tr>
<tr>
<td>Sweet and salty biscuits</td>
<td>16.5 [14.1, 38.9]</td>
<td>37.0 [9.8, 62.6]</td>
<td>0.46</td>
</tr>
<tr>
<td>Soft drinks without sugar</td>
<td>25.2 [16.2, 40.9]</td>
<td>34.8 [18.5, 68.9]</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Number of varieties

<table>
<thead>
<tr>
<th>Shelf length in meters</th>
<th>Primary school</th>
<th>Lower secondary school</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet bakery products</td>
<td>27.0 [14.0, 32.7]</td>
<td>54.0 [16.5, 64.0]</td>
<td>0.25</td>
</tr>
<tr>
<td>Flavored milk</td>
<td>7.0 [4.2, 15.0]</td>
<td>11.0 [5.0, 21.5]</td>
<td>0.51</td>
</tr>
<tr>
<td>Juice and fruit drinks</td>
<td>31.5 [14.2, 55.0]</td>
<td>29.0 [19.5, 81.0]</td>
<td>0.56</td>
</tr>
<tr>
<td>Unsweetened bakery</td>
<td>12.0 [7.0, 20.0]</td>
<td>13.0 [4.0, 19.0]</td>
<td>0.93</td>
</tr>
<tr>
<td>products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsweetened bakery</td>
<td>3.0 [3.0, 6.0]</td>
<td>5.0 [2.0, 6.5]</td>
<td>0.86</td>
</tr>
<tr>
<td>products with mixed grain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>14.5 [13.0, 21.0]</td>
<td>31.0 [8.0, 39.0]</td>
<td>0.25</td>
</tr>
<tr>
<td>Vegetables</td>
<td>23.0 [19.0, 30.5]</td>
<td>48.0 [12.0, 65.0]</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Values are median [25th and 75th percentile] unless otherwise stated
* Higher socio-economic position - schools with >10% of pupils from low income families
** Lower socio-economic position - schools with <10% of pupils from low income families

Nonparametric Mann-Whitney U independent samples test
(OF the 31 primary schools with determined socio-economic position, 10 had no food sales outlets in the neighborhood)
(OF the 28 lower secondary schools with determined socio-economic position, seven had no food sales outlets in the neighborhood)
(Neighborhood was defined as within 500 meter radius from schools)
5.4 School mean frequency of the intake per week of seven selected food items

The school mean frequency of raw vegetables intake per week showed significant difference between the three groups (having no food sales outlet; one food sales outlet; more than one food sales outlets) of schools (table 7). Post Hoc analyses showed that the significant difference was between schools with more then one food sales outlets compared with schools with one or none food sales outlet. The mean frequency of raw vegetables intake per week was 5.2 times per week compared to 6.6 and 6.3 times per week, respectively. The difference between one or no food sales outlet was not significant. Apart from that, only small variations were seen when comparing the three groups by the school mean frequency of the intake per week of seven selected food items. However, worth mentioning is the mean intake per week of soft drinks with sugar which showed higher frequency if there was a food sales outlet in the school neighborhood and even higher when there were several food sales outlets in the school neighborhood (not significant).

| School mean frequency | Without food sales outlets in the school neighborhood (n=10) | With one food sales outlet in the school neighborhood (n=8) | With more than one food sales outlets in the school neighborhood (n=7) | p-value*
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>9.6 (8.6, 10.7)</td>
<td>9.4 (7.9, 10.8)</td>
<td>9.0 (7.8, 10.3)</td>
<td>0.74</td>
</tr>
<tr>
<td>Vegetables, raw</td>
<td>6.3 (5.8, 6.7)</td>
<td>6.6 (5.6, 7.6)</td>
<td>5.2 (4.3, 6.0)</td>
<td>0.018</td>
</tr>
<tr>
<td>Chocolate and sweets</td>
<td>1.9 (1.7, 2.2)</td>
<td>2.0 (1.6, 2.4)</td>
<td>2.0 (1.8, 2.3)</td>
<td>0.84</td>
</tr>
<tr>
<td>Savory snacks</td>
<td>1.5 (1.3, 1.7)</td>
<td>1.4 (1.1, 1.8)</td>
<td>1.6 (1.4, 1.8)</td>
<td>0.56</td>
</tr>
<tr>
<td>Sweet bakery products</td>
<td>0.7 (0.5, 0.9)</td>
<td>0.7 (0.4, 1.1)</td>
<td>0.9 (0.7, 1.1)</td>
<td>0.52</td>
</tr>
<tr>
<td>Sweet and salty biscuits</td>
<td>0.8 (0.6, 0.9)</td>
<td>0.8 (0.5, 1.1)</td>
<td>0.9 (0.7, 1.0)</td>
<td>0.71</td>
</tr>
<tr>
<td>Soft drinks with sugar*</td>
<td>2.4 (1.6, 3.2)</td>
<td>2.9 (1.8, 4.0)</td>
<td>3.3 (2.5, 4.1)</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Table 7 School mean frequency of the intake per week of different food items based on reports by 7th graders (n=945) in 25 primary schools in Norway

