The Association Between School Meal Offers and Well-being, Learning Culture, Motivation, and School Performance among Norwegian Secondary School Pupils

EMIL SKARPEID BORØ

SUPERVISOR
Elling Bere

University of Agder, 2021
Faculty of Health and Sport Science
Department of Public Health, Sport and Nutrition

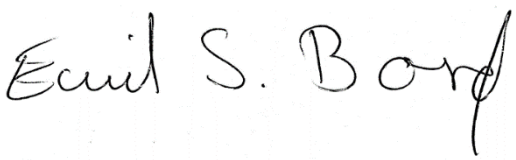
ACKNOWLEDGMENTS

This master's thesis represents the conclusion of my two years studying public health at University of Agder. The past year has been a valuable learning process, with both frustration and excitement.

I would like to thank my supervisor, Elling Bere, for all your guidance and feedback throughout the process.

Finally, I would like thank family, friends, and fellow students for all your moral support.

Kristiansand
2021



Emil Skarpeid Borø

ABSTRACT

Background

While the relationship between diet and nutrition, and school performance has been explored in several studies, there is a lacking number of studies addressing the effect of organized school meals on pupils' school performance and social health factors. Thus, the aim of this study is to examine the association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils.

Methods

The cross-sectional analyses of the present study are founded on data from a larger survey conducted by the Norwegian Institute of Public Health, and data from the survey *Elevundersøkelsen* carried out by the Norwegian Directorate of Education. Data from a total of 817 Norwegian secondary schools were included. Analysis of variance test was used to examine the association between the serving of school meals and pupils' well-being, learning culture, motivation, and school performance.

Results

Results showed no association between the availability of school meals and higher scores of either well-being, learning culture, motivation, or school performance.

Conclusion

The present study found no association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils. Further studies are needed to confirm the possible association.

Keywords:

School meals, well-being, learning culture, motivation, school performance.

SAMMENDRAG

Bakgrunn

Mens sammenhengen mellom kosthold og ernæring, og skoleprestasjon har blitt forsket på i flere studier, mangler det studier som tar for seg effekten av organiserte skolemåltider på elevers skoleprestasjoner og sosiale helsefaktorer. Målet med denne studien er derfor å undersøke sammenhengen mellom servering av skolemat og trivsel, læringskultur, motivasjon og skoleprestasjoner blant elever i norsk ungdomsskole.

Metode

Tverrsnittanalysene i denne studien er basert på data fra en større undersøkelse utført av Folkehelseinstituttet, og data fra *Elevundersøkelsen*, utført av Utdanningsdirektoratet. Data fra totalt 817 norske ungdomsskoler ble inkludert. Variansanalyser ble brukt for å undersøke sammenhengen mellom servering av skolemåltider og elevenes trivsel, læringskultur, motivasjon og skoleprestasjoner.

Resultater

Resultatene viste ingen sammenheng mellom tilgjengeligheten av skolemåltider og høyere nivåer av trivsel, læringskultur, motivasjon eller skoleprestasjoner.

Konklusjon

Denne studien fant ingen sammenheng mellom serving av skolemat i norsk ungdomsskole og trivsel, læringskultur, motivasjon og skoleprestasjoner blant elevene. Det behøves ytterligere studier for å kunne bekrefte den mulige sammenhengen.

Nøkkelord:

Skolemat, trivsel, læringskultur, motivasjon, skoleprestasjon.

TABLE OF CONTENT

1 INTRODUCTION

The implementation of school meal servings in Norwegian public schools is heavily debated by politicians and policy makers. The reason is an apparent agreement across political parties that a nutritious meal, served at school, can promote better health, well-being and learning outcomes among pupils. Despite the fact that most school children bring a packed lunch from home, national mappings and -surveys show that some children attend school without having eaten breakfast and without a brought packed lunch (Forskningsrådet, 2018). This trend increases with age and is particularly visible amid secondary school pupils. Additionally, survey results show that children and adolescent do not meet national dietary recommendations for fruit and vegetable intake (Hansen, Myhre, Johansen, Paulsen, & Andersen, 2016; Haug et al., 2020). A healthy diet is crucial to health, and healthy dietary habits among children and adolescents can prevent the development of non-communicable diseases (NCDs) later in life (Development-Initiatives, 2018). Furthermore, research indicates that there is association between diet and children and adolescents' learning outcomes and school performance (Florence, Asbridge, & Veugelers, 2008; Kunnskapsdepartementet, 2006).

The Public Health Act (Folkehelseloven, 2012) highlights schools as an important arena for health promoting measures, as school is a location where children and adolescent spend most of their time in everyday life. In addition, the most recent Public Health Report (2019) points to schools as promising arenas for promoting healthy dietary habits among pupils, and emphasizes that importance of healthy eating and regular meals to attain good health, learning, and satisfactory learning environments (Helse- og omsorgsdepartmenentet, 2019). The Public health report further highlights the importance of early interventions towards children and adolescents to promote good public health (Helse- og omsorgsdepartmenentet, 2019). Moreover, the Norwegian Directorate of Health (NDH) suggests that free daily school meals provided to all pupils may be one of the most important and efficient public health measures (Helsedirektoratet, 2018).

1.1 OBJECTIVES

The objectives of the present study were to analyze the association between the serving of school meals in Norwegian middle schools and well-being, learning culture, motivation, and academic achievement among its pupils.

The master's thesis is structured as follows: a widened theoretical background of the study is presented in chapter two. Chapter three contains the research paper, including the background of the study, methods, results, and a discussion of the findings. In chapter four further elaborations of the research paper with methodical considerations and further discussions of school meals are presented. References are provided in chapter six, at the end of the master's thesis. Research clearance and the article manuscript are attached as additional files.

2 SCHOOL MEAL

This chapter will present the theoretical background for the studies objective and form the basis for the research paper.

2.1 SCHOOL MEAL PROVIDINGS GLOBALLY

Worldwide, approximately one third of all pupils in elementary and secondary school are provided with school lunches (United Nations Standing Committee on Nutrition, 2017). School food programs has been implemented in developing countries as a longstanding contribution to reduce poverty and increase food security, with a goal to limit undernutrition among pupils (Morgan & Sonnino, 2008; Oostindjer et al., 2017). The World Food Programme is the largest school food program on a global scale, where pupils are offered meals both at school and as take-home rations. School food programs are implemented in great variety across the world, with some being exceedingly commercialized and others all-out state funded (Morgan & Sonnino, 2008).

School food programs differ in design and structure in European countries. In countries like France and Italy school food programs are based on fresh local food, and with low-income families being subsidized to have the ability to participate in the programs (Moffat & Gendron, 2019). The school food programs in the United Kingdom (UK) and United States (US) has seen great commercialization and has received much criticism for its alleged lack of nutritional quality and fast-food direction (Morgan & Sonnino, 2008; Waling et al., 2016). Whereas school food programs in the UK and the US are being run more as privatized businesses, the provisioning of school meals in the Nordic countries are a larger responsibility of the public sector. Sweden and Finland are providers of free school meals for all pupils. In Sweden, pupils started to receive a free school meal in the 1970s, and school children of Finland has been served a hot meal since 1948. School meal provisioning is government funded and managed at a municipal level in both countries (Waling et al., 2016). All Icelandic pupils are entitled to a meal at school, but they may also bring a bring a packed lunch (Juniusdottir et al., 2018). In Denmark there is no national school meal program, and most Danish children bring packed lunch to school (Hoppe, Biltoft-Jensen, Trolle, & Tetens, 2009).

2.2 SCHOOL MEAL PROVIDINGS NATIONALLY

Public serving of school meals in Norway has a longstanding tradition. Arrangements arouse alongside the emergence of public schools and mandatory schooling. At the end of the 19th century, warm school meals was offered to disadvantaged children at schools in the largest cities of Norway (Kunnskapsdepartementet, 2006). Through the years school meals became a universal measure, and warm meals were replaced by more basic meals of bread and milk. Around the 1950s around half of all Norwegian pupils was served breakfast at school. The public arrangement was gradually reduced and by the early 1960s it expired completely. School meals had become a matter of the private household and the packed lunch was introduced (Andresen & Elvbakken, 2007).

The Norwegian Nation Council of Nutrition (NCN) has committed to promoting a healthy school meal since the 1950s. When public school meal servings ended, the NCN shifted towards conveying information towards a healthy packed lunch. School meals became a part of the public agenda when the debate around class environment, and the lack of concentration among pupils were introduced to the school debate in the 1980s. A parent-paid school milk arrangement was introduced in Norwegian schools in the 1970s, and an equal fruit- and vegetable scheme started halfway through the 1990s (Kunnskapsdepartementet, 2006) A free fruit and vegetable scheme for secondary schools was introduced in 2007 but ended in the school year of 2013/2014, as a consequence of a change of government in 2013. With the conclusion of the national free fruit program, it became the municipalities' and the schools' own decision to maintain the program. With the introduction of *Kunnskapsløftet* in 2006 a greater freedom of school planning was given to the individual school owners. Schools were therefore given greater opportunities to implement school meals in a possible new organization of the school day. However, there is no law requirement to offer school meals in Norwegian public schools today (Kunnskapsdepartementet, 2006).

2.3 POLITICAL AGENDA

Renewed national guidelines for food and school meals were published by the Norwegian Directorate of Health (NDH) in 2015. The guidelines present recommendations regarding implementations of school meals, nutritional quality, food security and hygiene (Helsedirektoratet, 2015a). The guidelines' objective is to ensure a solid environment for pupils' meals, and that offered food and drinks are of high nutritional value. The guidelines are divided into three sections, concerning food and meals in primary school, secondary school, and high school, respectively. A total of sixteen recommendations for meals in secondary school is presented, with the first recommendation being: "It should be facilitated for regular meals which promotes food enjoyment, socializing, well-being and health". Further recommendations emphasize the importance of arrangements which ensures the availability of milk, fruits, and vegetables (Helsedirektoratet, 2015a). The recommendations also assert the importance of the nutritional quality of served food and meals (Helsedirektoratet, 2015a), which should be in line with the Norwegian Directorate of Health's dietary advice (Helsedirektoratet, 2011).

The most recent public health whitepaper *A good life in a safe society (2019),* published by the Ministry of Health and Care Services, emphasizes the importance of early intervention towards children and adolescent to promote good public health, and how good quality schools are essential for children and adolescents' development of learning, well-being and health. Further, it addresses how early intervention is vital to prevent the need for more invasive measures later in life (Helse- og omsorgsdepartmenentet, 2019).

The Norwegian Directorate of Health published in 2015 the report, *Well-being in school* (2015b), to impart knowledge of factors which promote the well-being of children and youths' in school. The report highlights how children and adolescents' mental health affects the opportunity of learning, and how learning climate is of importance for their mental health. Further, the report addresses how school meals can promote pupils' health, well-being, and learning. The authors accentuate an association between a healthy diet and school achievement, concentration, and improved mental health. Moreover, the report expresses the importance of school meals on pupils ability to maintain concentration, willingness to learn, and state of mind (Helsedirektoratet, 2015b).

The Norwegian public health act (2012) determines that public health is a responsibility in all public sectors, and at every level of government, i.e., municipalities, counties, and state authorities. The act provides authority stipulate requirements for enterprises regarding matter of importance to the population's health (Folkehelseloven, 2012). The public health act is based upon five principals of public health work: "Health in all policies", social cohesion in health, sustainable development, participation, and precaution. The law sets requirements for political efforts in public health work and for a long-term, systematic effort. Counties and municipalities are required to promote health within the tasks they are assigned to (Folkehelseloven, 2012).

Oslo Metropolitan University published in the autumn of 2020 the report "Healthier food environments in Norway" (Torheim et al., 2020). The aim of the report is to increase government actions to promote healthier food environments and prevent obesity and dietary noncommunicable diseases (NCDs). Food choices and diet are greatly influenced by food availability and the food our environment encourages us to buy. These factors are referred to as food environment, defined as "the collective physical, economic, political and sociocultural environment, opportunities and conditions which affect the population's food and drink choices and thereby its nutritional status" (Swinburn et al., 2013). Prioritized recommendations on how to improve food environments in Norway is suggested in the report. One of the top recommended actions is to increase public efforts to create a healthy food environment and make healthy dietary choices in a public context. Food offers in the public sector should be in line with official dietary advice (Torheim et al., 2020). There is a large number of public nutritional guidelines and recommendations, still, the authors highlights the lacking demand of implementation and compliance in schools, and call for greater effort by local- and state institutions (Torheim et al., 2020). Further, Torheim et al (2020) emphasizes the need to strengthen public nutritional work by: "Make all counties offer one daily school meal". The school meal is recommended to consist of free fruit as a minimum, with the possibility of local adaptions and government co-founding (Torheim et al., 2020).

2.4 SCHOOL MEALS TODAY

Surveys of food and school meal arrangements has been conducted in Norway since the early 1990s. The Norwegian Directory of Health (NDH) published a report in 2013 where the offer and implementation of food and meals in elementary-, secondary- and, high school was assessed (Staib, Bjelland, & Lien, 2013). Results from the report showed that most schools comply to the NDH's recommendations regarding food and meal offers in school. Several of the responding schools had a school milk offer, and nearly all secondary schools and combined elementary and secondary schools offered fruit for free. Over half the elementary schools offered fruit through a school fruit subscription scheme. Approximately four out of five secondary schools had a lunch cafeteria, whereas one fourth of these had a daily offer of sugary soda and snacks (Staib et al., 2013). The report highlights the importance of continuous work to ensure all pupils receive a twenty-minute lunch break, especially at secondary school. The importance of access to proper drinking water is also underlined, as this could help reduce intake of unhealthy drinks. The authors suggests that schools should limit pupils admittance to leave school property during the school day, as many pupils buy unhealthy foods from local shops (Staib et al., 2013).

A Norwegian case study was conducted in 2011 by Holte, Larsen and Samdal (2011). The researchers investigated the barriers of implementing national guidelines for healthy school meals at three Norwegian secondary schools. Lack of adaption to the target group, lack of resources and funding, conflicting values and goals, and access to unhealthy food outside school were highlighted as the four main barriers of implementation (Holthe et al., 2011).

Vik, Lippevelde and Øverby (2019) carried out a non-randomized study on the effect of serving a free, healthy school meal to Norwegian 10-12 year-olds. Children in the intervention group was served a meal at school every day for one school year, whereas the control group did not receive any meal from school. The intervention led to an increased intake of healthy foods among pupils of lower socio-economic status. The researchers therefore concluded that the serving of a free school meal for one year could help reduce health inequities between school aged children (Vik et al., 2019).

A Norwegian controlled intervention study investigated the impact of a free school lunch on pupils weight development and food intake, in addition to the association between pupils' food intake and their self-perceived school behavior (Ask et al., 2010). Nineth grade pupils at three different secondary schools participated in the study, where one of the schools functioned as the intervention school. Pupils in the intervention school were served a free meal for 4 months. The results showed no increase in BMI for girls but a significantly increase among boys at both intervention and control schools were found. The serving of a free school meal did not improve the intake of healthy foods, nor reduce intake of sugary soda, snacks, and candies (Ask et al., 2010).

2.4.1 DIETARY BEHAVIORS

The Norwegian National Council of Nutrition presented the National dietary guideline to promote public health and prevent chronic diseases in 2011 (Helsedirektoratet, 2011). The report displays twelve official dietary advice which applies to the general public, including children and adolescents. The first dietary advice summarizes the following eleven advices, and states that the inhabitants should have a varied diet with plenty of vegetables, fruits, berries, whole grains and fish, and limited amounts of processed meats, red meats, salt and sugar (Helsedirektoratet, 2011).

The Research Council of Norway (RCN) conducted in 2018 the research campaign *Sjekk skolematen* (Check the school meals) which included over 10 000 participant pupils from primary school, secondary school, and high school (Forskningsrådet, 2018). The participants registered their own school meals in a web form. The results show that 85 % of the pupils bring a packed lunch from home, and 77 % eats bread for lunch. The packed lunch generally consists of two to three slices of bread with spreading of cheese or meat. 31 % reported eating one or more fruits at school and 12 % reported eating vegetables. Around one third of the pupils drank milk at school. Results show that 94 % of primary school pupils bring lunch from home, while only 75 % of pupils in secondary school do the same. The pupils who did not bring a packed lunch reported to buy food in the school cafeteria, at the grocery store, or at nearby kiosks. Overall findings from the research campaign shows that the packed lunch is the most common among Norwegian pupils, but the share of pupils who bring a packed lunch to school decreases with age (Forskningsrådet, 2018).

