Healthy and sustainable diet and physical activity – Methodological considerations and development of a combined summary score

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UiA University of Agder

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APPENDICES

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Kristiansand, June 2016

Helga Birgit Bjørnarå

List of papers

Paper I

Bjørnarå HB, Hillesund E, Torstveit MK, Stea TH, Øverby NC, Bere E. An assessment of the test-retest reliability of the New Nordic Diet score. Food Nutr Res. 2015; 59: 28397. doi:10.3402/fnr.v59.28397

Paper II

Bjørnarå HB, Øverby NC, Stea TH, Torstveit MK, Hillesund E, Andersen LF, Berntsen S, Bere E. The association between adherence to the New Nordic Diet and diet quality. Food Nutr Res. 2016; 60: 31017 http://dx.doi.org/10.3402/fnr.v60.31017

Paper III

Bjørnarå HB, Torstveit MK, Stea TH, Bere E. Is there such a thing as sustainable physical activity? Scand J Med Sci Sports. 2016; doi: 10.1111/sms.12669

Paper IV

Bjørnarå HB, Torstveit MK, Stea TH, Helland SH, Øverby NC, Bere E. The Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score and socio-demographic correlates- a cross-sectional study. Int J Behav Nutr Phys Act. 2016; *submitted*

Abbreviations

BMI	Body Mass Index
CO_2	Carbon dioxide
CFDS	Climate-Friendly Diet Score
ENM	Environmental Nutrition Model
FFQ	Food frequency questionnaire
GHG	Greenhouse gases
HLI	Healthy Lifestyle Index
HSDPA	Healthy and Sustainable Dietary and Physical Activity
MoBa	The Norwegian Mother and Child Cohort Study
MVPA	Moderate-to-vigorous physical activity
NND	New Nordic Diet
PA	Physical activity
SWA	SenseWear Armband

Abstract

Background: Environmental sustainability and human health are connected through diets and physical activity. A major issue for the near future is how to feed the growing world population, expected to increase from today's 7 billion to close to 10 billion people in 2050, without compromising planetary sustainability and the needs of future generations. Dietary shifts away from traditional diets, to diets rich in processed foods, meats, refined sugars, refined fats, and oils, contributes to the environmental strain, and also to enhanced incidence of chronic diseases, currently responsible for nearly two thirds of all deaths worldwide. Another major public health challenge is that one third of adults and four-fifths of adolescents do not reach recommended physical activity levels, causing approximately 6-10% of the non-communicable diseases of coronary heart disease, type II diabetes, breast- and colon cancer, and 9% of premature deaths. Moreover, passive transport activities in total produce about 23% of global climate gas discharges. In many countries an increased share of travels could be conducted as active transportation, representing a potential mean to decrease carbon footprint and increase levels of physical activity. Still, as various types of physical activity could provide equal health benefits yet different environmental impacts, the topical issues of sustainability and physical activity should be bridged in a broader sense than for active transportation.

The interactions between diet, physical activity, health and the environment advocates promotion of dietary and physical activity habits potentially causing minimal environmental damage and facilitation of healthy eating and healthy levels of physical activity. To measure degree of adherence to selected aspects they need to be operationalized. Yet, to our best knowledge, there is currently no combined summary score incorporating diet, physical activity, health and environmental considerations. Such a composite index may function as a measurement tool capturing relations between degree of adherence and different outcomes in future studies, or for monitoring time-trends. Besides, although dietary scores are increasingly used for exploring relations between dietary patterns and various health outcomes, there is a general lack of methodological examinations related to these summary scores.

Aims: The overarching aim of this thesis was to develop a combined summary score capturing the interrelations between diet, physical activity, health and environmental sustainability. This overarching aim was further derived into four specific aims, addressed in four separate papers: (i) to assess the test-retest reliability of the New

Nordic Diet (NND) score, (ii) to assess the association between adherence to the NND and diet quality using two separate methods, (iii) to introduce the concept of sustainable physical activity and suggest certain physical activity habits due to their potentially sustainable properties, and (iv) to create a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, and to assess potential socio-demographic correlates of this score.