Only control schools (n=25) are included, due to possible effects in the intervention schools (n=12).
Values are mean (95% CI) unless otherwise stated
*One-way ANOVA between groups analysis
*Mean intake in decimals, per school week (five days)
(neighborhood was defined as within 500 meter radius from schools)

Table 8, show that there was also an almost significant negative correlation between the mean school frequency of raw vegetables intake per week and accessibility of vegetables in the school neighborhoods, measured as the total number of varieties.

<table>
<thead>
<tr>
<th>School mean frequency</th>
<th>Correlation coefficient</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>0.16</td>
<td>0.57</td>
</tr>
<tr>
<td>Vegetables, raw</td>
<td>-0.48</td>
<td>0.07</td>
</tr>
<tr>
<td>Chocolate and sweets</td>
<td>-0.04</td>
<td>0.90</td>
</tr>
<tr>
<td>Savory snacks</td>
<td>0.30</td>
<td>0.27</td>
</tr>
<tr>
<td>Sweet bakery products</td>
<td>0.23</td>
<td>0.40</td>
</tr>
<tr>
<td>Sweet and salty biscuits</td>
<td>0.15</td>
<td>0.59</td>
</tr>
<tr>
<td>Soft drinks with sugar*</td>
<td>0.05</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Table 8 Pearson’s correlation coefficient between school mean frequency* of the intake per week of seven selected food items and accessibility** in the neighborhoods to primary schools (n=15) with food sales outlets present

Only control schools with food sales outlets in the neighborhood are included (n=15), control schools without food sales outlets (n=10) and intervention schools (n=12) are excluded.
*School mean frequency of the intake per week of seven selected food items is aggregated from pupils (n=597) into mean variables in each school
**Accessibility measured as the total linear shelf space or total number of varieties available in the food sales outlets in each school neighborhood
(neighborhood was defined as within 500 meter radius from schools)
6 Discussion

The objective of this thesis was to describe the availability and accessibility of food items and beverages in food sales outlets in the neighborhood of primary and lower secondary schools, and to explore variation in the availability and accessibility by the schools’ socio-economic position and possible associations with the school mean frequency of the intake per week of selected food items by 7th grade pupils.

Food sales outlets were found in 25 (68%) of the 37 included primary schools and 28 (78%) of the 36 included lower secondary schools. The number of outlets in each school neighborhood varied but the total number of outlets around each school type (primary- vs. lower secondary schools) was similar (60/65). The most frequent occurring type of food sales outlets in the neighborhood of primary- and lower secondary schools were supermarkets (57%, 63%), kiosks (28%, 25%) and gas stations (15%, 12%). Overall, the best availability and accessibility of the investigated food items were found in supermarkets, there after gas stations and lowest overall availability and accessibility of the investigated food items were found in kiosks. Across all types of food sales outlets, the most available food items were those defined as unhealthy, then semi healthy and least overall availability was found for healthy food items, except in supermarkets were healthy food items had higher overall availability than the semi healthy items. Neighborhoods of lower secondary schools had higher accessibility of 10 (77%) of the investigated food items compared to neighborhoods of primary schools, but this was only significant for soft drinks with sugar.

Schools of lower socio-economic position (both primary- and lower secondary type) had non-significantly higher number of food sales outlets in the neighborhood, higher accessibility of the majority of the food items and also a trend of more kiosks and fewer supermarkets, compared to schools of higher socio-economic position.

Only small differences were found between schools’ mean frequency of the intake per week of seven selected food items among 7th graders and whether there were one, more than one or no food sales outlets in the school neighborhood. However, the schools mean frequency of raw vegetable intake per week was significant lower in schools with more than one food sales outlet in the neighborhood compared to school neighborhoods with only one or no food sales outlet. This pattern was also found as a non-significant negative correlation between schools mean frequency of raw vegetable intake per week and the accessibility in the school neighborhoods.
6.1 Interpretation of the results

6.1.1 Food sales outlets

Food sales outlets were found in 68% and 78% of the neighborhoods of primary schools and lower secondary schools in this study. Published research from Norway is absent but from New Zealand, Day et al. published in 2011 a study involving 406 schools (primary, middle and secondary schools), they found convenience stores (dairy, small food market, petrol station) within 400 meters of 42.9% of the schools and within 800 meters in 77.1% of the schools [93]. Further more Langellier published in 2012, a study conducted in USA involving 1694 public schools where they found corner stores within a half-mile (805 meters) of 68.7% of the schools [94]. A study from Scotland involving 991 adults found that 73% were living within 500 meters from a general store [95]. There are however, a couple of things to be aware of when comparing the result of this thesis with other results from outside Norway. Food environments outside Norway have other types of food sales outlets. The terminology and the definition of the different types of food sales outlets can differ between studies. For example during the litterateur review for this thesis the following terms were found: supermarkets, convenience store, grocery store, drug store, liquor store, medium-sized food store and variations of these. To use these terms in a Norwegian context is slightly obscuring. In addition, other countries usually have a different school system with generally more pupils enrolled in each school. These are some things that have to be kept in mind when discussing the result of this thesis with other results from outside Norway, and in fact sometime makes it hard to make fruitful comparisons.