The nationwide dietary survey *Ungkost 3* was carried out in 2015 among Norwegian 4th and 8th grade pupils (Hansen et al., 2016). Results from the report showed that the participants' diet to a large extend was in line with health authorities' recommendations regarding nutrient consumption. However, the diet contained to much saturated fat and added sugars, and insufficient amounts of fruit, vegetables, and fish. The results show that 92 % of 4th grade pupils reported to eat breakfast every day, while only 81 % of 8th graders consume breakfast. Further, 74 % of the 4th grade pupils ate lunch every day, and 97 % brought a packed lunch to school five days a week. The numbers were lower for 8th grade pupils, where 59 % ate lunch every day, and 70 % brought a packed lunch to school (Hansen et al., 2016).

Results from the 2010 nation representative survey HEVAS showed that older pupils eat both breakfast and lunch less often than younger pupils (Samdal et al., 2012). In addition, older pupils reported higher consumption of unhealthy snacks and soda, and lower intake of fruits than their younger fellow pupils. Samdal et al. (2012) concluded that the participants had insufficient intake of fruit and vegetables, and with consumptions of unhealthy snacks and soda being too high according to national dietary guidelines (Helsedirektoratet, 2011). There is seemingly no improvement in these aspects of children's dietary habits, as the most recent HEVAS report (2020) shows that over half of children aged 11, 13 and 15 do not fulfil national dietary guidelines of fruit and vegetable consumption. Approximately 40 % of 11-year-old children consumed fruits and vegetables every day, whereas only 25 % of 13- and 15-year-old boys reported a daily intake of fruits and vegetables. The authors of the report argues that there is a need for actions to increase the share of children and adolescents who follow national dietary guidelines. Further, as the beginning of adolescence seems to be particularly important in relation to eating habits, they suggests that measures towards this age group should be given increased attention (Haug et al., 2020).

2.5 SCHOOL AS A HEALTH PROMOTING ARENA

The United Nations Standing Committee on Nutrition (2017) suggests that health promoting efforts targeting children and youth may increase by three times in extent in the future. Individuals targeted by health promoting efforts may see a gain in health in both present day and in the future, as healthy habits set in childhood and adolescence tend to transfer into adulthood (Norwegian Ministry of Health and Care Services, 2013). Measures towards better health in adolescents may benefit the economic and development of future societies (United Nations Standing Committee on Nutrition, 2017), as the general health, weight, and diet of adolescent girls and young women are related to the health and development of their potential future children (De-Regil, Harding, & Roche, 2016). Considering that 91 % off all Norwegian children attend public school the institutions makes an ideal arena for health promotive measures (Helland, Øverby, & Vik, 2019). Environmental factors such as parents, teachers and peers are contributors the adolescents nutritional-related health behaviors (Helse- og omsorgsdepartmenentet, 2017).

The Norwegian Ministry of Health and Care Services presented in 2017 the Norwegian Action Plan for a Healthier Diet (2017). The action plan targets a set of goals to be achieved for 15-year-olds by the year of 2021 originally, but now extended to 2023. The goals include an increase in consumption of fruit, vegetables and fish, reduced intake of sugary snacks and candy, zero increase in overweight, and to increase the share of 15-year-olds that eat breakfast everyday (Helse- og omsorgsdepartmenentet, 2017).

The Norwegian governments action plan “#adolescencehealth” (2016) acknowledges adolescence as an important period in life and presents several goals for adolescents to have the best conditions for living good lives and experience everyday coping. The specific goals of diet and nutrition are to increase the share of youth with food and meal habits that complies to national guidelines, facilitate obtaining of healthy food habits, and strengthen youths nutritional and physical activity knowledge (Helse- og omsorgsdepartmenentet, 2016).

2.6 POSSIBLE ADDITIONAL EFFECTS OF SCHOOL MEALS

School meals might affect more than children and adolescents' diet and nutrition. This chapter will present theory on possible additional factors influenced by the serving of school meals.

2.6.1 WELL-BEING

International literature contains a series of understandings of the concept of well-being. A subjective perspective assumes that well-being exists of people's own experiences or attitudes, while an objective perspective focuses on how well people function in their everyday life (Helsedirektoratet, 2015c). Moreover, well-being can be considered as an ongoing process where it is characterized by interactions between people and surroundings in a broad sense, including the biology of the body, everyday arenas such as family and school and institutional and cultural conditions (Helsedirektoratet, 2015c). Schools in Norway are required by law to promote a healthy psychosocial environment where pupils can experience social affiliation and security (Opplæringsloven, 1998).

Well-being is the overall assessment across the arenas of life which children and youth are part of, including school. Well-being in school reflects whether the pupils feel included in the psychosocial environment at school, degree of adaption in the school environment, and the student's enjoyment and assessment of their own experiences at school (Huebner & Gilman, 2006). School is considered to be one of the most important arenas in life for children and adolescent, therefore school well-being are experienced as a key factor of the total well-being in pupil's life (Huebner & Gilman, 2006). Pupils' perceived competence has been shown to be associated with well-being (Danielsen, Samdal, Hetland, & Wold, 2009), thus learning and well-being can be assumed to be mutually reinforcing for pupils' self-regulated initiative and involvement in learning processes (Danielsen, 2012).

Results from 2010 shows that a total of 47 % of 6th grade pupils reported to thrive a lot at school, while only 30 % of 10th grade pupils did the same. Further, 9 % of the 6th graders reported to not thrive very well at school, whereas for 10th graders, 14 % did not thrive very well (Samdal et al., 2012). The same age decrease in school well-being can be seen in the

2020 HEVAS report (2020), where 46 % of 11-year-old children report to thrive well at school, but only 27 % of the 15-years-old report the same.

School meal offers may potentially strengthen the school environment by creating an including social platform where pupils share breakfast or lunch meals. Thus, the serving of school meals is hypothesized to be associated with pupils' well-being at school.

2.6.2 LEARNING CULTURE

Misbehaving and disrupting school children are of major concern to educators, and challenging classroom behavior is thought to be one of the greatest hurdles in public school today (Westling, 2010). Misbehaving pupils and students are assumed to have reduced learning outcomes, as disruptive classroom behavior obstruct learning and the time spent redirecting pupils back to task reduces costly instruction time, which in turn affects their academic performance (Musti-Rao & Haydon, 2011). Furthermore, behavior problems in school may lead to a disruption in academic engagement resulting in pupils who fail to master skills because of lack of academic engagement (Martella & Marchand-Martella, 2015), as academic and behavior problems in school are shown to be reciprocal (Payne, Marks, & Bogan, 2007). On the opposite, a classroom filled with pupils with high levels of academic achievement is a classroom with low levels of disrupting behaviors (Martella & Marchand-Martella, 2015). Misbehaving pupils will interfere with the learning of their fellow pupils and consume valuable teaching time, disrupting both classroom and school (McKinney, Campbell-Whately, & Kea, 2005). Undesirable pupil behavior in the classroom is in addition associated with teacher burnout, dissatisfaction, and stress, and a high contributor to teachers leaving their job (Crothers & Kolbert, 2008; McKinney et al., 2005). Although teacher prevention to undesired classroom behavior is of great importance, teachers report to feel inadequately prepared to manage pupils' problem behavior (Siebert, 2005). Even though pupils spend time in school, they may not pay attention to given learning tasks if they are hungry. Concentrating on school tasks is argued to be one of the most critical components of learning. Therefore, relief of hunger may lead to increased concentration which in time could facilitate learning (Grantham-McGregor, 2005).

Previous results from *Elevundersøkelsen* suggest that the learning culture at Norwegian schools have improved in recent years, as the level of classroom order has increased. These results are supported by international surveys carried out after the implementation of *Kunnskapsløftet (Kunnskapsdepartementet, 2017).* Results from the most recent PISA-survey, carried out in 2018, show that Norwegian pupils report higher levels of classroom order compared to results from 2000 and 2009. The same positive development can be seen in the score for the mean of the OECD countries, but with a smaller increase then for Norwegian pupils. Although results indicate generally high levels of classroom order, 18 % report that pupils is not working on-task for most, or all, of the school hours (Jensen et al., 2019). The introduction of a served school meal has been suggested to the Norwegian Government as a measure towards reducing misbehaving and disrupting behavior in Norwegian schools (Anundsen, Gåsvatn, & Schmidt, 2007).

2.6.3 MOTIVATION

Motivation is a key component for all human behavior, and describes why an individual chooses to participate in an activity (Wigfield & Wentzel, 2010). Pupils who are motivated are stimulated and develop in a positive manner, which can positively influence their self-esteem, life satisfaction and achievements (Ryan & Deci, 2000). It is important to work towards higher levels of motivation among pupils as many report a downward or low motivation towards school (Larson, 2000).

If pupils are to reach their full potential for learning in school it is important that they are willing and able to make an effort, and to make use of the resources made available to them. Therefore, pupils' motivation for learning is crucial for their learning outcomes. Motivation for learning can be defined as the propulsive effort which facilities learning (Skaalvik & Skaalvik, 2005). Analyses from the 2010 survey *Elevundersøkelsen* shows that secondary school pupils' motivation is strongly associated with school effort, which again is associated with academic achievement (Topland & Skaalvik, 2010).

Motivation has previously been considered as a somewhat stable personality trait, and something an individual possess in a small or large degree. In more recent year's motivation thought of as situational condition which is influenced by values, experiences, self-esteem,

and expectations. Learning environment and learning situation is therefore of great importance for pupils motivation (Skaalvik & Skaalvik, 2005).

Results from recent *Elevundersøkelsen* surveys shows that most pupils report to be highly motivated for schoolwork and learning, even though levels are lower for secondary school then elementary school (Kunnskapsdepartementet, 2017). Further, the results show an decrease in motivation towards school from 5th grade to 10th grade (Topland & Skaalvik, 2010).

There are several different factors in and surrounding school children and their learning situation which combined determines their motivation for learning. Examples of this are external conditions such as various forms of reward, or inner conditions like interest in a school topic. There is usually more than one factor which influences pupils' motivation in a given situation, and pupils may be motivated by various factors in different situations (Kunnskapsdepartementet, 2011).

A served meal at school may be more appetizing and attractive than a packed lunch brought from home. Thus, the serving of school meals may potentially be associated with pupils' motivation towards school.

2.6.4 SCHOOL PERFORMANCE

Academic achievement generally refers to mathematical, science, thinking and communicative skills and competence which enables pupils and students to succeed in school and society. Assessing these forms of achievement are often difficult, and researcher tend to turn to a narrower definition that is limited to outcomes on standardized achievement tests, or more general measures of school attainment, such as drop-out rates and grade point averages (Lindholm-Leary & Borsato, 2006). Several factors influence the academic achievement of schoolchildren, including gender, ethnicity, child health, socioeconomic factors, and quality of school (Considine & Zappala, 2002).

A literature review on key factors relating to adolescent's subjective wellbeing and educational outcomes was carried out in 2017, and the researcher found evidence for

parenting support, school contexts and school connectedness to be among the most significant predictors for adolescent's academic achievement (Cunsolo, 2017). Results from a systematic review (2014) show that pupils' personality places itself as a highly relevant predictor of the same magnitude as cognitive abilities. Agreeableness, openness, and conscientiousness were shown to be strong predictors of pupils' grade point averages. Therefore, the author argues that abilities are important, but more so is what we actually do with our abilities (Vedel, 2014). Singh et al. (2019) carried out a systematic review on the effects of physical activity interventions on cognitive and academic performance in children and adolescents. Although there was strong evidence for beneficial effects of physical activity on math performance, the researchers found inconclusive evidence for the beneficial effect of physical activity on cognitive and overall academic achievement in children and adolescent (Singh et al., 2019). Diet quality has been shown to be associated with adolescents' academic performance (Florence et al., 2008).

Learning outcomes are a complex concept which is influenced by a wide range of factors. Although there is a limited number of studies addressing the impact of a morning meal on learning outcomes, previous studies indicates that the introduction of a school meal makes school children more prepared and concentrated in the school lessons, which is believed to contribute to increased learning outcomes (Kunnskapsdepartementet, 2006).

Academic achievements made in school are dependent of several aspects. To ensure solid opportunities for learning, adequate nutrition is necessary. In Norway where the state of nutrition is generally good, the association between school meals and learning might be difficult to document. Nonetheless, a regular intake of food and nutrition is essential for pupil's ability to work, learn and perform. An orderly meal during the school day may help cover school children's need for energy and nourishment, which in line might lead to higher levels of order and concentration among those who previously ate unhealthy foods, or did not eat school meals (Kunnskapsdepartementet, 2006). Hungry students may be perceived as less concentrated, and researchers speculate that the serving of school meals will provide an increase in learning outcomes (Kunnskapsdepartementet, 2006). Further, they debate that academically and socially struggling pupils might have increased learning outcomes from a served meal at school, which could positively affect the learning outcomes of fellow pupils as well (Kunnskapsdepartementet, 2006).

Since the PISA survey from 2000, results from Norway have varied in both reading, math and science, and the changes from survey to survey has not pointed in any clear direction. However, the results are shown to be consistent over time in all subject areas (Jensen et al., 2019).

3 THE RESEARCH PAPER

3.1 INTRODUCTION

School meal policies is a trending subject of debate on the political agenda. There is a seemingly broad agreement among politicians that the serving of school meals can promote good health and learning, and some claim it can increase pupils' well-being and better the school environment. In Norway most children bring a packed lunch from home which generally consist of cold bread and occasionally greens and milk (Hansen et al., 2016). A parent-paid school fruit- and milk scheme are in place nationally and is offered to first to tenth grade children (Dahl & Jensberg, 2011). However, there are some local school meal arrangements in Norway, which is either subsidized by the municipalities and/or parent paid (Haugset & Nossum, 2012). The traditional packed lunch has led to concerns about children eating unhealthy packed lunch (Kainulainen, Benn, Fjellström, & Palojoki, 2012). Not all pupils consume the packed lunch but instead buy snacks or sweets from nearby stores. Therefore, serving of healthy school meals can potentially better pupils diet and the social environment at school (Lytle et al., 2006).

Childhood and adolescence are important periods of growth and development of social abilities, and a balanced diet is essential in this regard (Yujeong & Hyeja, 2011). Between one-third to one-half of adolescent's meals are consumed at school (Mozaffarian et al., 2012), therefore, school is regarded as a promising arena for promoting healthy eating strategies and dietary habits (Mikkelsen, 2014). The interest of school-based nutritional interventions is rapidly growing. A report from Oslo Metropolitan University emphasizes the importance of public policy making, and the offering of daily school meals is among the top recommended actions (Torheim et al., 2020).

As of today, the number of intervention studies addressing the effect of free school meals are limited (Bere & Stea, 2017). However, studies from Finland indicates an association between free school meals and healthier food habits at school and the remaining time of day (Raulio, Roos, & Prättälä, 2010; Tilles-Tirkkonen et al., 2011). A significant association between eating breakfast at school and increased academic achievement has been shown for American elementary school pupils (Frisvold, 2015). Results from a randomized intervention study

among American adolescents indicated that eating breakfast at school could positively effect students grade point averages (Hearst et al., 2019). Further, a randomized controlled trial among Danish children mapping the effects of serving healthy school meals on concentration and school performance, found a significant improvement in reading (Sørensen et al., 2015)

A systematic review highlights the relationship between dietary patterns and -quality, and adolescents' mental health (O'Neil et al., 2014). Results from a longitudinal study found a high-quality diet to serve as a protective factor for adolescent's positive well-being (Esteban-Gonzalo et al., 2019). Moreover, a study among New Zealand adolescents reported a significant association between healthy eating and higher well-being, with an equal association between unhealthy eating and decrease of well-being (Puloka, Utter, Denny, & Fleming, 2017).

Higher levels of classroom order have been found to increase students learning and academic growth (Gaskins, Herres, & Kobak, 2012). Adolphus et al. (2013) suggests that breakfast has a positive effect on on-task behavior in the classroom. "An improvement in classroom behavior has the potential to reduce disruption and produce a more productive learning environment". A systematic review addressed a moderate association between dietary intake, with breakfast consumption as a main factor, and higher academic achievement (Burrows, Goldman, Pursey, & Lim, 2017). Findings from a literature review showed that skipping breakfast has a negative effect on both children and adolescent's academic achievement by adversely affecting cognition and school absent (Basch, 2011). Further, a Norwegian study showed an association between both healthy eating and regular meal patterns, and increased odds of improved academic achievement in adolescents (Stea & Torstveit, 2014).

3.1.1 AIM

While the relationship between diet and nutrition, and school performance has been explored in several studies, there is a lacking number of studies addressing the effect of organized school meals on pupil's school performance and social health factors. Thus, the aim of this study is to examine the association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils.