Methods: Paper I and paper II are based on data collected in a methodological study conducted from March to August 2014, as part of the current PhD-project Healthy and Sustainable Lifestyle (HSL). A convenience sample of parents of toddlers born between 2008 and 2011 (n=86) was recruited from kindergartens in the county of Vest-Agder. Participants completed a web-based questionnaire twice, providing information on selected lifestyle behaviors, self-perceived health and quality of life, in addition to basic demographic and socioeconomic variables. Subsequently, two 24-hour dietary recalls were conducted, in addition to seven consecutive days of physical activity monitoring, and anthropometric measurements. Paper IV is based on cross-sectional data collected in collaboration with the Preschoolers' Food Courage project from October 2014 to January 2015, in a sample of parents with toddlers born in 2012 (n=605), residing in the counties of Aust-Agder and Vest-Agder. In paper III no original data was collected; relevant literature within selected fields was screened. On the grounds of this, we introduced the novel concept of sustainable physical activity, suggested a definition, and discussed specific physical activity aspects due to their potentially sustainable qualities.

The NND score, consisting of ten subscales, was derived from a food frequency questionnaire incorporated in the web-based questionnaire. Each subscale was dichotomized by the median, prior being merged into the total NND score, hence ranging from 0-10 points. Participants were further categorized into low (0-3 points), medium (4-5 points) and high (6-10 points) adherence. The HSDPA score included four selected dietary and PA aspects, each represented by one subscale constructed from a different number of indicator items. The four subscales were equally weighted, entailing a range from 0-10, hence the total HSDPA score ranged from 0-40 points.

In paper I bivariate correlations and Kappa measure of agreement (k) was used to assess the test-retest reliability of the NND score, while in paper II Kruskal-Wallis test was performed for exploring differences in food and nutrient intake across NND groups. In paper IV we applied multilevel linear mixed models for investigating the

associations between potential socio-demographic correlates and adherence to specific dietary and physical activity habits, measured as scoring on the HSDPA score.

Main results: Paper I: Test-retest correlations were r=0.80 (Pearson) for the NND score in total, and r=0.54-0.84 (Spearman's rank correlation coefficient) for the ten subscales, all p<0.001. There was 69% (k=0.52) and 67-88% (k=0.32-0.76) test-retest correct classification of the trichotomized score and the dichotomized subscales, respectively. Paper II: High NND adherence, determined from the food frequency questionnaire, was associated with high intake of fruits (p=0.004) and fiber (p=0.02), and a low intake of meat (p=0.004) and margarines (p=0.05), derived from dietary recalls. A larger proportion of high NND adherers (68%) complied with the national dietary recommendation targeting meat intake compared to low NND adherers (29%) (p=0.04).

Paper III: We defined sustainable physical activity as "*those activities that are conducted with sufficient duration, intensity and frequency for promoting health, yet without excessive expenditure of energy for food, transportation, training facilities or equipment. Sustainable physical activities have low environmental impact and they are culturally and economically acceptable and accessible*". We suggested certain physical activity habits due to their potentially health and sustainable properties; (i) active transportation, (ii) physical activity conducted in the local community, (iii) less use of equipment and appliances for everyday tasks and leisure activities, and (iv) balancing energy expenditure and energy intake.

In paper IV we created the HSDPA score and incorporated the following aspects: (I) NND, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities. For the fully adjusted models mean scoring on the HSDPA score in total was higher for highly educated participants (mean (95% CI): 18.2 (17.4-19.0)), compared to those with low education (16.8 (15.8-17.7), p=0.002), and for participants living centrally (18.4 (17.6-19.2)), compared to those living less centrally (16.5 (15.6-17.4), p=<0.001)). No differences were observed for sex, ethnicity or age.

Conclusions: In the present thesis we constructed the HSDPA score; a broad summary score aiming to capture the interrelations between diet, physical activity, health and environmental sustainability. The HSDPA score included specific dietary and PA aspects chosen on the grounds of their potentially health and sustainable properties. The HSDPA score could potentially function as a crude measurement tool for

monitoring time-trends regarding adherence to the selected aspects in different sub-groups of the population.

The NND score and the ten subscales appear to have acceptable test-retest reliability when tested in a Norwegian sample of parents of toddlers. Higher NND adherence, measured with FFQ, was associated with higher intake of selected healthy foods and nutrients, measured with dietary recalls. Moreover, higher education and centrality were found to be significant correlates of HSDPA, indicating that interventions could be tailored to low educated groups and to those living in non-central areas in order to facilitate lifestyle habits potentially promoting public health and environmental sustainability. Finally, considering that various types of physical activity could provide equal health benefits yet widely different environmental impacts, active transportation, physical activity conducted in the local community, less use of equipment in general, and energy balance, may represent more sustainable PA habits.