Of the 60 and 65 food sales outlets identified around primary schools and lower secondary schools, 57% and 63% were supermarkets, 28% and 25% were kiosks and 15% and 12% were gas stations. This is a bigger proportion of supermarkets compared to findings from food environments in the USA and the United Kingdom [96-98]. The finding of supermarkets as the most frequent occurring type of food sales outlets in neighborhoods of both primary- and lower secondary schools, is particularly positive and vouches for good possibilities for a more healthy food environment since studies reported that increased access to supermarkets is associated with healthier food intake among adolescents and adults [99, 100]. However, there were more than one food sales outlets in the neighborhood of 41% of the primary schools and 52% of the lower secondary schools. This can have a negative influence on dietary habits since several studies have linked proximity to convenience stores with reduced intake of fruits.
and vegetables, poor overall dietary intake patterns and risk for obesity [99, 101-103] and it has also been shown that closer perceived proximity (or travel time on foot) to food retail is related to increased sugar-sweetened beverages purchasing among adolescents [104]. However, as cautioned above, these results may not be directly comparable since the type of food sales outlets in these studies is not identical to the type in Norway. Further more, research has shown that corner stores and other food outlets that serve unhealthful foods tend to cluster near schools [40, 81, 82, 105, 106]. Given the generally low number of food sales outlets, this thesis do not support the idea of clustering of food sales outlets around Norwegian schools, but mapping of the overall density of food sales outlets of the communities was however, not a part of the HEIA-study or this thesis.

6.1.2 Availability of food items

Five food items (chocolate and sweets, soft drinks with sugar, juice and fruit drinks, soft drinks without sugar and still and sparkling water) were available in every store investigated (100% availability). Three of these food items (chocolate and sweets, soft drinks with sugar, juice and fruit drinks) are typically energy-dense, low-nutrient. Youth who shop at convenience stores have been reported to frequently purchase these foods [107]. Overall, the unhealthy food items had the best availability in all the three types of food sales outlets (100% in supermarkets, 100% in gas stations and 74% in kiosks). Supermarkets were the only type of outlet with 99% availability of healthy food items, which was higher than semi healthy (87%) indicating that supermarkets are positive for a healthy food environment.

The food items available when queuing at cash registers in the investigated supermarkets were dominated by sugar free pastilles and sugar free gum with over 95% availability. Three unhealthy food items (chocolate, other sweets and soft drinks with sugar) were also available around the cash registers in 79%, 56% and 32% of the supermarkets around primary schools and 37%, 44% and 46% around lower secondary schools. Farley et al investigated 1082 retail establishments in the USA and found that candy and sweetened beverages were available within arm’s reach of the cash register queue in 65% and 33% of the sample [108], which compares well with the data from primary schools reported here. Chocolate was in this thesis more than twice as common at the cash registers of supermarkets around primary schools compared to supermarkets around lower secondary schools. This could indicate that pupils around primary schools are more exposed to chocolate, but it may also be due to temporal trends since there were close to two years between the data collections in primary schools (2009) and lower secondary schools (2011). Some supermarkets in Norway have in recent
years reduced the availability of unhealthy food items around the cash registers and this have been presented in the media and may thus have spread to other supermarkets.

6.1.3 Accessibility of food items
The accessibility, measured by linear shelf length or number of varieties, of the 13 investigated food items was highest in supermarkets. Similar finding of highest accessibility of food items in supermarkets has also been seen in food environments in the USA except from candy which in their sample had higher accessibility in drug stores compared to supermarkets [85]. However, that kind of retail store (drug store) or equivalent, were not present in the investigated food environment in this thesis. In the investigated sample the second highest accessibility of the 13 investigated food items where found in gas stations and lowest in kiosks, with significant difference between the three groups (supermarkets, gas stations and kiosks) and also often significant difference between pairs (follow-up Mann-Whitney U tests). However, since store size was not taken in to account, this result was expected. Adjusting for store size was discussed but abandoned since the only available data was the number of cash registers. The number of cash registers was considered as not accurate enough due to discovering food sales outlets with an apparent difference in store size despite having the same number of cash registers. Some other studies have measured total floor space [88] or both total floor space and number of cash registers [84, 85].