3.2 METHODS

3.2.1 STUDY DESIGN AND SAMPLE

The present cross-sectional analyses, aggregated on schools, are based upon a larger survey conducted by the Norwegian Institute of Public Health (NIPH). This survey aimed to map out the offering of school meals in the school year of 2019/20 in Norwegian middle schools. The study sample was based upon records from *Grunnskolens Informasjonssystem* (GSI) by the Norwegian Directorate of Education (NDE). From a total of 1043 schools, 58 schools did not match the credentials of the study, by no longer having secondary school levels or being special education schools, and an additional 15 schools did not wish to participate, leaving the potential sample to 970 schools. In January 2020, the schools received an online questionnaire developed by NIPH. Nonresponding schools were contacted by phone. Data collection was delayed due to Covid-19 and the closing of Norwegian schools, and therefore did not end before September 2020. In total 817 schools participated in the survey, leaving the response rate at 84 %. All counties were well represented.

Data on pupils' perceived well-being, learning culture, motivation and school performance were retrieved from *Elevundersøkelsen*, an annual school survey conducted on behalf of NDE. Survey results are presented as school-level data and was retrieved from www.skoleporten.udir.no. The survey sample consist of 10th grade respondents. The aim of *Elevundersøkelsen* is to facilitate the improvement of schools by letting pupils share their opinion on factors of learning (motivation, well-being, participation, etc.). Pupils fill out an anonymous online questionnaire, and answers are utilized by schools, municipalities, and state to improve the schools. A total of 56 008 10th grade pupils respondent to the survey in 2020, which equals a 88.9 % response rate (Wendelborg, 2021). Data from a total of 1150 Norwegian primary and secondary schools were initially drawn from *Elevundersøkelsen* and was then matched by school's organization number with the NIPH survey data. A total of 333 schools were excluded to match the 817 participant schools from the NIPH survey.

3.2.2 MEASURES

Measures from the NIPH survey are based on an online questionnaire.
Participant schools were asked if they offered schools meals, with response alternatives 1) Yes, 2) No, but the school has a cafeteria where pupils can buy food, and 3) No. Alternative 2 and 3 were merged prior to statistical analyses.

School size was split into four groups based on the number of pupils: < 30 = Very small, 30 – 99 = Small, 100 – 299 = Medium-sized, and > 300 = Large.

Measures from *Elevundersøkelsen* are based on a self-reporting questionnaire. Participants could choose only one response alternative per measure. School level scores were calculated by adding pupils' response scores and dividing by the total number of responses given. A higher score is to be interpreted as a higher level of the investigated measure (Wendelborg, 2021).

Well-being was measured by asking pupils how they like being at school. Response alternatives were: 1) Do not thrive at all, 2) Do not thrive much, 3) Thrives some, 4) Thrives well, and 5) Thrives a lot.

Information on pupils' motivation was assessed trough the statement: I am looking forward to going to school. Response alternatives ranging from 1) completely disagree, 2) slightly disagree, 3) neither agree nor disagree, 4) slightly agree, and 5) completely agree.

Learning culture was measured by the response of the statement: The order in class is high. Response alternatives were 1) completely disagree, 2) slightly disagree, 3) neither agree nor disagree, 4) slightly agree, and 5) completely agree.

School performance, as measured by grade point averages were calculated by adding concluding grades and dividing by the total number of grades. The number is then multiplied by ten to get the primary school credit, which can vary from 10.0 to 60.0.

3.2.3 STATISTIC ANALYSES

IBM SPSs version 25 were used for data analyses. Analysis of variance (ANOVA) test was conducted to identify differences in well-being, learning culture, motivation and school performance among pupils offered school meals compared to those not offered school meals (table 2). Further, the ANOVA test was used to show differences in well-being, learning culture, motivation, and school performance between school with and without the offer of school meals, based on school size; very small, small, medium-sized, and large (table 3), and based on county (table 4).

3.2.4 ETHICS

The Norwegian Institute of Public Health holds legal responsibility for data collected through their survey. Data from *Elevundersøkelsen* is available to the public through open web portals at www.skoleporten.udir.no. Ethical approval for the present study was obtained from the Faculty Ethical Committee at the University of Agder.

3.3 FINDINGS AND RESULTS

The total sample included 817 participant schools, of which 133 (16%) reported to offer school meals and 684 (83%) reported not to. Very small schools (24%) were over ten percentage points more likely to offer schools meals then medium-sized (13%) and large (13%) schools. The counties of Nordland (27%), Trøndelag (27%) and Vestfold og Telemark (25%) had the highest rate of secondary schools offering schools meals, regardless of school size.

The mean score for pupils' well-being was measured to 4.1 ± 0.2 a-cross all participant schools. Further, the mean score for pupils' learning culture was measured to 3.6 ± 0.3 and 3.3 ± 0.3 for pupils' motivation. Pupils' mean grade point averages was measured to 42.9 ± 2.3 (table 1).

Table I. Characteristics of participating schools, in total, and by size and geographical affiliation.

	Schools, N (%)	**School meal offer** (%)	**Well-being** Mean ± SD	**Learning culture** Mean ± SD	**Motivation** Mean. ± SD	**GPA** Mean ± SD
Total	817 (100)	133 (16.3)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.3
School size						
Very Small	125 (15.5)	30 (24.0)	3.9 ± 0.4	3.5 ± 0.5	3.2 ± 0.5	44.3 ± 2.7
Small	175 (21.7)	32 (18.3)	3.9 ± 0.4	3.6 ± 0.5	3.2 ± 0.4	42.7 ± 2.9
Medium-sized	294 (36.4)	39 (13.3)	4.1 ± 0.2	3.6 ± 0.4	3.3 ± 0.2	42.4 ± 1.8
Large	213 (26.4)	29 (13.6)	4.1 ± 0.1	3.6 ± 0.3	3.4 ± 0.2	43.3 ± 2.0
County						
Agder	53 (100)	5 (9.4)	4.0 ± 0.3	3.5 ± 0.4	3.2 ± 0.3	42.4 ±1.8
Innlandet	62 (100)	9 (14.5)	4.2 ± 0.2	3.7 ± 0.3	3.5 ± 0.2	43.1 ± 1.7
Møre og Romsdal	51 (100)	6 (11.8)	4.1 ± 0.2	3.6 ± 0.3	3.2 ± 0.3	43.2 ± 2.2
Nordland	83 (100)	23 (27.7)	4.0 ± 0.2	3.6 ± 0.4	3.3 ± 0.3	42.9 ± 2.4
Oslo	42 (100)	5 (11.9)	4.2 ± 0.1	3.5 ± 0.2	3.4 ± 0.2	43.4 ± 3.7
Rogaland	73 (100)	8 (11.0)	4.0 ± 0.3	3.6 ± 0.3	3.1 ± 0.3	42.4 ± 1.9
Troms og Finnmark	66 (100)	9 (13.6)	3.9 ± 0.3	3.6 ± 0.4	3.1 ± 0.3	42.4 ± 2.5
Trøndelag	73 (100)	20 (27.4)	4.0 ± 0.2	3.5 ± 0.4	3.3 ± 0.3	42.4 ± 2.5
Vestfold og Telemark	58 (100)	15 (25.9)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.2	42.2 ± 1.7
Vestlandet	106 (100)	15 (14.2)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	43.1 ± 2.3
Viken	148 (100)	18 (12.2)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	43. 3 ± 2.1

GPA = Grade point averages
SD = Standard Deviation

No significant statistical difference in measured well-being (4.0 vs 4.1, p=.10), learning culture (3.6 vs 3.6, p=.95), motivation (3.3 vs 3.3, p=.34) or grade point averages (42.9 vs 42.9, p=.95) was observed between pupils with and without the offer of school meals (table 2).

Table II. Observed mean of learning factors, distributed by schools with and without school meal offerings.

	Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
All schools	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.3
School meal offer	4.0 ± 0.3	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.4
No school meal offer	4.1 ± 0.2 (.10)	3.6 ± 0.3 (.95)	3.3 ± 0.3 (0.34)	42.9 ± 2.2 (.95)

GPA = Grade point averages
SD = Standard Deviation
p = P-value,
P-value based upon ANOVA test

There was no significant statistical difference in pupils' observed well-being, learning culture, motivation or grade point averages between schools that offered school meals or not, distributed on school size (p>.05 for all) (table 3).

Table III.
Observed mean of learnings factors in schools with and without school meals, distributed by size.

		Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
Very small	School meals	3.9 ± 0.3	3.6 ± 0.3	3.1 ± 0.5	44.3 ± 2.2
	No School meals	4.0 ± 0.4 (.56)	3.5 ± 0.5 (.92)	3.2 ± 0.5 (.62)	44.3 ± 2.9 (.99)
Small	School meals	3.9 ± 0.4	3.6 ± 0.5	3.2 ± 0.4	42.3 ± 3.3
	No School meals	4.0 ± 0.3 (.35)	3.6 ± 0.5 (.55)	3.2 ± 0.4 (.95)	42.8 ± 2.8 (.40)
Medium-sized	School meals	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.2	42.4 ± 1.8
	No School meals	4.1 ± 0.2 (.68)	3.6 ± 0.3 (.87)	3.3 ± 0.2 (.21)	42.4 ± 1.8 (.93)
Large	School meals	4.1 ± 0.2	3.6 ± 0.3	3.4 ± 0.2	43.3 ± 1.9
	No School meals	4.1 ± 0.1 (.81)	3.6 ± 0.2 (.48)	3.4 ± 0.2 (.73)	43.3 ± 2.1 (.94)

GPA = Grade point averages
SD = Standard Deviation,
p = P-value,
P-value based upon ANOVA test

Pupils in the county of Nordland who were not offered school meals reported a higher level of well-being (4.1 vs 3.8, p<.0001) and motivation (3.4 vs 3.0, p<.0001) compared to those who were offered school meals. Data from the county of Troms og Finmark showed that pupils who were offered school meals reported a lower score of learning culture (3.0 vs 3.7, p=0.02) compared to pupils without the offer. Pupils mean grade point averages were higher (43.2 vs 41.9, p=.02) at schools with the offer of school meals compared to those without the offer in Vestfold og Telemark county. No other significant statistical differences between groups distributed on geographical affiliation was reported (table 4).

Table IV. Observed mean of learnings factors in schools with and without school meals, divided by geographical affiliation.

		Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
Agder	School meal	3.8 ± 0.6	3.5 ± 0.3	3.1 ± 0.3	43.0 ± 1.8
	No school meal	4.0 ± 0.3 (.13)	3.5 ± 0.4 (.97)	3.2 ± 0.3 (.22)	42.3 ± 1.8 (.45)
Innlandet	School meal	4.2 ± 0.2	3.6 ± 0.2	3.5 ± 0.3	42.2 ± 1.7
	No school meal	4.2 ± 0.2 (.80)	3.7 ± 0.4 (.47)	3.6 ± 0.2 (.56)	43.3 ± 1.7 (.15)
Møre og Romsdal	School meal	4.0 ± 0.2	3.5 ± 0.2	3.3 ± 0.1	42.5 ± 0.8
	No school meal	4.0 ± 0.2 (.52)	3.7 ± 0.3 (.29)	3.3 ± 0.3 (.99)	43.3 ± 2.3 (.48)
Nordland	School meal	3.8 ± 0.2	3.6 ± 0.6	3.0 ± 0.2	42.7 ± 1.6
	No School meal	4.1 ± 0.2 **(.00)**	3.7 ± 0.4 (.80)	3.4 ± 0.3 **(.00)**	42.9 ± 2.6 (.75)
Oslo	School meal	4.3 ± 0.1	3.1 ± 0.3	3.4 ± 0.1	42.5 ± 6.9
	No school meal	4.2 ± 0.1 (.09)	3.5 ± 0.2 (.15)	3.5 ± 0.2 (.83)	43.5 ± 3.2 (.55)
Rogaland	School meal	3.9 ± 0.3	3.7 ± 0.2	3.1 ± 0.4	43.8 ± 1.9
	No School meal	4.0 ± 0.3 (.26)	3.6 ± 0.3 (.58)	3.2 ± 0.3 (.75)	42.3 ± 1.9 (.07)
Troms og Finnmark	School meal	3.8 ± 0.4	3.0 ± 0.1	3.1 ± 0.5	41.5 ± 4.4
	No School meal	3.9 ± 0.3 (.47)	3.7 ± 0.4 **(.02)**	3.2 ± 0.3 (.75)	42.3 ± 1.9 (.55)
Trøndelag	School meal	4.0 ± 0.3	3.6 ± 0.4	3.4 ± 0.3	42.5 ± 2.6
	No school meal	4.0 ± 0.2 (.70)	3.4 ± 0.4 (.12)	3.3 ± 0.3 (.54)	42.4 ± 2.4 (.98)
Vestfold og Telemark	School meal	4.1 ± 0.3	3.7 ± 0.4	3.4 ± 0.3	43.2 ± 1.5
	No school meal	4.0 ± 0.2 (.44)	3.6 ± 0.3 (.30)	3.3 ± 0.2 (.34)	41.9 ± 1.7 **(.02)**
Vestlandet	School meal	4.1 ± 0.2	3.6 ± 0.4	3.3 ± 0.4	43.9 ± 1.8
	No School meal	4.1 ± 0.3 (.72)	3.6 ± 0.3 (.80)	3.3 ± 0.3 (.98)	43.0 ± 2.3 (.23)
Viken	School meal	4.1 ± 0.1	3.5 ± 0.3	3.3 ± 0.1	42.8 ± 1.9
	No School meal	4.1 ± 0.2 (.97)	3.6 ± 0.3 (.59)	3.3 ± 0.2 (.59)	43.3 ± 2.1 (.35)

GPA = Grade point averages
SD = Standard Deviation,
p = P-value,
P-value based upon ANOVA test
Statistically significant results at p-value ≤0.05 shown in bold

3.4 DISCUSSION OF THE RESULTS

This cross-sectional study examined the school level association between the serving of school meals and Norwegian secondary school pupils' school performance and self-reported well-being, learning culture, and motivation. Results showed in general no association between the availability of school meals and higher scores of either well-being, learning culture, motivation, or school performance, however a very few significant associations were seen within some counties.

3.4.1 WELL-BEING

The serving of school meals was not associated with higher levels of pupils' well-being in the present study. There is to our knowledge few studies addressing the association between the serving of school meals and pupils' well-being. Still, Sooyoun et al. (2018) investigated the relationship between pupils' school meal satisfaction and pupils' happiness. Although there was no significant relationship between overall meal satisfaction and overall happiness, overall meal satisfaction was found to have a significant influence on pupils' school happiness (Sooyoun et al., 2018).

3.4.2 LEARNING CULTURE

In the present study, the serving of school meals was not associated with classroom order, referred to as learning culture. These findings are in line with the results of a previous cluster-randomized controlled trial which showed no effect on improving pupils' cognition after being served a free school meal for 12 months (Moore et al., 2014) Further, a randomized crossover study found no difference in pupils' short-term cognitive functioning between days of eating lunch at school and days of skipping lunch (Müller et al., 2013).

Oppositely, results from a systematic review by Hoyland et al. (2009) indicates that breakfast consumption has positive effects in school-aged children´s cognitive performance in comparison with breakfast omission. The authors do however argue that the effect of school breakfast programs may be linked to reduced absenteeism (Hoyland et al., 2009). Further,

Golley at al. (2010) conducted a randomized controlled trial and found a significant improvement in productive classroom interactions, were pupils attending intervention schools were 3.4 times (CI: 1.56-7.36) more likely to be “on-task” than controls in the post-lunchtime period. Moreover, Storey et al. (2011) carried out a randomized controlled trial, which showed positive evidence of the benefits of modifying pupils’ school food and -eating environments on learning-related behaviors. Schröder et al. (2015) studied the effect of lunch on pupils’ executive functions. The results indicates that pupils’ executive function is not impaired after eating lunch (Schröder et al., 2015).

A possible explanation of the divergent results may be the nutritional quality of the meals eaten, as intake of refined carbohydrates and saturated fatty acids has been related to reduced cognitive performance in adolescent (Howard et al., 2011; Nyaradi et al., 2014). Studies on animals shows these nutrients interfere with synaptic plasticity and neurogenesis in the hippocampus and the medial prefrontal cortex, preventing memory- and learning processes (Davidson et al., 2009; Kanoski, Zhang, Zheng, & Davidson, 2010).

3.4.3 MOTIVATION

No association between the serving of school meals and the levels of pupils’ academic motivation was revealed in this study. Other studies address the possible factors which influence pupils’ academic motivation. Ranita and Santoshi (2020) reviewed the influence of parenting styles on school children’s academic motivation. The authors found different parenting styles to be an important contributor to academic motivation in both a positive and negative manner (Ranita & Santoshi, 2020). Further, Opdenakker et al. (2012) found the teacher-student interpersonal relationships to be a significant predictor of academic motivation. Gillen-O`Neel & Fuligni (2013) examined how school belonging is associated with academic engagement. The researchers highlight the importance of school belonging for maintaining pupils’ engagement at school (Gillen-O'Neel & Fuligni, 2013). Still, there is to our knowledge a lack of studies investigating the direct association between the serving of school meals and pupil’s academic motivation.