1 Introduction

Sustainable development was in 1987 defined by the Brundtland Commission as development that meets the needs of the present generation without compromising the ability of future generations (1). In September 2015 the General Assembly of the United Nations (UN) adopted 17 Sustainable Development Goals, including 169 targets, seeking to achieve sustainable development within three dimensions; economic, social and environmental (2). Griggs and colleagues (3) aimed for a more integrated definition of sustainable development through proposing the following: *"Development that meet the needs of the present by safeguarding Earth's life-support system, on which the welfare of current and future generations depend"*, and further six sustainable development goals; thriving lives and livelihoods, sustainable food security, sustainable water security, universal clean energy, healthy and productive ecosystems, and governance for sustainable societies (3). The driving principles were to reduce poverty and hunger, improve health and well-being, and create sustainable production and consumption patterns, entailing an integration of social, economic and environmental dimensions (3). Both the abovementioned sets of goals express the comprehensiveness of sustainable development. In line with this complexity, however, it has been claimed that environmental sustainability and human health are closely related and connected through diets (4) and physical activity (PA) (5), which in turn advocates a shared route for promotion and protection. Grounded in this, the interrelations between diet, PA, health and the environment should be further addressed.

1.1 Physical activity and food in a historical context

Unlike for our ancestors, food procurement is no longer inextricably linked to PA and energy expenditure (6), meaning that being physically active today requires conscious choices to a larger degree. For illustration, calculations have suggested that modern sedentary adults spend about 62% less energy on PA daily, compared with typical hunter-gatherers (7). In turn, it would require one additional hour of aerobic PA daily to equalize these differences in PA level (8). Human genes were selected and evolved in an environment demanding high levels of PA for survival, i.e. hunting and foraging for foods, and human genome is largely the same as for 40 000 years ago (7). From such an evolutionary perspective, scientific evidence regarding the biological effects of reduced PA on the development of chronic diseases is scarce (9). Still, it has been proposed that the decline in PA level from that of typical Stone Agers to modern

sedentary lifestyles causes energy redistribution in terms of decreased insulin sensitivity and increased fat storage, which could progress to type 2 diabetes and obesity (9). Following the industrial revolution technological inventions and development of new devices have caused additional reduction in PA levels, as PA for accomplishing everyday tasks has been replaced with inactivity (10). In tandem with the significant change in PA habits, human diets have undergone remarkable alterations (11). Initially humans ate what lived and grew in nature, since this was the only food available. With the introduction of agriculture, about 10 000 years ago, the diet was changed to include cultivated plants and livestock/livestock products. The intensification of food production as part of the green revolution, occurring between the 1940s and the late 1960s, did result in more foods per ha, yet also monoculture with high consumption of resources like water, energy, nitrogen and phosphorous (12), and a global food market. At present, simultaneous with increased incomes and urbanization, a dietary transition takes place entailing shifts from traditional diets to diets rich in processed foods, meats, oils, and refined sugar and fats, which in turn aggravates the increased incidence of obesity and chronic diseases (4). It has been claimed that the main dietary cause of the global obesity epidemic and its related diseases is the rapid rise in consumption of ultra-processed foods (13). In short, the development into a modern society with concurrent change in PA habits, decline in PA levels, and less favourable diets, naturally impacts human health and also the environment (4).

1.2 Public health issues

1.2.1 Diet and public health

It is well documented that unhealthy diets and physical inactivity are key risk factors for the major non-communicable diseases (14), currently causing about two thirds of all deaths worldwide (15). Systematic analyses have documented that more than ten of the thirty leading risk factors for the global burden of disease are directly related to diet, including high intake of sodium and processed meat, low intake of nuts and seeds, fruits, vegetables and whole grain (16). Moreover, five additional leading risk factors including hypertension, high body mass index (BMI) and high total cholesterol, are indirectly related to diet and also physical inactivity (16). The influence of dietary aspects on morbidity and mortality risk may be direct, i.e. through nutritional imbalance affecting organ function, metabolism and antioxidant defence negatively, or it could be indirect through over-nutrition resulting in insulin resistance, obesity, diabetes and cardiovascular disease (17). Regarding obesity, high BMI (>25 kg/m^2)

was in 2010 ranked the sixth leading risk for mortality globally, causing 3.4 million deaths and 3.8% of disability-adjusted life-years (16). From 1980 to 2013 there was a 28% and 47% increase in the prevalence of overweight and obesity combined, in adults and children respectively, yet in developed countries it seems that the increment in adult obesity has decelerated since 2006 (18).