The accessibility of 10 (77%) of the investigated food items was considerable higher around lower secondary schools, but only significantly higher (median 37.9/65.7, p=0.037) for soft drinks with sugar. This could be retailers adjustments to pupils purchasing power since the lower secondary schools houses a bigger proportion of pupils with own money and more freedom to leave school during the school day. Yet, the difference may also be due to the close to two years between the data collections as previously mentioned.

6.1.4 Variation by the schools socio-economic position
There was a non-significant higher number of food sales outlets around schools of lower socio-economic position from both primary- and lower secondary type. Furthermore, around both primary- and lower secondary schools, the accessibility of 12 (92%) and 11 (85%) of the 13 investigated food items were non-significantly higher in schools of lower socio-economic position, probably due to the previously mentioned higher number of food sales outlets. Around schools of lower socio-economic position there was also a smaller proportion of supermarkets and a greater proportion of kiosks compared to higher socio-economic position
schools, from both primary- and lower secondary type. This consistent pattern was to some extent expected since studies, despite some inconsistencies, have shown that residents of low income communities are most often affected by poor access to supermarkets, chain grocery stores, and healthful food products [45, 74, 78-80, 109-114]. School-level analyses of socio-economic position and food accessibility are limited but one study found food source exposure around schools to be inversely associated with neighborhood income [106]. Disparities between countries in how public environments are built and how they are populated are most likely to exist and this complicates comparisons. If the current findings of higher number of food sales outlets, higher accessibility, smaller proportion of supermarkets and higher proportion of kiosks around schools of lower socio-economic position are correct and justly, this could indicate that the current used method (further discussed later) of determining socio-economic position, which is built on a subjective assessment by the school principal, could be entitled.

6.1.5 School mean frequency of the intake per week of selected food items

Only small variations were seen when grouping schools by the number of food sales outlets in the neighborhood into three categories (no food sales outlets, one food sales outlet and more than one food sales outlets) and comparing these by school mean frequency of the intake per week of seven selected food items (fruit, raw vegetables, chocolate and sweets, savory snacks, sweet bakery products, sweet and salt biscuits and soft drinks with sugar). The only school mean frequency of the intake per week that showed the expected association was soft drinks with sugar which showed a non-significant but consistent trend of increasing mean frequency of the intake per week by increasing number of food sales outlets. This is also supported in some studies were the intake of sugar-sweetened beverages has been shown to be negatively associated with distance from home to the nearest restaurant or grocery store [115], and positively associated with food outlet density [46, 115].

The schools mean frequency of raw vegetable intake per week showed a significantly lower mean frequency of the intake per week in schools with more than one food sales outlets compared to schools with only one or no food sales outlet. The significant result was surprising considering the small sample in each of the three groups (n=10, n=8, n=7). The result could however be dependent on which particular type of food sales outlets (supermarket, gas station and kiosks) that were present in the neighborhoods, and this extended analysis was not done. However, results presented earlier in this thesis show that all neighborhoods with more than one food sales outlet had at least one supermarket, which also
suggest that vegetables were available (100% availability in supermarkets) in all of the neighborhoods in this current sample. Research has shown that having fresh vegetables available in outlets in the neighborhood is a positive predictor of vegetable intake [63]. In contrast, having convenience store(s) (non-supermarket) in the neighborhood is associated with less consumption of vegetables [103] and increased distance to convenience store(s) (non-supermarket) is associated with higher intake of vegetables [116]. This could be the case in the current group of neighborhoods with more than one food sales outlets that the selection of food sales outlets is mostly of non-supermarket kind. The finding of a significantly lower mean frequency of raw vegetables intake per week in schools with more than one food sales outlets compared to schools with only one or no food sales outlet was also reflected in the correlation analysis were raw vegetables showed borderline significantly inverse correlation (Pearson’s correlation coefficient -0.48) to the accessibility in the school neighborhoods (p=0.07). This was unexpected since logic says otherwise with support from research were the intake of vegetables have been shown to correlate to accessibility [117]. Further results in the correlation analyses were limited, which could have been caused by the low number of subjects (n=15) in the analyses.