3.4.4 SCHOOL PERFORMANCE

No association between the serving of school meals and pupils' school performance was found in this study. Previous observational studies demonstrate an association between both healthy and regular eating, and increased school performance among pupils (Correa-Burrows, Burrows, Orellana, & Ivanovic, 2015; Faught, Gleddie, Storey, Davison, & Veugelers, 2017) Still, studies examining the direct link between school meals and pupil's school performance is less conclusive. A systematic review conducted by Jomaa et al. (2011) found school feeding programs in developing countries to have a positive effect on pupils arithmetic scores, but the effect was inconclusive for reading, writing, and spelling tests. The shift from traditional to healthier school meals has been shown to have a modest positive effect on American primary and secondary school pupils' academic performance (Anderson, Gallagher, & Ramirez Ritchie, 2018). Imberman & Kugler (2014) suggests that pupils at wealthier school tend to eat breakfast more regularly and have higher test scores than pupils at poorer schools with lower levels of breakfast consumption, independent of learning. A recent longitudinal study points to a positive effect of universal free school meals on test scores of secondary school pupils (Schwartz & Rothbart, 2020).

However, results from a one year stepped-wedge, cluster randomized controlled trail among pupils from New Zealand found no significant effect of school breakfast programs on the participants academic achievement (Mhurchu et al., 2013). Further, a study on the effect of eating breakfast in the classroom found no evidence for increased academic performance among pupils (Corcoran, Elbel, & Schwartz, 2016).

3.4.5 STRENGTHS AND LIMITATIONS OF THE STUDY

Several methodological limitations of this study should be acknowledged. The main limitation is the study's cross-sectional design, and the aggregate data which it is based upon. This prevents us from making inference regarding causality (Wang & Cheng, 2020). Thus, one could not have made assumptions whether the serving of school meals lead to higher levels of pupils' well-being, learning culture, motivation, or school performance, or if lower scores of the factors mentioned induce schools to serve food to their pupils. Second, the data drawn

from the survey conducted by NIPH does not display the variety of school meal offers. It is not taken into consideration whether school meals are free for all or parent paid, served warm or cold, served as breakfast or lunch, or how many days per week it is served. Further, data on pupils' well-being, learning culture, and motivation is based upon self-reported measures which could have led to recall bias (Wang & Cheng, 2020). The dearth of objective data might also have led to socially desirable responding (Polit & Beck, 2017). Thirdly, a common bias in cross-sectional studies is selection bias (P. Sedgwick, 2015). One could argue that non meal serving schools might not have responded to the survey at all, which could have affected the results of this study.

However, the present study is strengthened by a large sample size from the NIPH survey, and the very high participation rate. With the inclusion of all public Norwegian secondary schools and a high participation rate, the possibility of selection bias is greatly reduced. Furthermore, data from the survey *Elevundersøkelsen* is based upon pupils' self-reported answers, which limits the possibility of interviewer bias. This could have been a limitation had the questionnaire been filled out by the pupils' teachers or parents. The survey is compulsory for schools to conduct, resulting in a high participation rate. Further, data on pupils' grade point averages from *Elevundersøkelsen* are drawn from public register, which strengthens its objectivity.

3.5 CONCLUSION

The present study found no association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils. However, the study holds several methodical limitations, and the results should be interpretated with precaution. Further well-designed studies are needed confirm the possible association.

4 FURTHER ELABORATION OF THE RESEARCH PAPER

The following chapter will include further elaborations of the present study and research paper. Methodical considerations will be discussed initially, followed by an extended discussion of school meals.

4.1 METHODICAL CONSIDERATION

4.1.1 STUDY DESIGN

The cross-sectional study is observational in design. Therefore, investigators do not intervene but merely observe and record behavior, attitudes or choices of the study participant (Philip Sedgwick, 2014). The aim of a cross-sectional study is to obtain a representative sample by including a cross section of the studied population. The recruitment period for a cross-sectional study may vary in duration, however sample member measures are obtained at single point in time (Philip Sedgwick, 2014). Cross-sectional studies are relatively inexpensive, easily managed and takes little time to conduct (Levin, 2006). A cross-sectional study allows for the opportunity to examine several exposures and outcomes at once. Still, since data from each participant is collected at a single point only, one cannot make inferences regarding temporal associations between risk factors and outcomes. Thus, causation cannot be inferred from a study of cross-sectional design (Philip Sedgwick, 2014).

Cross-sectional studies are useful in generating hypotheses for further research, as they do indicate associations that may exist (Levin, 2006). Cross-sectional studies are usually based on questionnaire surveys, which eliminate the chance of loss to follow-up as participants are interviewed at one point solely. Further, they are susceptible to non-response bias if participants in the study differ from non-respondents, which make the study sample not representative to the examined population (Philip Sedgwick, 2014). Moreover, the sampling method and availability of possible participants will always affect the degree of selection bias (P. Sedgwick, 2015). Selection bias occurs when the included study sample is systematically different from the intended research population. Thus, a study sample obtained from a population-based study have a higher chance of being representative of the population, and by that reducing the possibility of selection bias. Random sampling of the population will further minimize the selection bias (P. Sedgwick, 2015).

The present study might be susceptible to ascertainment bias. Pupils reporting their well-being, learning motivation, or academic motivation might have been inclined to overreport their scores because of social acceptance, also known as response bias (P. Sedgwick, 2015). If information bias occurs on account of researchers or interviewers, it is referred to as assessment bias or observer bias. Data recording in the NIPH survey could have been colored by attitudes or previous experiences of the interviewers (P. Sedgwick, 2015).

The present study makes use of aggregated data for its statistical analyses. As field data often include several observations from the same patient or individual it is customary to aggregate data, generating a mean score per individual, and use the aggregated data for statistical analyzing to avoid pseudo replication (Pollet, Stulp, Henzi, & Barrett, 2015). However, data aggregation may lead to loss of valuable information as it does not take individual behavior into consideration. Aggregating data may also result in lower statistical power as the sample size are reduced, which again can lead to possible effects or associations not being detected in the statistical analyses (Pollet et al., 2015). By working with aggregated data, the possibility of an ecological fallacy increases. The term ecological fallacy is used when data collected at group level are analyzed and results are assumed to apply to relationship or associations at the individual level (P. Sedgwick, 2011).

Data on schools' socioeconomic status, level of urbanity or ethnicity distribution were not collected for the present study. These measures could however have served as useful covariates to highlight the association between school meal servings and outcome measures (Polit & Beck, 2017).

4.1.2 VALIDITY & GENERALIZATION

Research cannot contribute evidence if the findings are biased, inaccurate or fail to represent experiences of the target group. Multiple criteria are used in quantitative research to assess the quality of a study, this is by many referred to as a study's scientific merit (Polit & Beck, 2017). A study's validity determines whether its results are answering the actual research question of the study, and to what extent the answers are accurate and trustworthy (Malterud, 2017). Validity is defined as the extent to which a concept is accurately measured in a quantitative study (Heale & Twycross, 2015).

Validity is often separated into internal- and external validity. Internal validity is the extent to which a studies results represents the truth in the studied population, and thus are not due to methodological errors. The internal validity of a study can be weakened by errors in measurement or in participant selection (Patino & Ferreira, 2018). Evidence hierarchies often rank study design in terms of internal validity, where randomized controlled trials have higher internal validity than cross-sectional studies (Polit & Beck, 2017). External validity involves conclusions about whether relationships found for participants in a study can apply to different people or settings. Thus, one element of a study's external validity concerns sampling. If the studied sample is representative to the population, one can generalize results to the population with greater certainty. External validity may also involve the possibility of generalizing to other groups of people, situations, or settings (Polit & Beck, 2017). For example, are results from the present study transferable to school children in the US or UK? The interest for external and internal validity may conflict. If researchers aim too much attention towards increasing a study's internal validity the setting may be too simulated to generalize to more realistic environments (Polit & Beck, 2017).

The present study includes a large sample of Norwegian secondary schools (84 %), thus generalization towards the Norwegian population of children and adolescent can be done with strengthened certainty. However, comparisons of our results with studies from other countries and population groups should be done with greater care as these settings and contexts may vary to those of Norway.

4.1.3 MEASURES

School meals

The measure of school meal servings varies in different studies, depending on research topic, study design or affiliation. Whereas Vik et al. (2019) defined a school meal as a daily healthy cold meal served at lunchtime, participants in Ask, Hernes, Aarek, Johannessen & Haugen (2006) were served a school meal as breakfast at the beginning of each school day. The present study does not take into consideration the timing of served school meals, nor the composition of the meals. While some schools may serve prepared warm meals, others might

offer a cold meal consisting of bread, milk, and fruits. These variations are not accounted for in the analyses for this study. Further, no data on weekly meal frequency is included, and schools who offer school meals on the daily falls under the same category as schools who offer meals once a week. In the present study, the percentage of schools reporting to offer school meals were low (16,3 %). To not further decrease the sample size, the measure of school meals where not divided into subgroups of variations of school meal servings, as this could potentially weaken the statistical power of the study (Polit & Beck, 2017).

Outcome measures

The term well-being is a direct translation from the definition *Trivsel* used in *Elevundersøkelsen*. In the present study pupil's well-being was measured in regard of how they like being at school. The construct of well-being is there for limited to pupil's situational well-being at school, and not in other aspects of their everyday life. This limits the possibility of generalization of an association between school meal serving and children and adolescent's overall well-being (Polit & Beck, 2017).

The term learning culture is a direct translation from the definition *Læringskultur* used in *Elevundersøkelsen.* The present study measured learning culture through pupils' perception of the order in the classroom. There are few studies assessing the direct association or effect of school meals on classroom order. Therefore, studies addressing both cognition (Moore et al., 2014), executive function (Schröder et al., 2015) and readiness to learn (Taylor, Garnett, Horton, & Farineau, 2020) are included in the discussion of this research paper. Comparisons of results should therefore be done with precaution.

The term motivation is a direct translation from the definition *Motivasjon* used in *Elevundersøkelsen.* The measure of school children's motivation was assessed through the extent of which they were looking forward to going to school. This prevents us from making any assumptions regarding pupils' motivation towards schoolwork or learning. Several interpretations of motivation towards school are applied in research (Gillen-O'Neel & Fuligni, 2013; Opdenakker et al., 2012; Ranita & Santoshi, 2020), and this methodical issue makes comparison of results across studies challenging.

School performance was measured through pupils' grade point averages. School children's performance in school is in other studies assessed through different research terms. While

Anderson et al. (2018) measures school performance as academic performance trough standardized tests, Faught et al (2017) defines pupils' school performance as pupils' self-reported academic achievement. Furthermore, the term school performance was applied when assessing academic tests in Sørensen et al. (2015). The different terms of pupils' school performance may vary in measure methods, however, as research included in the present study all evaluates outcomes of learning, they are considered to be of relevance to result comparison.

***Elevundersøkelsen* in general**

Teachers and school leaders were in 2014 asked their opinion regarding the effects and implementation of the annual survey *Elevundersøkelsen.* There was a general agreement that the survey was more comprehensive than necessary, and that it is perceived as too complicated by some pupils. Some teachers stated that the complexity of the questionnaire led to pupil's gave "negative" responses when they were meant to answer in a "positive" manner (Grindheim, Skutlaberg, Høgestøl, Rasmussen, & Hansen, 2014). Further, teachers states that pupils seem unmotivated towards accomplishing the survey and spend little time answering the questionnaire. The report states that answers given by pupils may be excessively influenced by recent events, and therefore is not an accurate measure of their overall perception of school. Authors of the report therefore questions the reliability and validity of the survey (Grindheim et al., 2014).

4.1.4 STATISTICAL ANALYSES

The statistical method chosen for the analyses in the present study was the Analysis of variance (ANOVA). The ANOVA is used to test mean group differences between groups (Polit & Beck, 2017). Results of the ANOVA analyses is presented as p values. In the present study, to determine the level of significance, p value was set at $p \leq 0.05$. This is in line with scientific standards (Polit & Beck, 2017). Results which fall below the set significance level has not been discussed. As results from the main analyses showed no statistical significance between groups with and without serving of school meals, the hypothesis of an association between the serving of school meals and pupils' level of well-being, motivation, learning culture and school performance are rejected. Thus, no further analyses were conducted.

4.2 FURTHER DISCUSSIONS OF SCHOOL MEALS

The results of the present study show no association between the serving of school meals and pupils' perceived levels of well-being, motivation, learning culture, and obtained school performance. However, other studies exploring the impacts of school meal offers have found positive effects on school children's health, school performance and dietary habits (Andersen et al., 2014; Ask et al., 2006; Sørensen et al., 2015; Vik et al., 2019).

Ask et al. (2006) explored the effect of offering breakfast in school for secondary school graders. One school class were offered a free breakfast for 4 months, whereas a second class operated as controls. Pupils in the intervention group showed a reduction in weight gain. In addition, an improved food pattern was seen among boy pupils in the intervention group (Ask et al., 2006). The framework for the study conducted by Vik et al. (2019) is previously described in this thesis (chapter 2.4). Results from the study showed increased consumption of healthy foods among school children of lower socio-economic status. The researchers concluded that the serving of a daily free school meal could help reduce health inequities among Norwegian pupils (Vik et al., 2019).

The OPUS (Optimal well-being, development, and health for Danish children through a healthy New Nordic Diet) School Meal study investigated the effects on food and nutrient consumption after introducing school meals based on the New Nordic Diet. Results from the cluster-randomized cross-over designed study showed that overall dietary intake at food and nutrient level was improved when the participants packed lunch were replaced by school meals based on the New Nordic Diet (Andersen et al., 2014). Further, Sørensen et al. (2015) studied the effect of Nordic school meals on concentration and school performance in danish school children. The cluster-randomized, controlled, crossover trail found school meal serving to positively influence pupils' reading performance. The authors argue that, although evidence is scarce, the promotion of healthy meals at school is of importance (Sørensen et al., 2015).

Nevertheless, results from the studies previously mentioned in this chapter also displays limited or negative effects of school meal offers. The findings by Ask et al. (2006) showed no

improvement in pupils' school performance, measured by time spent doing home-work. Moreover, the pupils' rating of the school environment did not improve as a result of the school meal offering (Ask et al., 2006). The framework of the "Serving of free school lunch to secondary-school pupils – a pilot study with health implications" (Ask et al., 2010) study is previously described in this thesis (chapter 2.4). Results showed a significant increase in BMI among the male participants. In addition, the serving of free school meals did not help reduce consumption of sugary sodas and snacks, and no increase of healthy foods was found (Ask et al., 2010). Furthermore, the school meal intervention examined by Sørensen et al. (2015) showed no improvement on pupils' math performance, nor did it effect their concentration, measured through an attention test (Sørensen et al., 2015). Findings by Vik et al. (2019) showed that school children who received a healthy free school meal for one year in fact had a significant increase in BMI, whereas pupils in the control group saw a decrease in BMI (Vik et al., 2019).

Considering the divergent results shown in the studies mentioned above, (Andersen et al., 2014; Ask et al., 2006; Ask et al., 2010; Sørensen et al., 2015; Vik et al., 2019) we argue that the impact of school meal offers may be less conclusive than that presumed by politicians and policy makers in Norway. Therefore, the promotion of school meal implementations may arguably be done with greater care.