1.2.2 Physical activity and public health

As one mean to meet the major public health challenges related to diet and PA habits, national authorities communicate dietary and PA guidelines (19, 20). Globally, self-reported data available from 122 countries revealed that one third of adults and four fifths of adolescents do not meet the PA recommendations (10). Likewise, recent Norwegian device-based data showed that only 32% of the adult population comply with the guidelines (21). This inactivity has been estimated to generate 6-10% of the prime chronic diseases of coronary heart disease, type 2 diabetes, breast cancer and colon cancer, and 9% of premature deaths worldwide, i.e. similar health effects as the established risk factors of obesity and smoking (22). Low cardiorespiratory fitness per se, as a result of insufficient levels of PA, has been reported to imply even greater mortality risk than obesity, diabetes type II and hypertension combined (23). PA is conducted across various domains including occupational (job/study-related), transportation, household, and leisure-time. Active transportation, i.e. walking or cycling for transportation purposes, may be a feasible way to incorporate PA into daily routines and further increase total PA levels (24, 25). In turn, this could prevent obesity (26, 27) and promote health (24, 28-34), entailing significant advantages for both individuals and the society (35).

1.3 Environmental sustainability

The way we live our lives confronts not only public health but also environmental sustainability. Lifestyle behaviors such as dietary patterns (36) and transportation habits (24), are largely responsible for increased anthropogenic emissions of greenhouse gases (GHG) and further global warming. The Paris Agreement aims to limit global warming well below 2°C above pre-industrial levels, as this would reduce the risks and impacts of climate change significantly, including the threat to global food security (37). A major concern for the near future is how to feed the growing world population without undermining planetary sustainability and the needs of coming generations (36). It has been estimated that the expected population growth from today's 7 billion to just about 10 billion in 2050 will require a doubling of the global food production (36).

1.3.1 Diet and environmental sustainability

Since foods providing similar nutrition and equal health impact could differ widely in terms of lifecycle environmental impact (4), the environmental burden of diets ought to be accounted for. This link between global diets, human health and environmental sustainability (4) was recently acknowledged in the Food and Agriculture Organization of the United Nations' (FAO) definition of sustainable diets: *"those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources"* (36). Correspondingly, four countries have developed official food based dietary guidelines that embed health and sustainability aims (38); Germany (39), Brazil (40) Sweden (41), and Qatar (42). All these four countries' integrated guidelines highlight the importance of increased intake of plant foods and decreased intake of meat for both health and sustainability issues, yet the Swedish recommendations also include more details on which type of plant based foods to prefer, e.g. root vegetables over salad greens (38). Although fish is presented as the main aspect entailing health-environment trade-offs, recommended quantities are those complying with health considerations. Moreover, the nature of advices targeting milk and dairy consumption, and also food waste and energy efficient cooking, is variable and fragmented (38). Nonetheless, the Brazilian guidelines stand out through underscoring the detrimental effects of processed foods, and through including the social and cultural aspects of eating (40).

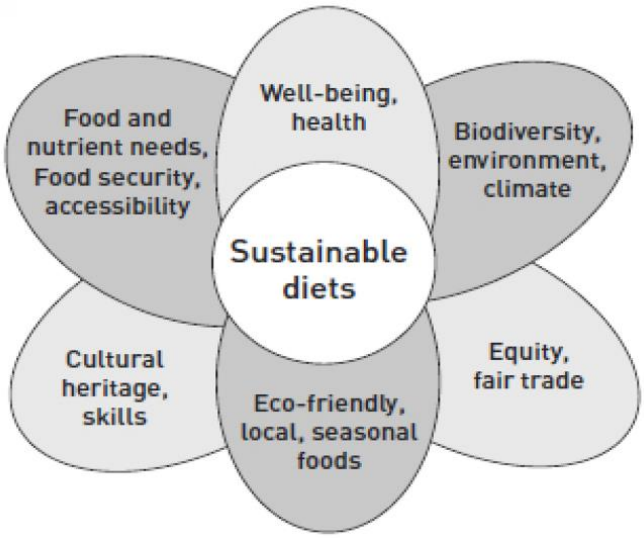

Figure 1 Schematic representation of the key components of a sustainable diet as described by FAO (36).

Approximately 30-35% of current GHG discharges globally come from agriculture (43), with about 18% released from the livestock sector separately (44). GHG emissions differ widely across agricultural systems and food types, yet in general a decrease in livestock-based foods is considered the most relevant factor for climate change (45). For illustration, beef and lamb is reported to have lifecycle GHG emissions per gram of protein about 250 times those of legumes (4). Within 2050 the dietary shift away from traditional diets is likely to account for a significant share of the expected 80% increase in GHG emissions resulting from food production, and also enhanced land clearing (4). Still, determining the environmental impact of foods is highly complex. A recent study by Drewnowski et al.(46) showed that processed and fresh fruit and vegetables had a low carbon footprint when considered as per 100 grams, compared with meat and dairy products, but when considered as energy density per 100 grams the GHG emissions increased remarkably. Nonetheless, in light of FAO's broad definition of sustainable diets (36), one may question if the higher GHG emissions by some foods could be offset by higher nutritional value (46).