### 6.2 Strengths and weaknesses of the methods

#### 6.2.1 Study design and sample

When the research group of the HEIA project worked with the recruitment of schools to the original HEIA project, it was decided to invite schools in counties near Oslo to be able to have a data collection which was logistically realistic. By selecting counties near Oslo it was possible to reach schools by car within the same day. There were 177 primary schools which fulfilled the inclusion criteria. Ideally a randomized sample is selected, but the participation was voluntarily which ended in 37 schools who agreed to participate. The 12 intervention schools were then randomly selected from the sample of 37 schools and the remaining 25 became the control group. This cluster randomized study design gave a sample which is believed to be representative for at least this part (south-east) of the country which is more densely populated compared to the rest of Norway. Those 37 primary schools held a total of 2165 pupils enrolled in 6th grade, thus invited and a consent was obtained for 1580 (73%) [90] which was considered as sufficient for the required analyses but sampling bias could not be ruled out and a representative sample from the enrolled pupils was not guaranteed.
Discussion

When the food sales outlets in the school neighborhoods were identified there was a chance that any single food sales outlet was not found and thus unknown but still present. The radius of 500 meters from included schools, which formed the defined neighborhood, is a manageable area. On the day of visit field workers confirmed the whereabouts of the preidentified food sales outlets, drove or walked thru the neighborhood to double check for any missed food sales outlets and checked with pupils or school staff about their knowledge and experience of food sales outlets in the area.

The research group identified a total of 131 food sales outlets in the neighborhoods of the included primary- and lower secondary schools. The managers of the food sales outlets were generally positive towards having the outlet observed, but some managers and staff initially seemed to think it was an inspection and were suspicious. Three managers did not give permission and two food sales outlets lacked personnel with authority to give clearance. Those five food sales outlets (less than 4 %) had to be excluded and one of those food sales outlets were the only one in that particular school neighborhood which meant that this particular school neighborhood was recorded as having no food sales outlets present. It is believed to have only negligible effects on the final result and the included food sales outlets are thus considered as representative.

6.2.2 Data collection

An observational form was used for obtaining information from the food sales outlets. The observational form is designed to be used for direct and objective assessment of food sales outlets in school neighborhoods. Objective measurements have been found to be the best way of assessing food environments, because subjective assessments may lead to varying interpretation of the food environment [29, 43, 76]. The observational form have been found to have a high inter-rater and test-retest reliability [89] and have the form of a check list of a number of food items. Check lists have been widely used for investigating food environments [44] and have strengths of accurate measurements of the items in your interest without obtaining a huge amount of data [118]. The accessibility was measured by linear shelf space or counting number of varieties and this method, with small variations, have been used in research before [63, 84, 85, 87, 88]. Cohen et al. specifically tested the reliability of his developed store observation tool and did report an excellent reliability for measures of items availability and shelf space [84]. However, he also discussed the low amount of research and the varying results on validity and reliability reported on this method of using a direct,
Discussion

objective observational tool for assessment of food sales outlets [84]. The currently used observational form could be a limitation of the research in this thesis.

Primary schools were compared to lower secondary schools in part of the analyses. However, the data collection in those two food environments (primary- and lower secondary schools) was conducted two years apart due to the longitudinal design of the HEIA and the HEIA II studies. This is an important weakness of the data collection from the food sales outlets. It can not be ruled out that the food sales outlets in general have undergone a change in food assortment and their way to offer and display these items during the span of two years.

In Norwegian food sales outlets, the following three beverages: soft drinks with sugar, soft drinks without sugar and sparkling water, are usually offered and displayed in three different ways (on loading pallets, in crates or regular store shelves). On the observation form these were recorded as the number of loading pallets, the number of crates and the linear shelf space in meters. In the analysis these three were aggregated to total linear shelf space by multiplying the total number of loading pallets and crates with its long side and adding it to the measured shelf space. By doing this, easy comparisons between stores were possible, but at the same time it could be a source for bias since the trend of how to display those beverages can vary between stores and also vary over time. A shelf meter from the refrigerator, store shelf, loading pallet or a crate does not correspond to the same volume of beverages and therefore not necessarily the same accessibility.

6.2.3 Socio-economic position of the schools

It was desirable to determine the socio-economic position of the schools individually. Sometimes there were several schools within the same municipal, thus not possible to use official data from the authorities which is only on municipality level. Self reported data on parent’s education level was another option, but was abandoned since this sample consisted of 73% of the enrolled 6th graders (mentioned earlier) and in addition the other grades were not included, hence the sample of these parents education level might not have been representative for the school. It was decided to use data from the principal questionnaire and the question on the amount of pupils coming from families with low income. The principal should be the most suited person in each school to give this kind of information. Although, it has to be taken into account that this is a subjective assessment and can only be treated as an indication of the real socio economic position. With this approach an assessment that tries to represent all the pupils in each school was obtained. The categorical variable on the amount of pupils coming from families with low income was recoded into a dichotomous variable as
described in method (higher/lower socio-economic position). A downside to this particular procedure however, was that the principal questionnaire was used twice in primary schools but only once in lower secondary schools (described in method). When the principal questionnaire was used twice in primary schools it was discovered that some principals did not give the same answer at those two occasions. If those two answers ended up in different categories after dichotomization, the school (n=5) was excluded due to difficulties in determining socio-economic position. The amount of pupils coming from families with low income could differ over time but it also demonstrates some of the uncertainty of this method. But on the contrary, the dichotomization of the data may have helped reducing the effect of this uncertainty since deviations were mostly to the neighboring category.