5 REFERENCES

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Front Hum Neurosci, 7*, 425-425. doi:10.3389/fnhum.2013.00425

Andersen, R., Biltoft-Jensen, A., Christensen, T., Andersen, E. W., Ege, M., Thorsen, A. V., . . . Tetens, I. (2014). Dietary effects of introducing school meals based on the New Nordic Diet – a randomised controlled trial in Danish children. The OPUS School Meal Study. *Br J Nutr, 111*(11), 1967-1976. doi:10.1017/S0007114514000634

Anderson, M. L., Gallagher, J., & Ramirez Ritchie, E. (2018). School meal quality and academic performance. *Journal of public economics, 168*, 81-93. doi:10.1016/j.jpubeco.2018.09.013

Andresen, A., & Elvbakken, K. T. (2007). From poor law society to the welfare state: school meals in Norway 1890s–1950s. *J Epidemiol Community Health, 61*(5), 374-377. doi:10.1136/jech.2006.048132

Anundsen, A., Gåsvatn, J. J., & Schmidt, Å. M. (2007). *Dokument nr. 8:113. Representantforslag fra stortingsrepresentantene Anders Anundsen, Jon Jæger Gåsvatn og Åse M. Schmidt om en nasjonal tiltakspakke for å bekjempe uro og disiplinproblemer i den norske skolen*. Retrieved from https://www.stortinget.no/globalassets/pdf/representantforslag/2006-2007/dok8-200607-113.pdf

Ask, A. S., Hernes, S., Aarek, I., Johannessen, G., & Haugen, M. (2006). Changes in dietary pattern in 15 year old adolescents following a 4 month dietary intervention with school breakfast - A pilot study. *Nutr J, 5*(1), 33-33. doi:10.1186/1475-2891-5-33

Ask, A. S., Hernes, S., Aarek, I., Vik, F. N., Brodahl, C., & Haugen, M. (2010). Serving of free school lunch to secondary-school pupils - a pilot study with health implications. *13*(2). doi:10.1017/S1368980009990772

Basch, C. E. (2011). Breakfast and the Achievement Gap Among Urban Minority Youth. *J Sch Health, 81*(10), 635-640. doi:10.1111/j.1746-1561.2011.00638.x

Bere, E., & Stea, T. H. (2017). Editorial: School food provided for free. *Scandinavian Journal of Public Health, 45*(1), 1-2. doi:10.1177/1403494816683297

Burrows, T., Goldman, S., Pursey, K., & Lim, R. (2017). Is there an association between dietary intake and academic achievement: a systematic review. *J Hum Nutr Diet, 30*(2), 117-140. doi:10.1111/jhn.12407

Considine, G., & Zappala, G. (2002). The influence of social and economic disadvantage in the academic performance of school students in Australia. *Journal of sociology (Melbourne, Vic.), 38*(2), 129-148. doi:10.1177/144078302128756543

Corcoran, S. P., Elbel, B., & Schwartz, A. E. (2016). The Effect of Breakfast in the Classroom on Obesity and Academic Performance: Evidence from New York City. *J Policy Anal Manage, 35*(3), 509-532. doi:10.1002/pam.21909

Correa-Burrows, P., Burrows, R., Orellana, Y., & Ivanovic, D. (2015). The relationship between unhealthy snacking at school and academic outcomes: a population study in Chilean schoolchildren. *Public Health Nutr, 18*(11), 2022-2030. doi:10.1017/S1368980014002602

Crothers, L. M., & Kolbert, J. B. (2008). Tackling a Problematic Behavior Management Issue: Teachers' Intervention in Childhood Bullying Problems. *Intervention in school and clinic, 43*(3), 132-139. doi:10.1177/1053451207311606

Cunsolo, S. (2017). Subjective wellbeing during adolescence: a literature review on key factors relating to adolescent's subjective wellbeing and education outcomes. *Studi sulla formazione, 20*(1), 81. doi:10.13128/Studi_Formaz-20941

Dahl, T., & Jensberg, H. (2011). *Kost i skole og barnehage og betydningen for helse og læring: En kunnskapsoversikt*. København: København: Nordisk ministerråd.

Danielsen, A. G. (2012). Hva henger sammen med skoletrivselen til norske ungdomsskoleelever? *Nordic studies in education, 32*(2), 115-125.

Danielsen, A. G., Samdal, O., Hetland, J., & Wold, B. (2009). School-Related Social Support and Students' Perceived Life Satisfaction. *The Journal of educational research (Washington, D.C.), 102*(4), 303-320. doi:10.3200/JOER.102.4.303-320

Davidson, T. L., Chan, K., Jarrard, L. E., Kanoski, S. E., Clegg, D. J., & Benoit, S. C. (2009). Contributions of the hippocampus and medial prefrontal cortex to energy and body weight regulation. *Hippocampus, 19*(3), 235-252. doi:10.1002/hipo.20499

De-Regil, L. M., Harding, K. B., & Roche, M. L. (2016). Preconceptional nutrition interventions for adolescent girls and adult women: Global guidelines and gaps in evidence and policy with emphasis on micronutrients. *J Nutr, 146*(7), 1461S-1470S. doi:10.3945/jn.115.223487

Development-Initiatives. (2018). *Global nutrition report: shining a light to spur action on nutrition.* Retrieved from Bristol: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwilrJ7Hj87wAhUtpIsKHZg4CeIQFjADegQIAhAD&url=https%3A%2F%2Fwww.who.int%2Fnutrition%2Fglobalnutritionreport%2F2018_Global_Nutrition_Report.pdf%3Fua%3D1&usg=AOvVaw1ccpgqy0HstSnsg_YODg0o

Esteban-Gonzalo, L., Turner, A. I., Torres, S. J., Esteban-Cornejo, I., Castro-Piñero, J., Delgado-Alfonso, Á., . . . Veiga, Ó. L. (2019). Diet quality and well-being in children and adolescents: the UP&DOWN longitudinal study. *Br J Nutr, 121*(2), 221-231. doi:10.1017/S0007114518003070

Faught, E. L., Gleddie, D., Storey, K. E., Davison, C. M., & Veugelers, P. J. (2017). Healthy lifestyle behaviours are positively and independently associated with academic achievement: An analysis of self-reported data from a nationally representative sample of Canadian early adolescents. *PLoS One, 12*(7), e0181938-e0181938. doi:10.1371/journal.pone.0181938

Florence, M. D., Asbridge, M., & Veugelers, P. J. (2008). Diet Quality and Academic Performance. *J Sch Health, 78*(4), 209-215. doi:10.1111/j.1746-1561.2008.00288.x

Lov om folkehelsearbeid (LOV-2011-06-24-29), (2012).

Forskningsrådet. (2018). *Forskningskampanjen 2018: Sjekk skolematen - Rapport fra undersøkelse om skolemat på alle trinn, gjennomført av over 10 000 elver høsten 2018*. Retrieved from

Frisvold, D. E. (2015). Nutrition and cognitive achievement: An evaluation of the School Breakfast Program. *J Public Econ, 124*, 91-104. doi:10.1016/j.jpubeco.2014.12.003

Gaskins, C. S., Herres, J., & Kobak, R. (2012). Classroom order and student learning in late elementary school: A multilevel transactional model of achievement trajectories. *Journal of applied developmental psychology, 33*(5), 227-235. doi:10.1016/j.appdev.2012.06.002

Gillen-O'Neel, C., & Fuligni, A. (2013). A Longitudinal Study of School Belonging and Academic Motivation Across High School. *Child Dev, 84*(2), 678-692. doi:10.1111/j.1467-8624.2012.01862.x

Golley, R., Baines, E., Bassett, P., Wood, L., Pearce, J., & Nelson, M. (2010). School lunch and learning behaviour in primary schools: an intervention study. *Eur J Clin Nutr, 64*(11), 1280-1288. doi:10.1038/ejcn.2010.150

Grantham-McGregor, S. (2005). Can the Provision of Breakfast Benefit School Performance? *Food Nutr Bull, 26*(2_suppl2), S144-S158. doi:10.1177/15648265050262S204

Grindheim, J. E., Skutlaberg, L. S., Høgestøl, A., Rasmussen, I., & Hansen, V. W. (2014). *Rapporterings- og dokumentasjonskrav i skolesektoren*. Retrieved from https://www.regjeringen.no/globalassets/upload/kd/vedlegg/rapporter/rapport_endelig.pdf

Hansen, L. B., Myhre, J. M., Johansen, A. M. W., Paulsen, M. M., & Andersen, L. F. (2016). *Ungkost 3*. Retrieved from https://www.fhi.no/studier/nasjonale-kostholdsundersokelser/kosthold-blant-9--og-13-aringer-i-norge/:

Haug, E., Robson-Wold, C., Helland, T., Jåstad, A., Torsheim, T., Fismen, A.-S., . . . Samdal, O. (2020). *Barn og unges helse og trivsel. Forekomst og sosial ulikhet i Norge og Norden*. Retrieved from https://www.uib.no/sites/w3.uib.no/files/attachments/hevas_rapport_v10.pdf

Haugset, A., & Nossum, G. (2012). *School meal in Nord-Trondelag. Mapping of food serving in schools*. Retrieved from

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evid Based Nurs, 18*(3), 66-67. doi:10.1136/eb-2015-102129

Hearst, M. O., Jimbo-Llapa, F., Grannon, K., Wang, Q., Nanney, M. S., & Caspi, C. E. (2019). Breakfast Is Brain Food? The Effect on Grade Point Average of a Rural Group Randomized Program to Promote School Breakfast. *J Sch Health, 89*(9), 715-721. doi:10.1111/josh.12810

Helland, S. H., Øverby, N. C., & Vik, F. N. (2019). Arenaer for folkehelse og ernæring. In D. Engeset, L. E. Torheim, & N. C. Øverby (Eds.), *Samfunnsernæring* (Vol. 1, pp. 186-191). Oslo: Universitetsforlaget.

Helse- og omsorgsdepartmenentet. (2016). Ungdomshelse; regjeringens strategi for ungdomshelse 2016–2021. Retrieved from https://www.regjeringen.no/contentassets/838b18a31b0e4b31bbfa61336560f269/ungdomshelsestrategi_2016.pdf

Helse- og omsorgsdepartmenentet. (2017). *Nasjonal handlingsplan for bedre kosthold (2017-2021)*. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiZn6n53bfwAhVxCRAIHTtcBl8QFjABegQIAxAD&url=https%3A%2F%2Fwww.regjeringen.no%2Fcontentassets%2Ffab53cd681b247bfa8c03a3767c75e66%2Fhandlingsplan_kosthold_2017-2021.pdf&usg=AOvVaw2fIbohIHg1l49a235mZpXk

Helse- og omsorgsdepartmenentet. (2019). *Folkehelsemeldinga - Gode liv i eit trygt samfunn (Meld. St. Nr. (2018-2019))*. Retrieved from https://www.regjeringen.no/no/dokumenter/meld.-st.-19-20182019/id2639770/

Helsedirektoratet. (2011). *Kostråd for å fremme folkehelsen og forebygge kroniske sykdommer. Metodologi og vitenskapelig kunnskapsgrunnlag. Nasjonalt råd for ernæring 2011 (IS-1881)*. Retrieved from https://www.helsedirektoratet.no/rapporter/kostrad-for-a-fremme-folkehelsen-og-forebygge-kroniske-sykdommer-metodologi-og-vitenskapelig-kunnskapsgrunnlag/Kostr%C3%A5d%20for%20%C3%A5%20fremme%20folkehelsen%20og%20forebygge%20kroniske%20sykdommer%20%E2%80%93%20metodologi%20og%20vitenskapelig%20kunnskapsgrunnlag.pdf/_/attachment/inline/2a6293e0-169e-41bd-a872-f3952dbb22c2:0d09926111d614e6059e804b7f9b21c17bd0c1cd/Kostr%C3%A5d%20for%20%C3%A5%20fremme%20folkehelsen%20og%20forebygge%20kroniske%20sykdommer%20%E2%80%93%20metodologi%20og%20vitenskapelig%20kunnskapsgrunnlag.pdf

Helsedirektoratet. (2015a). *Nasjonal faglig retningslinje for mat og måltider i skolen (nettdokument)*. Oslo Retrieved from https://www.helsedirektoratet.no/retningslinjer/mat-og-maltider-i-skolen

Helsedirektoratet. (2015b). *Trivsel i skolen* Retrieved from https://www.helsedirektoratet.no/rapporter/trivsel-i-skolen/Trivsel%20i%20skolen.pdf/_/attachment/inline/9e76ad2b-14eb-4c5f-bf8b-e157f5efcc06:176ea3b766b3d06407dbd9395c3b1776682c5ab7/Trivsel%20i%20skolen.pdf

Helsedirektoratet. (2015c). *Well-being på norsk* (IS-2344). Retrieved from https://helsedirektoratet.no/publikasjoner/well-being-pa-norsk

Helsedirektoratet. (2018). *Anbefalte tiltak mot sosial ulikhet i helse, Fagrådet for sosial ulikhet i helse*. Retrieved from

https://www.helsedirektoratet.no/rapporter/anbefalte-tiltak-mot-sosial-ulikhet-i-helse/Anbefalte%20tiltak%20mot%20sosial%20ulikhet%20i%20helse.pdf/_/attachment/inline/61dc43e0-cdc6-43a7-97aa-033087123180:16c32d7c42b3ed5a8fbfafc35742e986133a0749/Anbefalte%20tiltak%20mot%20sosial%20ulikhet%20i%20helse.pdf

Holthe, A., Larsen, T., & Samdal, O. (2011). Understanding barriers to implementing the Norwegian national guidelines for healthy school meals: a case study involving three secondary schools. *Matern Child Nutr, 7*(3), 315-327. doi:10.1111/j.1740-8709.2009.00239.x

Hoppe, C., Biltoft-Jensen, A., Trolle, E., & Tetens, I. (2009). *Dietary habits of Danish 8- to 10-year-old and 12- to 14- year-old children*. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiKz7jk7rLwAhVshosKHWY0BfUQFjAAegQIAxAD&url=https%3A%2F%2Fwww.food.dtu.dk%2F-%2Fmedia%2FInstitutter%2FFoedevareinstituttet%2FPublikationer%2FPub-2009%2FBeskrivelse-af-8-10-%25C3%25A5rige-og-12-14-%25C3%25A5rige-b%25C3%25B8rns-kost---med-fokus-p%25C3%25A5-indtag-i-skole-og-fritidsordning.ashx%3Fla%3Dda%26hash%3DA52FB7F5005C64C03CCD14593F0264686F24AEEF&usg=AOvVaw1ys6RubCQhkzmTpbXMKZzJ

Howard, A. L., Robinson, M., Smith, G. J., Ambrosini, G. L., Piek, J. P., & Oddy, W. H. (2011). ADHD Is Associated With a "Western" Dietary Pattern in Adolescents. *J Atten Disord, 15*(5), 403-411. doi:10.1177/1087054710365990

Hoyland, A., Dye, L., & Lawton, C. L. (2009). A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutr Res Rev, 22*(2), 220-243. doi:10.1017/S0954422409990175

Huebner, E. S., & Gilman, R. (2006). Students Who Like and Dislike School. *Applied Research in Quality of Life, 1*(2), 139-150. doi:10.1007/s11482-006-9001-3

Imberman, S. A., & Kugler, A. D. (2014). The Effect of Providing Breakfast in Class on Student Performance: The Effect of Providing Breakfast in Class. *Journal of policy analysis and management, 33*(3), 669-699. doi:10.1002/pam.21759

Jensen, F., Pettersen, A., Frønes, T. S., Kjærnsli, M., Rohatgi, A., Eriksen, A., & Narvhus, E. K. (2019). *PISA 2018 - Norske elevers kompetanse i lesing, matematikk og naturfag*. Retrieved from https://www.udir.no/contentassets/2a429fb8627c4615883bf9d884ebf16d/kortrapport-pisa-2018.pdf

Jomaa, L. H., McDonnell, E., & Probart, C. (2011). School feeding programs in developing countries: impacts on children's health and educational outcomes. *Nutr Rev, 69*(2), 83-98. doi:10.1111/j.1753-4887.2010.00369.x

Juniusdottir, R., Hörnell, A., Gunnarsdottir, I., Lagstrom, H., Waling, M., Olsson, C., . . . Olafsdottir, A. S. (2018). Composition of School Meals in Sweden, Finland, and Iceland: Official Guidelines and Comparison With Practice and Availability. *J Sch Health, 88*(10), 744-753. doi:10.1111/josh.12683

Kainulainen, K., Benn, J., Fjellström, C., & Palojoki, P. (2012). Nordic adolescents' school lunch patterns and their suggestions for making healthy choices at school easier. *Appetite, 59*(1), 53-62. doi:10.1016/j.appet.2012.03.012

Kanoski, S. E., Zhang, Y., Zheng, W., & Davidson, T. L. (2010). The effects of a high-energy diet on hippocampal function and blood-brain barrier integrity in the rat. *J Alzheimers Dis, 21*(1), 207-219. doi:10.3233/jad-2010-091414

Kunnskapsdepartementet. (2006). *Skolemåltidet i grunnskolen : kunnskapsgrunnlag, nytte- og kostnadsvirkninger og vurderinger av ulike skolemåltidsmodeller*. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwic79uKw7zwAhX9AxAIHfPwDBIQFjACegQIFRAD&url=https%3A%2F%2Fwww.regjeringen.no%2Fglobalassets%2Fupload%2Fkilde%2Fkd%2Frap%2F2006%2F0008%2Fddd%2Fpdfv%2F284882-skolemaltid_26.06.06.pdf&usg=AOvVaw2CsnqFH4uH57LmM3Iyyvg7

Kunnskapsdepartementet. (2011). *Meld.St.22. Motivasjon - Mestring - Muligheter*. Retrieved from https://www.regjeringen.no/contentassets/0b74cdf7fb4243a39e249bce0742cb95/no/pdfs/stm201020110022000dddpdfs.pdf

Kunnskapsdepartementet. (2017). *Meld. St. 21 (2016-2017). Lærelyst - tidlig innsats og kvalitet i skolen*. Retrieved from https://www.regjeringen.no/no/dokumenter/meld.-st.-21-20162017/id2544344/

Larson, R. W. (2000). Toward a Psychology of Positive Youth Development. *Am Psychol, 55*(1), 170-183. doi:10.1037/0003-066X.55.1.170

Levin, K. A. (2006). Study design III: Cross-sectional studies. *Evid Based Dent, 7*(1), 24-25. doi:10.1038/sj.ebd.6400375

Lindholm-Leary, K., & Borsato, G. (2006). Academic Achievemnt. In F. Genesee, K. Lindholm-Leary, B. Saunders, & C. Donna (Eds.), *Educating English Language Learners: A Synthesis of Research Evidence* (pp. 176-222).