6.2.4 School mean frequency of the intake per week of selected food items

Only 25 of the 37 primary schools were used to investigate the association of the school mean frequency of the intake per week of seven selected food items and the food sales outlets, because some of these food items were targeted in the intervention and this could have introduced systematic biases in the data. Dietary data from lower secondary schools had been collected but were not yet available for analysis during this thesis. The schools mean frequency of the intake per week of selected food items in the 25 primary schools originated from a total of 945 pupils of which the data were aggregated up to school level to form a mean for each school. These 25 schools were the subjects when comparing the schools mean frequency of the intake per week of seven selected food items by three groups of schools (no food sales outlets, one food sales outlet and more than one food sales outlets). Due to the high level of data aggregation (mean of the pupils and then mean of schools in each of the three groups of number of stores) and the low number of subjects (n=25) in which the three groups were taken, only weak associations were expected. Moreover, the subsequent correlation analyses between the school mean frequency of the intake per week of selected food items and the accessibility of the schools, were only possible to do in the schools that had food sales outlets in the neighborhood (and therefore measurable accessibility). This reduced the sample even more to only 15 subjects (schools) with aggregated data from a total of 597 pupils to form mean variables for each school. Only week associations were also found here. Ideally, multilevel analysis should have been applied to investigate the pupils frequencies of intake and its potential associations and correlations, but such analyses were considered beyond the expected level of a master thesis. The high degree of data aggregation may have limited the possibilities of findings around the school mean frequency of the intake per week among the pupils, this is in the litterateur referred to as ecological fallacy [119] and should be avoided.
7 Conclusions and implications for future research

- Food sales outlets were present in approximately three quarters of the school neighborhoods but the number of food sales outlets in each school neighborhood varied and there were no clear difference between primary and lower secondary schools.
- Across all types of food sales outlets, the most available food items were those defined as unhealthy.
- The accessibility of soft drinks with sugar was significantly higher, and another nine food items of the 13 investigated was non-significantly higher, in the neighborhoods of lower secondary schools compared to primary schools.
- Both primary and lower secondary schools of lower socio-economic position, had non-significant:
  - higher number of food sales outlets in the neighborhood and higher accessibility of the majority of the investigated food items compared to schools of higher socio-economic position.
  - tendency of more kiosks and fewer supermarkets, compared to schools of higher socio-economic position.

The food environment and its food sales outlets in Norwegian school neighborhoods need to be further investigated as a potential environmental factor that may affect dietary behavior and body weight of adolescents. Data collected at the same time should be used when describing and comparing different neighborhoods in order to not jeopardize the quality of the result due to natural development and changes in the food sales outlets over time. Adjusting for store size and/or present the ratio between healthy/unhealthy foods in each food sales outlet should be considered in future studies. Moreover, taking into account which food sales outlets in school neighborhoods that are actually being used by adolescents would further enhance the likelihood of finding the associations if they are there. Knowledge about adolescents’ use of food sales outlets can lead to development of instruments that with greater probability are able to measure the true aspects of the adolescents’ food environment. The determination of the schools’ socio-economic position should be done, if possible, with an objective and valid method and not only by a subjective assessment from a key person in the schools. Any variation by socio-economic position is important to identify in order to inform effective policy actions or intervention strategies designed to promote more equitable access to healthy foods.
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Appendix 1

Appendix 1: The information letter that was handed out to the general manager when visiting the food sales outlet.
Til den det måtte angå

September 2011

Til informasjon

"HEIA – mat og aktivitet for god helse" er et forskningsprosjekt ved Avdeling for ernæringsvitenskap, Universitetet i Oslo og Norges idrettshøgskole. Prosjektet har som hovedmål å se på kosthold og fysisk aktivitet hos barn og unge. Vår medarbeider ønsker å gjennomføre en kartlegging av tilbud av mat og drikke hos ulike utsalgssteder rundt ungdomsskolene som deltar i prosjektet.

Dette innebærer i praksis at vi besøker deres butikk/kiosk/spisested for å observere tilstedeværelse av noen matvaregrupper, samt måle hyllemeter av noen matvarer.

All informasjon som samles inn vil bli behandlet konfidensielt, og informasjonen vil bli rapportert og offentliggjort på en slik måte at ingen individuelle utsalgssteder ved skolen kan gjenkjennes.

Besøket vi avlegger i deres butikk/kiosk/spisested vil ikke kreve noe av dere, og vi vil gjøre alt vi kan for å ikke forhindre vanlige kunder sine innkjøp.

Dersom dere har kommentarer eller spørsmål til undersøkelsen, må dere gjerne ta kontakt med Nanna Lien på telefon: 97 59 38 16.

Med hilsen

Forsker Nanna Lien, Dr. Philos
Appendix 2

The instrument for investigating food sales outlets.
HEIA II-høst 2011:

Observasjonsskjema for å måle tilgjengelighet av mat i ungdomsskoler sitt nærmiljø

Før du begynner å observere:


Observatørens navn: ________________________________________________________________

Dato: _____.____._______ (dato dd – måned mm – år åå)

Tid ved start av observasjon: ______._____ (time tt – minutt mm)

Informasjon om utsalgsstedet for mat:

1. Navn: ________________________________________________________________

2. Kjede (hvis aktuelt): ________________________________________________

3. Type utsalgssted for mat:
   □ Kiosk
   □ Bensinstasjon
   □ Restaurant/café
   □ Matbutikk
   □ Spesialbutikk (som for eksempel bakeri eller utsalgssted for frukt og grønnsaker)
   □ Annen type utsalgssted: ________________________________________________

4. Størrelse på utsalgsstedet:
   Tell antall kassaapparater: __________

5. Eventuelle kommentarer:
Sjekkliste for matvarer:

1. **Søte og salte kjeks:**
   Som for eksempel: Ritz, Kaptein, Maryland Cookies, Bixit, First Price sjokolade/vanilje

   Tilgjengelig (kryss av): □ Ja □ Nei

   Antall hylle meter med kjeks – mål og noter:

   Plass til notater:

   Totalt: __________________________________________________________ meter

2. **Sjokolade og søtsaker (ikke sukkerfri produkter)**
   Som for eksempel smågodt i løsvekt, poser med sjokolade/vingummi, sjokoladebarer

   Tilgjengelig (kryss av): □ Ja □ Nei

   Antall hylle meter med sjokolade og søtsaker – mål og noter:

   Plass til notater:

   Totalt: __________________________________________________________ meter

   **NB! Husk å måle – dette står ofte spredt rundt i butikken.**

3. **Søte bakverk (ikke kaker eller frosne produkter):**
   Som for eksempel boller, skolebrød, wienerbrød, donuts, berlinerboller, påsmurte lefser i porsjonspakker og pakker med flere lefser, kanelsnurrer, muffins i porsjonspakning, myke vafler i porsjonspakninger, croissanter

   Tilgjengelig (kryss av): □ Ja □ Nei

   Antall ulike typer av søte bakverk som er tilgjengelig (tell og noter antall):

   ________________________________________________________________

   Fant du produkter i kategorien som ikke er nevnt ovenfor, vennligst noter hvilke:
4. **Usøtet bakverk (ikke frosne produkter eller brød):**
   Som for eksempel som rundstykker av ulike slag, baguetter, pizzaboller, ostebriks

   Tilgjengelig (kryss av): □ Ja □ Nei

   Antall typer av usøtet bakverk som er tilgjengelig: __________________________

   Antall typer grovt usøtet bakverk som er tilgjengelig: __________________________

5. **Frukt (frisk, ikke tørket eller hermetisk):**

   Tilgjengelig: (kryss av): □ Ja □ Nei

   Antall ulike typer av frukt som er tilgjengelig: __________________________

   Ser fruktutvalget innbydende ut for deg (kryss av): □ Ja □ Nei

6. **Grønnsaker (friske, ikke poteter og krydderurter):**

   Tilgjengelig: (kryss av): □ Ja □ Nei

   Antall ulike typer grønnsaker som er tilgjengelig: __________________________

   Er Knaskerøtter, Snacksgulrot eller liknende gulrotprodukt tilgjengelig (kryss av):
   □ Ja □ Nei

   Er cherrytomater tilgjengelig (kryss av): □ Ja □ Nei

   Er sukkererter tilgjengelig (kryss av): □ Ja □ Nei

   Ser grønnsaksutvalget innbydende ut for deg (kryss av): □ Ja □ Nei

7. **Salt snacks (ikke nøtter beregnet til for eksempel baking, som usalzte hasselnøtter, mandler, valnøtter)**
   Som for eksempel nøtter og potetchips

   Tilgjengelig (kryss av): □ Ja □ Nei

   Antall hylle meter med salt snacks – mål og noter:

   Plass til notater:

   Totalt: _________________________________ meter

   **NB! Husk nøtteblanding som for eksempel ”Polly småsulten – nøtter og frukt”**
8. **Brus med sukker**
Sukkerholdige produkter med kullsyre

Tilgjengelig (kryss av): □ Ja □ Nei

Antall hyllemeter med brus med sukker – mål og noter. Fyll inn antall pallebrett, kasser og hyllemeter.

Antall **pallebrett** (ofte røde eller i papp):

Antall **kasser** (oftest gule):

**Mål hyller** (husk hyller i evt. kjøleskap):

Totalt brus med sukker: ______________________________________________ meter

9. **Brus uten sukker (ikke Farris eller Farris – liknende produkter):**
Produkter med kullsyre

Tilgjengelig (kryss av): □ Ja □ Nei

Antall hyllemeter med brus uten sukker – mål og noter. Fyll inn antall pallebrett, kasser og hyllemeter.