Lytle, L. A., Kubik, M. Y., Perry, C., Story, M., Birnbaum, A. S., & Murray, D. M. (2006). Influencing healthful food choices in school and home environments: Results from the TEENS study. *Prev Med, 43*(1), 8-13. doi:10.1016/j.ypmed.2006.03.020

Malterud, K. (2017). *Kvalitative forskningsmetoder for medisin og helsefag*. Oslo: Universitetsforlaget.

Martella, R. C., & Marchand-Martella, N. E. (2015). Improving Classroom Behavior Through Effective Instruction: An Illustrative Program Example Using "SRA FLEX Literacy". *Education & Treatment of Children, 38*(2), 241-271. doi:10.1353/etc.2015.0010

McKinney, S. E., Campbell-Whately, G. D., & Kea, C. D. (2005). Managing Student Behavior in Urban Classrooms The Role of Teacher ABC Assessments. *The Clearing house, 79*(1), 16-20. doi:10.3200/TCHS.79.1.16-20

Mhurchu, C. N., Gorton, D., Turley, M., Jiang, Y., Michie, J., Maddison, R., & Hattie, J. (2013). Effects of a free school breakfast programme on children's attendance, academic achievement and short-term hunger: results from a stepped-wedge,

cluster randomised controlled trial. *J Epidemiol Community Health, 67*(3), 257-264. doi:10.1136/jech-2012-201540
Moffat, T., & Gendron, D. (2019). Cooking up the "gastro-citizen" through school meal programs in France and Japan. *Food, culture, & society, 22*(1), 63-77. doi:10.1080/15528014.2018.1547587
Moore, G. F., Murphy, S., Chaplin, K., Lyons, R. A., Atkinson, M., & Moore, L. (2014). Impacts of the Primary School Free Breakfast Initiative on socio-economic inequalities in breakfast consumption among 9–11-year-old schoolchildren in Wales. *Public Health Nutr, 17*(6), 1280-1289. doi:10.1017/S1368980013003133
Morgan, K., & Sonnino, R. (2008). *The school food revolution; Public food and the challenge of sustainable development*. London: Earthscan.
Mozaffarian, D., Afshin, A., Popkin, B. M., Whitsel, L. P., Zakai, N. A., Benowitz, N. L., . . . Krummel, D. A. (2012). Population Approaches to Improve Diet, Physical Activity, and Smoking Habits: A Scientific Statement From the American Heart Association. *Circulation, 126*(12), 1514-1563. doi:10.1161/CIR.0b013e318260a20b
Musti-Rao, S., & Haydon, T. (2011). Strategies to Increase Behavior-Specific Teacher Praise in an Inclusive Environment. *Intervention in school and clinic, 47*(2), 91-97. doi:10.1177/1053451211414187
Müller, K., Libuda, L., Gawehn, N., Drossard, C., Bolzenius, K., Kunz, C., & Kersting, M. (2013). Effects of lunch on children's short-term cognitive functioning: a randomized crossover study. *Eur J Clin Nutr, 67*(2), 185-189. doi:10.1038/ejcn.2012.209
Norwegian Ministry of Health and Care Services. (2013). *NCD-Strategy (2013 – 2017) For the prevention, diagnosis, treatment and rehabilitation of four noncommunicable diseases; cardiovascular disease, diabetes, COPD and cancer*. Retrieved from https://www.regjeringen.no/contentassets/e62aa5018afa4557ac5e9f5e7800891f/ncd_strategy_060913.pdf
Nyaradi, A., Foster, J. K., Hickling, S., Li, J., Ambrosini, G. L., Jacques, A., & Oddy, W. H. (2014). Prospective associations between dietary patterns and cognitive performance during adolescence. *J Child Psychol Psychiatry, 55*(9), 1017-1024. doi:10.1111/jcpp.12209
O'Neil, A., Quirk, S. E., Housden, S., Brennan, S. L., Williams, L. J., Pasco, J. A., . . . Jacka, F. N. (2014). Relationship between diet and mental health in children and adolescents: a systematic review. *Am J Public Health, 104*(10), e31-e42. doi:10.2105/AJPH.2014.302110
Oostindjer, M., Aschemann-Witzel, J., Wang, Q., Skuland, S. E., Egelandsdal, B., Amdam, G. V., . . . Van Kleef, E. (2017). Are school meals a viable and sustainable tool to improve the healthiness and sustainability of children´s diet and food consumption? A cross-national comparative perspective. *Crit Rev Food Sci Nutr, 57*(18), 3942-3958. doi:10.1080/10408398.2016.1197180
Opdenakker, M.-C., Maulana, R., & den Brok, P. (2012). Teacher-student interpersonal relationships and academic motivation within one school year: developmental

changes and linkage. *School effectiveness and school improvement, 23*(1), 95-119. doi:10.1080/09243453.2011.619198
Lov om grunnskolen og den videregåande opplæringa (LOV-1998-07-17-61), (1998).
Patino, C. M., & Ferreira, J. C. (2018). Internal and external validity: can you apply research study results to your patients? *J. bras. pneumol, 44*(3), 183-183. doi:10.1590/s1806-37562018000000164
Payne, L. D., Marks, L. J., & Bogan, B. L. (2007). Using Curriculum-Based Assessment to Address the Academic and Behavioral Deficits of Students With Emotional and Behavioral Disorders. *Beyond behavior, 16*(3), 3-6.
Polit, D. E., & Beck, C. T. (2017). *Study Guide for Essentials of Nursing Research* (Vol. 9th): Lippincot Williams and Wilkins.
Pollet, T. V., Stulp, G., Henzi, S. P., & Barrett, L. (2015). Taking the aggravation out of data aggregation: a conceptual guide to dealing with statistical issues related to the pooling of individual-level observational data. *Am J Primatol, 77*(7), 727-740. doi:10.1002/ajp.22405
Puloka, I., Utter, J., Denny, S., & Fleming, T. (2017). Dietary behaviours and the mental well-being of New Zealand adolescents: Diet and mental health. *Journal of paediatrics and child health, 53*(7), 657-662. doi:10.1111/jpc.13524
Ranita, B., & Santoshi, H. (2020). Parenting style and academic motivation: A critical review. *Indian journal of positive psychology, 11*(3), 172-178.
Raulio, S., Roos, E., & Prättälä, R. (2010). School and workplace meals promote healthy food habits. *Public Health Nutr, 13*(6A), 987-992. doi:10.1017/S1368980010001199
Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemp Educ Psychol, 25*(1), 54-67. doi:10.1006/ceps.1999.1020
Samdal, O., Bye, H. H., Torsheim, T., Birkeland, M. S., Diseth, Å. R., Fismen, A.-S., . . . Wold, B. (2012). Sosial ulikhet i helse og læring blant barn og unge. Resultater fra den landsrepresentative spørreskjemaundersøkelsen "Helsevaner blant skoleelever. En WHO-undersøkelse i flere land". In: HEMIL-senteret, Universitetet i Bergen.
Schröder, M., Müller, K., Falkenstein, M., Stehle, P., Kersting, M., & Libuda, L. (2015). Short-term effects of lunch on children's executive cognitive functioning: The randomized crossover Cognition Intervention Study Dortmund PLUS (CogniDo PLUS). *Physiol Behav, 152*(Pt A), 307-314. doi:10.1016/j.physbeh.2015.09.025
Schwartz, A. E., & Rothbart, M. W. (2020). Let Them Eat Lunch: The Impact of Universal Free Meals on Student Performance. *Journal of policy analysis and management, 39*(2), 376-410. doi:10.1002/pam.22175
Sedgwick, P. (2011). The ecological fallacy. In. [London]: BMJ.
Sedgwick, P. (2014). Cross sectional studies: advantages and disadvantages. *BMJ : British Medical Journal, 348*(mar26 2), g2276-g2276. doi:10.1136/bmj.g2276
Sedgwick, P. (2015). Bias in observational study designs: cross sectional studies. *Bmj, 350*, h1286. doi:10.1136/bmj.h1286

Siebert, C. J. (2005). Promoting Preservice Teachers' Success in Classroom Management by Leveraging a Local Union's Resources: A Professional Development School Initiative. *Education, 125*(3), 385.

Singh, A. S., Saliasi, E., van den Berg, V., Uijtdewilligen, L., de Groot, R. H. M., Jolles, J., . . . Chinapaw, M. J. M. (2019). Effects of physical activity interventions on cognitive and academic performance in children and adolescents: a novel combination of a systematic review and recommendations from an expert panel. *Br J Sports Med, 53*(10), 640-647. doi:10.1136/bjsports-2017-098136

Skaalvik, E. M., & Skaalvik, S. (2005). *Skolen som læringsarena. Selvoppfatning, motivasjon og læring*. Oslo: Universitetsforlaget.

Sooyoun, K., Oksun, K., & Youngmi, L. (2018). Effects of students' satisfaction with school meal programs on school happiness in South Korea. *Nutr Res Pract, 12*(4), 342-347. doi:10.4162/nrp.2018.12.4.342

Staib, M., Bjelland, M., & Lien, N. (2013). Mat og måltider i grunnskolen- En kvantitativ landsdekkende undersøkelse blant kontaktlærere, skoleledere og ansvarlige for kantine/matbod. [Food and meals in primary school; A quantitative national survey amongst teachers, school leaders and those in charge of canteens/food booths]. Retrieved from https://www.helsedirektoratet.no/rapporter/mat-og-maltider-i-skolen-og-skolefritidsordningen-undersokelser

Stea, T. H., & Torstveit, M. K. (2014). Association of lifestyle habits and academic achievement in Norwegian adolescents: a cross-sectional study. *BMC Public Health, 14*(1), 829-829. doi:10.1186/1471-2458-14-829

Storey, H. C., Pearce, J., Ashfield-Watt, P., Wood, L., Baines, E., & Nelson, M. (2011). A randomized controlled trial of the effect of school food and dining room modifications on classroom behaviour in secondary school children. *Eur J Clin Nutr, 65*(1), 32-38. doi:10.1038/ejcn.2010.227

Swinburn, B., Vandevijvere, S., Kraak, V., Sacks, G., Snowdon, W., Hawkes, C., . . . Walker, C. (2013). Monitoring and benchmarking government policies and actions to improve the healthiness of food environments: a proposed Government Healthy Food Environment Policy Index. *Obes Rev, 14*(S1), 24-37. doi:10.1111/obr.12073

Sørensen, L. B., Dyssegaard, C. B., Damsgaard, C. T., Petersen, R. A., Dalskov, S.-M., Hjorth, M. F., . . . Egelund, N. (2015). The effects of Nordic school meals on concentration and school performance in 8- to 11-year-old children in the OPUS School Meal Study: a cluster-randomised, controlled, cross-over trial. *Br J Nutr, 113*(8), 1280-1291. doi:10.1017/S0007114515000033

Taylor, J., Garnett, B., Horton, M. A., & Farineau, G. (2020). Universal Free School Meal Programs in Vermont Show Multi-domain Benefits. *Journal of hunger & environmental nutrition, 15*(6), 753-766. doi:10.1080/19320248.2020.1727807

Tilles-Tirkkonen, T., Pentikäinen, S., Lappi, J., Karhunen, L., Poutanen, K., & Mykkänen, H. (2011). The quality of school lunch consumed reflects overall eating patterns in 11–16-year-old schoolchildren in Finland. *Public Health Nutr, 14*(12), 2092-2098. doi:10.1017/S1368980011001388

Topland, B., & Skaalvik, E. M. (2010). *Meninger fra klasserommet. Analyse av Elevundersøkelsen 2010*. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwihjeSCo8HwAhVXAhAIHXHFDoAQFjAAegQIAhAD&url=https%3A%2F%2Fwww.udir.no%2Fglobalassets%2Fupload%2Fforskning%2F2010%2F5%2Felevundersokelsen_2010_analyse.pdf&usg=AOvVaw0ysXI36L7G3GxOBwXO4iYk

Torheim, L. E., Løvhaug, A. L., Huseby, C. S., Terragni, L., Henjum, S., & Roos, G. (2020). *Sunnere matomgivelser i Norge. Vurdering av gjeldende politikk og anbefalinger for videre innsats. Food-EPI 2020.* . Retrieved from Oslo:

United Nations Standing Committee on Nutrition. (2017). *Schools as a system to improve nutrition; A new statement for school-based food and nutrition interventions*. Retrieved from https://www.unscn.org/uploads/web/news/document/School-Paper-EN-WEB-nov2017.pdf

Vedel, A. (2014). The Big Five and tertiary academic performance: A systematic review and meta-analysis. *Personality and individual differences, 71*, 66-76. doi:10.1016/j.paid.2014.07.011

Vik, F. N., Van Lippevelde, W., & Øverby, N. C. (2019). Free school meals as an approach to reduce health inequalities among 10-12- year-old Norwegian children. doi:https://doi.org/10.1186/s12889-019-7286-z

Waling, M., Olafsdottir, A. S., Lagström, H., Wergedahl, H., Jonsson, B., Olsson, C., . . . Hörnell, A. (2016). School meal provision, health, and cognitive function in a Nordic setting - the ProMeal-study: description of methodology and the Nordic context. *Food & nutrition research, 60*(1), 30468-30468. doi:10.3402/fnr.v60.30468

Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest, 158*(1s), S65-s71. doi:10.1016/j.chest.2020.03.012

Wendelborg, C. (2021). *Analyser av indekser på skoleporten. Analyser på fylkes- og nasjonalt nivå for 7. trinn, 10. trinn og Vg1*. Retrieved from https://www.udir.no/globalassets/filer/tall-og-forskning/rapporter/2021/analyser-av-indekser-pa-skoleporten-2020.pdf

Westling, D. L. (2010). Teachers and Challenging Behavior: Knowledge, Views, and Practices. *Remedial and special education, 31*(1), 48-63. doi:10.1177/0741932508327466

Wigfield, A., & Wentzel, K. R. (2010). *Handbook of motivation at school* (Vol. 25). Portland: Portland: Ringgold, Inc.

Yujeong, K., & Hyeja, C. (2011). Correlation between attention deficit hyperactivity disorder and sugar consumption, quality of diet, and dietary behavior in school children. *Nutr Res Pract, 5*(3), 236-245. doi:10.4162/nrp.2011.5.3.236

Emil Skarpeid Borø

Besøksadresse:
Universitetsveien 25
Kristiansand

Ref: [object Object]

Tidspunkt for godkjenning: : 17/11/2020

Søknad om etisk godkjenning av forskningsprosjekt - Skolemat, trivsel og prestasjon i skolen

Vi informerer om at din søknad er ferdig behandlet og godkjent.

Kommentar fra godkjenner:
Søknaden godkjennes under forutsetning av at prosjektet gjennomføres som beskrevet i søknaden.

Hilsen
Forskningsetisk komite
Fakultet for helse - og idrettsvitenskap
Universitetet i Agder

The Association Between School Meal Offers and Well-being, Learning Culture, Motivation, and School Performance among Norwegian Secondary School Pupils

Emil S. Borø, Elling Bere

Department of Public Health, Sport and Nutrition, Faculty of Health and Sport Sciences, University of Agder,
Kristiansand, Norway

Corresponding author:

Elling Bere

University of Agder

Faculty of Health and Sport Science PO. Box 422

4604 Kristiansand, Norway

Tel: + 47 980 17 067

E-mail: elling.bere@uia.no

Following SJP guidelines

https://journals.sagepub.com/home/sjp

ABSTRACT

Background

While the relationship between diet and nutrition, and school performance has been explored in several studies, there is a lacking number of studies addressing the effect of organized school meals on pupils' school performance and social health factors. Thus, the aim of this study is to examine the association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils.