Antall **pallebrett** (ofte røde eller i papp):

Antall **kasser** (oftest gule):

**Mål hyller** (husk hyller i evt. kjøleskap):

Totalt brus uten sukker: ______________________________________________ meter
10. Vann med og uten smak
Inkludert Farris og Farris – liknende produkter (Bris, Bonaqua, Taffelvann…)

Tilgjengelig (kryss av): □ Ja  □ Nei


Antall pallebrett (ofte røde eller i papp):

Antall kasser (oftest gule):

Mål hyller (husk hyller i evt. kjøleskap):

Totalt vann og Farris – liknende produkter: _____________________________ meter

11. Juice og saft – liknende drikker i porsjonskartonger (½ liter eller mindre)
Som for eksempel juice, Kuli, Friskus, TINE 40/60, Mana, iste (Lipton, Tine, Nestea), Mer,  
Fruktvann, Solrik, smoothie i ulike varianter

Tilgjengelig: (kryss av): □ Ja  □ Nei

Antall ulike typer av juice og saft – liknende drikker som er tilgjengelig: ____________

NB! Husk at juice og saftliknende drikker kan stå plassert flere ulike steder.

Er lett iste tilgjengelig?  □ Ja  □ Nei

12. Smakssatt melk i porsjonskartonger (½ liter eller mindre):
Som for eksempel 24, milkshake, Litago jordbær/sjokolade, lett sjokolademelk, Q  
sjokolademelk, Coco (glassflaske)

Tilgjengelig: (kryss av): □ Ja  □ Nei

Antall ulike typer av smakssatt melk som er tilgjengelig: __________________________

NB! Husk at smakssatt melk kan stå plassert flere ulike steder.

Er varianter med mindre sukker og/eller fett tilgjengelig (som 24, Q sjokolademelk 0 %, Litago lett  
sjokolademelk): □ Ja  □ Nei
13. Matvarer rundt kassene:

Finnes følgende matvarer rundt en eller flere av kassene?

☐ Sukkerfri tyggegummi  ☐ Sukkerfri pastiller

☐ Sjokolade  ☐ Andre søtsaker

☐ Grønnsaker  ☐ Frukt

☐ Nøtter (Trigger, Småsulten el.)  ☐ Vann/ Farris – liknende produkter

☐ Brus med sukker  ☐ Brus uten sukker

☐ Eventuelt andre matvarer ved kassene, vennligst noter:

Tid når observasjonen er ferdig: _____._____ (time tt – minutt mm)

14. Eventuelle kommentarer:

Nevn evt. problemer som dukket opp under observasjonen eller andre kommentarer du måtte ha i forhold til utsalgsstedet du nå har observert eller selve observasjonsprosessen.
Appendix 3

Flow diagram for the procedure determining socio-economic position in the primary schools.
HEIA
Primary schools (n=37)

Baseline (2007)

Received 35 Principal questionnaires

30 Ok

5 missing data

One school had missing on both BL and FU2

Follow-up 2 (2009)

Received 37 Principal questionnaires

35 Ok

2 missing data

16 schools answered in different categories

13 schools answered the same category at both Baseline and Follow-up 2

7 schools answered only in one of these two occasions and had missing data in the other

Dichotomize into answering <10% or >10%

Dichotomize into answering <10% or >10%

Dichotomize into answering <10% or >10%

11 answered categories which both led to the same category after dichotomization

5 schools were excluded due to giving answers resulting in different categories after dichotomy

24 primary schools of higher socio-economic position
(of which eight did not have food sales outlets in the neighborhood)
(Higher socio-economic position – schools with <10% of students from families with low income)

7 primary schools of lower socio-economic position
(of which two did not have food sales outlets in the neighborhood)
(Lower socio-economic position – schools with >10% of students from families with low income)
Appendix 4

Flow diagram for the procedure determining socio-economic position in the lower secondary schools
HEIA II
Lower secondary schools (n=36)

Received 32 Principal questionnaires

28 Ok 4 missing data

6 schools <5% of students from low income families
9 schools 5-9% of students from low income families
6 schools 10-19% of students from low income families
5 school 20-29% of students from low income families
2 school 30-39% of students from low income families
0 school 40% or more students from low income families
(28 in total)

Dichotomize into answering <10% or >10%

15 lower secondary schools of higher socio-economic position
(of which five did not have food sales outlets in the neighborhood)
(Higher socio-economic position – schools with <10% of students from families with low income)

13 lower secondary schools of lower socio-economic position
(of which two did not have food sales outlets in the neighborhood)
(Lower socio-economic position – schools with >10% of students from families with low income)