Methods

The cross-sectional analyses of the present study are founded on data from a larger survey conducted by the Norwegian Institute of Public Health, and data from the survey *Elevundersøkelsen* carried out by the Norwegian Directorate of Education. Data from a total of 817 Norwegian secondary schools were included. Analysis of variance test was used to examine the association between the serving of school meals and pupils' well-being, learning culture, motivation, and school performance.

Results

Results showed no association between the availability of school meals and higher scores of either well-being, learning culture, motivation, or school performance.

Conclusion

The present study found no association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils. Further studies are needed to confirm the possible association.

Keywords:

School meals, well-being, learning culture, motivation, school performance.

Wordcount: 2869

INTRODUCTION

School meal policies is a trending subject of debate on the political agenda. There is a seemingly broad agreement among politicians that the serving of school meals can promote good health and learning, and some claim it can increase pupils' well-being and better the school environment. In Norway most children bring a packed lunch from home which generally consist of cold bread and occasionally greens and milk (1). A parent-paid school fruit- and milk scheme are in place nationally and is offered to first to tenth grade children (2). However, there are some local school meal arrangements in Norway, which is either subsidized by the municipalities and/or parent paid (3). The traditional packed lunch has led to concerns about children eating unhealthy packed lunch (4). Not all pupils consume the packed lunch but instead buy snacks or sweets from nearby stores. Therefore, serving of healthy school meals can potentially better pupils diet and the social environment at school (5).

Childhood and adolescence are important periods of growth and development of social abilities, and a balanced diet is essential in this regard (6). Between one-third to one-half of adolescent's meals are consumed at school (7), therefore, school is regarded as a promising arena for promoting healthy eating strategies and dietary habits (Mikkelsen, 2014). The interest of school-based nutritional interventions is rapidly growing. A report from Oslo Metropolitan University emphasizes the importance of public policy making, and the offering of daily school meals is among the top recommended actions (8).

As of today, the number of intervention studies addressing the effect of free school meals are limited (9). However, studies from Finland indicates an association between free school meals and healthier food habits at school and the remaining time of day (10, 11). A significant association between eating breakfast at school and increased academic achievement has been shown for American elementary school pupils (12). Results from a randomized intervention study among American adolescents indicated that eating breakfast at school could positively effect students grade point averages (13). Further, a randomized controlled trial among Danish children mapping the effects of serving healthy school meals on concentration and school performance, found a significant improvement in reading (14)

A systematic review highlights the relationship between dietary patterns and -quality, and adolescents' mental health (15). Results from a longitudinal study found a high-quality diet to serve as a protective factor for adolescent's positive well-being (16). Moreover, a study among New Zealand adolescents reported a significant association between healthy eating and higher well-being, with an equal association between unhealthy eating and decrease of well-being (17).

Higher levels of classroom order have been found to increase students learning and academic growth (18). Adolphus et al. (19) suggests that breakfast has a positive effect on on-task behavior in the classroom. "An improvement in classroom behavior has the potential to reduce disruption and produce a more productive learning environment". A systematic review addressed a moderate association between dietary intake, with breakfast consumption as a main factor, and higher academic achievement (20). Findings from a literature review showed that skipping breakfast has a negative effect on both children and adolescent's academic

achievement by adversely affecting cognition and school absent (21). Further, a Norwegian study showed an association between both healthy eating and regular meal patterns, and increased odds of improved academic achievement in adolescents (22).

AIM

While the relationship between diet and nutrition, and school performance has been explored in several studies, there is a lacking number of studies addressing the effect of organized school meals on pupil's school performance and social health factors. Thus, the aim of this study is to examine the association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils.

METHODS

STUDY DESIGN AND SAMPLE

The present cross-sectional analyses, aggregated on schools, are based upon a larger survey conducted by the Norwegian Institute of Public Health (NIPH). This survey aimed to map out the offering of school meals in the school year of 2019/20 in Norwegian middle schools. The study sample was based upon records from *Grunnskolens Informasjonssystem* (GSI) by the Norwegian Directorate of Education (NDE). From a total of 1043 schools, 58 schools did not match the credentials of the study, by no longer having secondary school levels or being special education schools, and an additional 15 schools did not wish to participate, leaving the potential sample to 970 schools. In January 2020, the schools received an online questionnaire developed by NIPH. Nonresponding schools were contacted by phone. Data collection was delayed due to Covid-19 and the closing of Norwegian schools, and therefore did not end before September 2020. In total 817 schools participated in the survey, leaving the response rate at 84 %. All counties were well represented.

Data on pupils' perceived well-being, learning culture, motivation and school performance were retrieved from *Elevundersøkelsen*, an annual school survey conducted on behalf of NDE. Survey results are presented as school-level data and was retrieved from www.skoleporten.udir.no. The survey sample consist of 10th grade respondents. The aim of *Elevundersøkelsen* is to facilitate the improvement of schools by letting pupils share their opinion on factors of learning (motivation, well-being, participation, etc.). Pupils fill out an anonymous online questionnaire, and answers are utilized by schools, municipalities, and state to improve the schools. A total of 56 008 10th grade pupils respondent to the survey in 2020, which equals a 88.9 % response rate (23). Data from a total of 1150 Norwegian

primary and secondary schools were initially drawn from *Elevundersøkelsen* and was then matched by school's organization number with the NIPH survey data. A total of 333 schools were excluded to match the 817 participant schools from the NIPH survey.

MEASURES

Measures from the NIPH survey are based on an online questionnaire.

Participant schools were asked if they offered schools meals, with response alternatives 1) Yes, 2) No, but the school has a cafeteria where pupils can buy food, and 3) No. Alternative 2 and 3 were merged prior to statistical analyses.

School size was split into four groups based on the number of pupils: < 30 = Very small, 30 – 99 = Small, 100 – 299 = Medium-sized, and > 300 = Large.

Measures from *Elevundersøkelsen* are based on a self-reporting questionnaire. Participants could choose only one response alternative per measure. School level scores were calculated by adding pupils' response scores and dividing by the total number of responses given. A higher score is to be interpreted as a higher level of the investigated measure (23).

Well-being was measured by asking pupils how they like being at school. Response alternatives were: 1) Do not thrive at all, 2) Do not thrive much, 3) Thrives some, 4) Thrives well, and 5) Thrives a lot.

Information on pupils' motivation was assessed trough the statement: I am looking forward to going to school. Response alternatives ranging from 1) completely disagree, 2) slightly disagree, 3) neither agree nor disagree, 4) slightly agree, and 5) completely agree.

Learning culture was measured by the response of the statement: The order in class is high. Response alternatives were 1) completely disagree, 2) slightly disagree, 3) neither agree nor disagree, 4) slightly agree, and 5) completely agree.

School performance, as measured by grade point averages were calculated by adding concluding grades and dividing by the total number of grades. The number is then multiplied by ten to get the primary school credit, which can vary from 10.0 to 60.0.

STATISTIC ANALYSES

IBM SPSs version 25 were used for data analyses. Analysis of variance (ANOVA) test was conducted to identify differences in well-being, learning culture, motivation and school performance among pupils offered school meals compared to those not offered school meals (table 2). Further, the ANOVA test was used to show differences in well-being, learning culture, motivation, and school performance between school with and without the offer of school meals, based on school size; very small, small, medium-sized, and large (table 3), and based on county (table 4).

ETHICS

The Norwegian Institute of Public Health holds legal responsibility for data collected through their survey. Data from *Elevundersøkelsen* is available to the public through open web portals at www.skoleporten.udir.no. Ethical approval for the present study was obtained from the Faculty Ethical Committee at the University of Agder.

FINDINGS AND RESULTS

The total sample included 817 participant schools, of which 133 (16%) reported to offer school meals and 684 (83%) reported not to. Very small schools (24%) were over ten percentage points more likely to offer schools meals then medium-sized (13%) and large (13%) schools. The counties of Nordland (27%), Trøndelag (27%) and Vestfold og Telemark (25%) had the highest rate of secondary schools offering schools meals, regardless of school size.

The mean score for pupils' well-being was measured to 4.1 ± 0.2 a-cross all participant schools. Further, the mean score for pupils' learning culture was measured to 3.6 ± 0.3 and 3.3 ± 0.3 for pupils' motivation. Pupils' mean grade point averages was measured to 42.9 ± 2.3 (table 1).

No significant statistical difference in measured well-being (4.0 vs 4.1, p=.10), learning culture (3.6 vs 3.6, p=.95), motivation (3.3 vs 3.3, p=.34) or grade point averages (42.9 vs 42.9, p=.95) was observed between pupils with and without the offer of school meals (table 2).

There was no significant statistical difference in pupils' observed well-being, learning culture, motivation or grade point averages between schools that offered school meals or not, distributed on school size (p>.05 for all) (table 3).

Pupils in the county of Nordland who were not offered school meals reported a higher level of well-being (4.1 vs 3.8, p<.0001) and motivation (3.4 vs 3.0, p<.0001) compared to those who were offered school meals. Data from the county of Troms og Finmark showed that pupils who were offered school meals reported a lower score of learning culture (3.0 vs 3.7, p=0.02) compared to pupils without the offer. Pupils mean grade point averages were higher (43.2 vs 41.9, p=.02) at schools with the offer of school meals compared to those without the offer in Vestfold og Telemark county. No other significant statistical differences between groups distributed on geographical affiliation was reported (table 4).

DISCUSSION OF THE RESULTS

This cross-sectional study examined the school level association between the serving of school meals and Norwegian secondary school pupils' school performance and self-reported well-being, learning culture, and motivation. Results showed in general no association between the availability of school meals and higher scores of either well-being, learning culture, motivation, or school performance, however a very few significant associations were seen within some counties.

WELL-BEING

The serving of school meals was not associated with higher levels of pupils' well-being in the present study. There is to our knowledge few studies addressing the association between the serving of school meals and pupils' well-being. Still, Sooyoun et al. (24) investigated the relationship between pupils' school meal satisfaction and pupils' happiness. Although there was no significant relationship between overall meal satisfaction and overall happiness, overall meal satisfaction was found to have a significant influence on pupils' school happiness (24).

LEARNING CULTURE

In the present study, the serving of school meals was not associated with classroom order, referred to as learning culture. These findings are in line with the results of a previous cluster-randomized controlled trial which showed no effect on improving pupils' cognition after

being served a free school meal for 12 months (25) Further, a randomized crossover study found no difference in pupils' short-term cognitive functioning between days of eating lunch at school and days of skipping lunch (26).

Oppositely, results from a systematic review by Hoyland et al. (27) indicates that breakfast consumption has positive effects in school-aged children´s cognitive performance in comparison with breakfast omission. The authors do however argue that the effect of school breakfast programs may be linked to reduced absenteeism (27). Further, Golley at al. (28) conducted a randomized controlled trial and found a significant improvement in productive classroom interactions, were pupils attending intervention schools were 3.4 times (CI: 1.56-7.36) more likely to be "on-task" than controls in the post-lunchtime period. Moreover, Storey et al. (29) carried out a randomized controlled trial, which showed positive evidence of the benefits of modifying pupils' school food and -eating environments on learning-related behaviors. Schröder et al. (30) studied the effect of lunch on pupils' executive functions. The results indicates that pupils' executive function is not impaired after eating lunch (30).

A possible explanation of the divergent results may be the nutritional quality of the meals eaten, as intake of refined carbohydrates and saturated fatty acids has been related to reduced cognitive performance in adolescent (31, 32). Studies on animals shows these nutrients interfere with synaptic plasticity and neurogenesis in the hippocampus and the medial prefrontal cortex, preventing memory- and learning processes (33, 34).

MOTIVATION

No association between the serving of school meals and the levels of pupils' academic motivation was revealed in this study. Other studies address the possible factors which influence pupils' academic motivation. Ranita and Santoshi (35) reviewed the influence of parenting styles on school children's academic motivation. The authors found different parenting styles to be an important contributor to academic motivation in both a positive and negative manner (35). Further, Opdenakker et al. (36) found the teacher-student interpersonal relationships to be a significant predictor of academic motivation. Gillen-O`Neel & Fuligni (37) examined how school belonging is associated with academic engagement. The researchers highlight the importance of school belonging for maintaining pupils' engagement at school (37). Still, there is to our knowledge a lack of studies investigating the direct association between the serving of school meals and pupil's academic motivation.

SCHOOL PERFORMANCE

No association between the serving of school meals and pupils' school performance was found in this study. Previous observational studies demonstrate an association between both healthy and regular eating, and increased school performance among pupils (38, 39) Still, studies examining the direct link between school meals and pupil's school performance is less conclusive. A systematic review conducted by Jomaa et al. (40) found school feeding programs in developing countries to have a positive effect on pupils arithmetic scores, but the effect was inconclusive for reading, writing, and spelling tests. The shift from traditional to

healthier school meals has been shown to have a modest positive effect on American primary and secondary school pupils' academic performance (41). Imberman & Kugler (42) suggests that pupils at wealthier school tend to eat breakfast more regularly and have higher test scores than pupils at poorer schools with lower levels of breakfast consumption, independent of learning. A recent longitudinal study points to a positive effect of universal free school meals on test scores of secondary school pupils (43).

However, results from a one year stepped-wedge, cluster randomized controlled trail among pupils from New Zealand found no significant effect of school breakfast programs on the participants academic achievement (44). Further, a study on the effect of eating breakfast in the classroom found no evidence for increased academic performance among pupils (45).

STRENGTHS AND LIMITATIONS OF THE STUDY

Several methodological limitations of this study should be acknowledged. The main limitation is the study's cross-sectional design, and the aggregate data which it is based upon. This prevents us from making inference regarding causality (46). Thus, one could not have made assumptions whether the serving of school meals lead to higher levels of pupils' well-being, learning culture, motivation, or school performance, or if lower scores of the factors mentioned induce schools to serve food to their pupils. Second, the data drawn from the survey conducted by NIPH does not display the variety of school meal offers. It is not taken into consideration whether school meals are free for all or parent paid, served warm or cold, served as breakfast or lunch, or how many days per week it is served. Further, data on pupils' well-being, learning culture, and motivation is based upon self-reported measures which could have led to recall bias (46). The dearth of objective data might also have led to socially

desirable responding (47). Thirdly, a common bias in cross-sectional studies is selection bias (48). One could argue that non meal serving schools might not have responded to the survey at all, which could have affected the results of this study.

However, the present study is strengthened by a large sample size from the NIPH survey, and the very high participation rate. With the inclusion of all public Norwegian secondary schools and a high participation rate, the possibility of selection bias is greatly reduced. Furthermore, data from the survey *Elevundersøkelsen* is based upon pupils' self-reported answers, which limits the possibility of interviewer bias. This could have been a limitation had the questionnaire been filled out by the pupils' teachers or parents. The survey is compulsory for schools to conduct, resulting in a high participation rate. Further, data on pupils' grade point averages from *Elevundersøkelsen* are drawn from public register, which strengthens its objectivity.

CONCLUSION

The present study found no association between the serving of school meals in Norwegian secondary schools and well-being, learning culture, motivation, and school performance among its pupils. However, the study holds several methodical limitations, and the results should be interpretated with precaution. Further well-designed studies are needed confirm the possible association.

360

REFERANCES

1. Hansen LB, Myhre JM, Johansen AMW, Paulsen MM, Andersen LF. Ungkost 3. https://www.fhi.no/studier/nasjonale-kostholdsundersokelser/kosthold-blant-9--og-13-aringer-i-norge/; 2016.

2. Dahl T, Jensberg H. Kost i skole og barnehage og betydningen for helse og læring: En kunnskapsoversikt. København: København: Nordisk ministerråd; 2011.

3. Haugset A, Nossum G. School meal in Nord-Trondelag. Mapping of food serving in schools. 2012.

4. Kainulainen K, Benn J, Fjellström C, Palojoki P. Nordic adolescents' school lunch patterns and their suggestions for making healthy choices at school easier. Appetite. 2012;59(1):53-62.

5. Lytle LA, Kubik MY, Perry C, Story M, Birnbaum AS, Murray DM. Influencing healthful food choices in school and home environments: Results from the TEENS study. Prev Med. 2006;43(1):8-13.

6. Yujeong K, Hyeja C. Correlation between attention deficit hyperactivity disorder and sugar consumption, quality of diet, and dietary behavior in school children. Nutr Res Pract. 2011;5(3):236-45.

7. Mozaffarian D, Afshin A, Popkin BM, Whitsel LP, Zakai NA, Benowitz NL, et al. Population Approaches to Improve Diet, Physical Activity, and Smoking Habits: A Scientific Statement From the American Heart Association. Circulation. 2012;126(12):1514-63.

8. Torheim LE, Løvhaug AL, Huseby CS, Terragni L, Henjum S, Roos G. Sunnere matomgivelser i Norge. Vurdering av gjeldende politikk og anbefalinger for videre innsats. Food-EPI 2020. . Oslo; 2020.

9. Bere E, Stea TH. Editorial: School food provided for free. Scandinavian Journal of Public Health. 2017;45(1):1-2.

10. Raulio S, Roos E, Prättälä R. School and workplace meals promote healthy food habits. Public Health Nutr. 2010;13(6A):987-92.
11. Tilles-Tirkkonen T, Pentikäinen S, Lappi J, Karhunen L, Poutanen K, Mykkänen H. The quality of school lunch consumed reflects overall eating patterns in 11–16-year-old schoolchildren in Finland. Public Health Nutr. 2011;14(12):2092-8.
12. Frisvold DE. Nutrition and cognitive achievement: An evaluation of the School Breakfast Program. J Public Econ. 2015;124:91-104.
13. Hearst MO, Jimbo-Llapa F, Grannon K, Wang Q, Nanney MS, Caspi CE. Breakfast Is Brain Food? The Effect on Grade Point Average of a Rural Group Randomized Program to Promote School Breakfast. J Sch Health. 2019;89(9):715-21.
14. Sørensen LB, Dyssegaard CB, Damsgaard CT, Petersen RA, Dalskov S-M, Hjorth MF, et al. The effects of Nordic school meals on concentration and school performance in 8- to 11-year-old children in the OPUS School Meal Study: a cluster-randomised, controlled, cross-over trial. Br J Nutr. 2015;113(8):1280-91.
15. O'Neil A, Quirk SE, Housden S, Brennan SL, Williams LJ, Pasco JA, et al. Relationship between diet and mental health in children and adolescents: a systematic review. Am J Public Health. 2014;104(10):e31-e42.
16. Esteban-Gonzalo L, Turner AI, Torres SJ, Esteban-Cornejo I, Castro-Piñero J, Delgado-Alfonso Á, et al. Diet quality and well-being in children and adolescents: the UP&DOWN longitudinal study. Br J Nutr. 2019;121(2):221-31.
17. Puloka I, Utter J, Denny S, Fleming T. Dietary behaviours and the mental well-being of New Zealand adolescents: Diet and mental health. Journal of paediatrics and child health. 2017;53(7):657-62.

18. Gaskins CS, Herres J, Kobak R. Classroom order and student learning in late elementary school: A multilevel transactional model of achievement trajectories. Journal of applied developmental psychology. 2012;33(5):227-35.
19. Adolphus K, Lawton CL, Dye L. The effects of breakfast on behavior and academic performance in children and adolescents. Front Hum Neurosci. 2013;7:425-.
20. Burrows T, Goldman S, Pursey K, Lim R. Is there an association between dietary intake and academic achievement: a systematic review. J Hum Nutr Diet. 2017;30(2):117-40.
21. Basch CE. Breakfast and the Achievement Gap Among Urban Minority Youth. J Sch Health. 2011;81(10):635-40.
22. Stea TH, Torstveit MK. Association of lifestyle habits and academic achievement in Norwegian adolescents: a cross-sectional study. BMC Public Health. 2014;14(1):829-.
23. Wendelborg C. Analyser av indekser på skoleporten. Analyser på fylkes- og nasjonalt nivå for 7. trinn, 10. trinn og Vg1. 2021.
24. Sooyoun K, Oksun K, Youngmi L. Effects of students' satisfaction with school meal programs on school happiness in South Korea. Nutr Res Pract. 2018;12(4):342-7.
25. Moore GF, Murphy S, Chaplin K, Lyons RA, Atkinson M, Moore L. Impacts of the Primary School Free Breakfast Initiative on socio-economic inequalities in breakfast consumption among 9–11-year-old schoolchildren in Wales. Public Health Nutr. 2014;17(6):1280-9.
26. Müller K, Libuda L, Gawehn N, Drossard C, Bolzenius K, Kunz C, et al. Effects of lunch on children's short-term cognitive functioning: a randomized crossover study. Eur J Clin Nutr. 2013;67(2):185-9.
27. Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. Nutr Res Rev. 2009;22(2):220-43.

28. Golley R, Baines E, Bassett P, Wood L, Pearce J, Nelson M. School lunch and learning behaviour in primary schools: an intervention study. Eur J Clin Nutr. 2010;64(11):1280-8.

29. Storey HC, Pearce J, Ashfield-Watt P, Wood L, Baines E, Nelson M. A randomized controlled trial of the effect of school food and dining room modifications on classroom behaviour in secondary school children. Eur J Clin Nutr. 2011;65(1):32-8.

30. Schröder M, Müller K, Falkenstein M, Stehle P, Kersting M, Libuda L. Short-term effects of lunch on children's executive cognitive functioning: The randomized crossover Cognition Intervention Study Dortmund PLUS (CogniDo PLUS). Physiol Behav. 2015;152(Pt A):307-14.

31. Nyaradi A, Foster JK, Hickling S, Li J, Ambrosini GL, Jacques A, et al. Prospective associations between dietary patterns and cognitive performance during adolescence. J Child Psychol Psychiatry. 2014;55(9):1017-24.

32. Howard AL, Robinson M, Smith GJ, Ambrosini GL, Piek JP, Oddy WH. ADHD Is Associated With a “Western” Dietary Pattern in Adolescents. J Atten Disord. 2011;15(5):403-11.

33. Davidson TL, Chan K, Jarrard LE, Kanoski SE, Clegg DJ, Benoit SC. Contributions of the hippocampus and medial prefrontal cortex to energy and body weight regulation. Hippocampus. 2009;19(3):235-52.

34. Kanoski SE, Zhang Y, Zheng W, Davidson TL. The effects of a high-energy diet on hippocampal function and blood-brain barrier integrity in the rat. J Alzheimers Dis. 2010;21(1):207-19.

35. Ranita B, Santoshi H. Parenting style and academic motivation: A critical review. Indian journal of positive psychology. 2020;11(3):172-8.

458 36. Opdenakker M-C, Maulana R, den Brok P. Teacher-student interpersonal relationships
459 and academic motivation within one school year: developmental changes and linkage. School
460 effectiveness and school improvement. 2012;23(1):95-119.
461 37. Gillen-O'Neel C, Fuligni A. A Longitudinal Study of School Belonging and Academic
462 Motivation Across High School. Child Dev. 2013;84(2):678-92.
463 38. Faught EL, Gleddie D, Storey KE, Davison CM, Veugelers PJ. Healthy lifestyle
464 behaviours are positively and independently associated with academic achievement: An
465 analysis of self-reported data from a nationally representative sample of Canadian early
466 adolescents. PLoS One. 2017;12(7):e0181938-e.
467 39. Correa-Burrows P, Burrows R, Orellana Y, Ivanovic D. The relationship between
468 unhealthy snacking at school and academic outcomes: a population study in Chilean
469 schoolchildren. Public Health Nutr. 2015;18(11):2022-30.
470 40. Jomaa LH, McDonnell E, Probart C. School feeding programs in developing
471 countries: impacts on children's health and educational outcomes. Nutr Rev. 2011;69(2):83-
472 98.
473 41. Anderson ML, Gallagher J, Ramirez Ritchie E. School meal quality and academic
474 performance. Journal of public economics. 2018;168:81-93.
475 42. Imberman SA, Kugler AD. The Effect of Providing Breakfast in Class on Student
476 Performance: The Effect of Providing Breakfast in Class. Journal of policy analysis and
477 management. 2014;33(3):669-99.
478 43. Schwartz AE, Rothbart MW. Let Them Eat Lunch: The Impact of Universal Free
479 Meals on Student Performance. Journal of policy analysis and management. 2020;39(2):376-
480 410.
481 44. Mhurchu CN, Gorton D, Turley M, Jiang Y, Michie J, Maddison R, et al. Effects of a
482 free school breakfast programme on children's attendance, academic achievement and short-

term hunger: results from a stepped-wedge, cluster randomised controlled trial. J Epidemiol Community Health. 2013;67(3):257-64.

45. Corcoran SP, Elbel B, Schwartz AE. The Effect of Breakfast in the Classroom on Obesity and Academic Performance: Evidence from New York City. J Policy Anal Manage. 2016;35(3):509-32.

46. Wang X, Cheng Z. Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. Chest. 2020;158(1s):S65-s71.

47. Polit DE, Beck CT. Study Guide for Essentials of Nursing Research: Lippincot Williams and Wilkins; 2017.

48. Sedgwick P. Bias in observational study designs: cross sectional studies. Bmj. 2015;350:h1286.

APPENDIX

Table I. Characteristics of participating schools, in total, and by size and geographical affiliation.

	Schools, N (%)	**School meal offer** (%)	**Well-being** Mean ± SD	**Learning culture** Mean ± SD	**Motivation** Mean. ± SD	**GPA** Mean ± SD
Total	817 (100)	133 (16.3)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.3
School size						
Very Small	125 (15.5)	30 (24.0)	3.9 ± 0.4	3.5 ± 0.5	3.2 ± 0.5	44.3 ± 2.7
Small	175 (21.7)	32 (18.3)	3.9 ± 0.4	3.6 ± 0.5	3.2 ± 0.4	42.7 ± 2.9
Medium-sized	294 (36.4)	39 (13.3)	4.1 ± 0.2	3.6 ± 0.4	3.3 ± 0.2	42.4 ± 1.8
Large	213 (26.4)	29 (13.6)	4.1 ± 0.1	3.6 ± 0.3	3.4 ± 0.2	43.3 ± 2.0
County						
Agder	53 (100)	5 (9.4)	4.0 ± 0.3	3.5 ± 0.4	3.2 ± 0.3	42.4 ±1.8
Innlandet	62 (100)	9 (14.5)	4.2 ± 0.2	3.7 ± 0.3	3.5 ± 0.2	43.1 ± 1.7
Møre og Romsdal	51 (100)	6 (11.8)	4.1 ± 0.2	3.6 ± 0.3	3.2 ± 0.3	43.2 ± 2.2
Nordland	83 (100)	23 (27.7)	4.0 ± 0.2	3.6 ± 0.4	3.3 ± 0.3	42.9 ± 2.4
Oslo	42 (100)	5 (11.9)	4.2 ± 0.1	3.5 ± 0.2	3.4 ± 0.2	43.4 ± 3.7
Rogaland	73 (100)	8 (11.0)	4.0 ± 0.3	3.6 ± 0.3	3.1 ± 0.3	42.4 ± 1.9
Troms og Finnmark	66 (100)	9 (13.6)	3.9 ± 0.3	3.6 ± 0.4	3.1 ± 0.3	42.4 ± 2.5
Trøndelag	73 (100)	20 (27.4)	4.0 ± 0.2	3.5 ± 0.4	3.3 ± 0.3	42.4 ± 2.5
Vestfold og Telemark	58 (100)	15 (25.9)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.2	42.2 ± 1.7
Vestlandet	106 (100)	15 (14.2)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	43.1 ± 2.3
Viken	148 (100)	18 (12.2)	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	43. 3 ± 2.1

GPA = Grade point averages
SD = Standard Deviation

Table II. Observed mean of learning factors, distributed by schools with and without school meal offerings.

	Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
All schools	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.3
School meal offer	4.0 ± 0.3	3.6 ± 0.3	3.3 ± 0.3	42.9 ± 2.4
No school meal offer	4.1 ± 0.2 (.10)	3.6 ± 0.3 (.95)	3.3 ± 0.3 (0.34)	42.9 ± 2.2 (.95)

GPA = Grade point averages
SD = Standard Deviation
p = P-value,
P-value based upon ANOVA test

512

Table III.
Observed mean of learnings factors in schools with and without school meals, distributed by size.

		Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
Very small	School meals	3.9 ± 0.3	3.6 ± 0.3	3.1 ± 0.5	44.3 ± 2.2
	No School meals	4.0 ± 0.4 (.56)	3.5 ± 0.5 (.92)	3.2 ± 0.5 (.62)	44.3 ± 2.9 (.99)
Small	School meals	3.9 ± 0.4	3.6 ± 0.5	3.2 ± 0.4	42.3 ± 3.3
	No School meals	4.0 ± 0.3 (.35)	3.6 ± 0.5 (.55)	3.2 ± 0.4 (.95)	42.8 ± 2.8 (.40)
Medium-sized	School meals	4.1 ± 0.2	3.6 ± 0.3	3.3 ± 0.2	42.4 ± 1.8
	No School meals	4.1 ± 0.2 (.68)	3.6 ± 0.3 (.87)	3.3 ± 0.2 (.21)	42.4 ± 1.8 (.93)
Large	School meals	4.1 ± 0.2	3.6 ± 0.3	3.4 ± 0.2	43.3 ± 1.9
	No School meals	4.1 ± 0.1 (.81)	3.6 ± 0.2 (.48)	3.4 ± 0.2 (.73)	43.3 ± 2.1 (.94)

GPA = Grade point averages
SD = Standard Deviation,
p = P-value,
P-value based upon ANOVA test

513

514

515

Table IV. Observed mean of learnings factors in schools with and without school meals, divided by geographical affiliation.

		Well-being ± SD (p)	**Learning culture** ± SD (p)	**Motivation** ± SD (p)	**GPA** ± SD (p)
Agder	School meal	3.8 ± 0.6	3.5 ± 0.3	3.1 ± 0.3	43.0 ± 1.8
	No school meal	4.0 ± 0.3 (.13)	3.5 ± 0.4 (.97)	3.2 ± 0.3 (.22)	42.3 ± 1.8 (.45)
Innlandet	School meal	4.2 ± 0.2	3.6 ± 0.2	3.5 ± 0.3	42.2 ± 1.7
	No school meal	4.2 ± 0.2 (.80)	3.7 ± 0.4 (.47)	3.6 ± 0.2 (.56)	43.3 ± 1.7 (.15)
Møre og Romsdal	School meal	4.0 ± 0.2	3.5 ± 0.2	3.3 ± 0.1	42.5 ± 0.8
	No school meal	4.0 ± 0.2 (.52)	3.7 ± 0.3 (.29)	3.3 ± 0.3 (.99)	43.3 ± 2.3 (.48)
Nordland	School meal	3.8 ± 0.2	3.6 ± 0.6	3.0 ± 0.2	42.7 ± 1.6
	No School meal	4.1 ± 0.2 **(.00)**	3.7 ± 0.4 (.80)	3.4 ± 0.3 **(.00)**	42.9 ± 2.6 (.75)
Oslo	School meal	4.3 ± 0.1	3.1 ± 0.3	3.4 ± 0.1	42.5 ± 6.9
	No school meal	4.2 ± 0.1 (.09)	3.5 ± 0.2 (.15)	3.5 ± 0.2 (.83)	43.5 ± 3.2 (.55)
Rogaland	School meal	3.9 ± 0.3	3.7 ± 0.2	3.1 ± 0.4	43.8 ± 1.9
	No School meal	4.0 ± 0.3 (.26)	3.6 ± 0.3 (.58)	3.2 ± 0.3 (.75)	42.3 ± 1.9 (.07)
Troms og Finnmark	School meal	3.8 ± 0.4	3.0 ± 0.1	3.1 ± 0.5	41.5 ± 4.4
	No School meal	3.9 ± 0.3 (.47)	3.7 ± 0.4 **(.02)**	3.2 ± 0.3 (.75)	42.3 ± 1.9 (.55)
Trøndelag	School meal	4.0 ± 0.3	3.6 ± 0.4	3.4 ± 0.3	42.5 ± 2.6
	No school meal	4.0 ± 0.2 (.70)	3.4 ± 0.4 (.12)	3.3 ± 0.3 (.54)	42.4 ± 2.4 (.98)
Vestfold og Telemark	School meal	4.1 ± 0.3	3.7 ± 0.4	3.4 ± 0.3	43.2 ± 1.5
	No school meal	4.0 ± 0.2 (.44)	3.6 ± 0.3 (.30)	3.3 ± 0.2 (.34)	41.9 ± 1.7 **(.02)**
Vestlandet	School meal	4.1 ± 0.2	3.6 ± 0.4	3.3 ± 0.4	43.9 ± 1.8
	No School meal	4.1 ± 0.3 (.72)	3.6 ± 0.3 (.80)	3.3 ± 0.3 (.98)	43.0 ± 2.3 (.23)
Viken	School meal	4.1 ± 0.1	3.5 ± 0.3	3.3 ± 0.1	42.8 ± 1.9
	No School meal	4.1 ± 0.2 (.97)	3.6 ± 0.3 (.59)	3.3 ± 0.2 (.59)	43.3 ± 2.1 (.35)

GPA = Grade point averages
SD = Standard Deviation,
p = P-value,
P-value based upon ANOVA test
Statistically significant results at p-value ≤0.05 shown in bold