Food waste represents another sustainability issue that ought to be targeted, considering that about 30% of all foods produced globally are either discarded, spoiled, lost or crops are consumed by pests (43). In developing countries food losses occur mainly in the early stages of the supply chain, i.e. during production, harvesting and distribution, while in the developed world the majority of foods are wasted at the consumer stage (47). Within the US food system it has been calculated that avoidable food waste accounts for up to 40% of annual production, meaning that about $165 billion are thrown away yearly, in addition to 25% of all freshwater, giant amounts of energy, chemicals, land and not the least nutrients (48). Moreover, Hoolohan et al. (49) calculated that reduced meat consumption, a shift from beef and lamb to pork and poultry, and reduced waste, could enable a 25% reduction in food-related GHG emissions in UK, if these dietary shifts were conducted across the whole population. In turn, such a reduction would be equivalent to a 71% reduction in exhaust pipe emissions of CO_2 from the entire UK passenger car fleet (49), expressing the relevance of especially amount and type of meat consumed, in addition to food waste, for mitigating GHG emissions at the consumer level.

Excess food consumption and further accumulation of fat tissue is another form of inefficient resource use, and may even be regarded food waste (47), bearing in mind that approximately one billion people worldwide suffer from chronic hunger (36),

while at the same time about 1.9 billion adults are overweight or obese (50). Moreover, choosing local and seasonal foods would reduce food miles and thus climate gas discharges related to transportation and cooling underway (51), and local produce contributes to food and nutrition security. Yet, locally produced foods are not necessarily more climate-friendly than imported foods if grown in heated greenhouses (52), and in some cases the energy spent for storing of local foods may outweigh the energy costs related to transportation (12). Regarding organic produce, it is generally assumed to cause lower environmental impact than conventional agriculture (53), mainly due to use of organic fertilisers and limited use of pesticides, as well as care for animal welfare (54, 55). Total environmental footprint of organic produce has however been contentious because of lower production per unit of land, differences across food types (51), and use of external energy e.g. for greenhouses (12). Nevertheless, a recent review summarizes that although organic farming produces lower yields compared with conventional agriculture, it is more profitable and environmentally friendly, it provides equally or more nutritious foods with less or no pesticide residues, and it seem to promote ecosystem services and also social benefits (56). Still, the authors stress that no single approach can feed the planet alone; likely a combination of organic and other innovative agricultural systems are required.

1.3.2 Physical activity and environmental sustainability

Transportation habits and PA patterns add significantly to GHG emissions and further environmental strain. Car use and other forms of motorized transportation favour neither health nor environmental sustainability as it entails sedentariness and GHG emissions. Active transportation is possible to a large degree in many regions, and could be conducted not only to school or work, but also to various destinations during leisure time. At present, transport activities in total are responsible for about 23% of energy-related CO2 emissions globally (24), with emissions expected to double within 2050 (57). According to the Intergovernmental Panel on Climate Change's 5th Assessment Report (58), a stabilization of transport related carbon emissions at roughly 2010-levels would be compatible with the global mean temperature increase target of 2°C (37). One suggested scenario to achieve these levels is to combine infrastructure development, land-use policies and behavioral interventions, including a shift to low carbon intensity modes such as active transportation (57). There is likely an unexploited potential for increased active transportation, considering that for instance in Norway, 25% of daily travels done by car are shorter than 2.5 kilometers (35), and average distance of bicycle trips is 4 kilometers (59). Accordingly, in the

United Kingdom 20% of all travels are shorter than one mile (60). Also, it has been calculated that in Norway, 35% of all short trips (<5km) conducted by car could potentially be done by bicycle (61). Estimating effects of such mode shifts on climate gas emissions is complex and uncertain, and few real-world examples are currently available. Still, it has been proposed in a transport scenario for year 2030 that compared with a "business-as-usual" projection, a combination of active transportation and lower-emission motor vehicles could reduce annual CO_2 emissions in London and Delhi with 38% and 48%, respectively (5). Moreover, in Norway it has been estimated that approximately 1 million tons CO_2 equivalents may be avoided annually, if a shift from motorized transportation to active transportation was carried out in the largest cities (35). Nevertheless, feasibility is relevant in this regard, related to aspects such as environmental barriers and traditions for active transportation.

Various types of PA could be equally beneficial for health yet provide different environmental impact; a Norwegian study revealed that the share of private car use for long-distance transportation to outdoor recreation areas has expanded, and leisure activities in general have become more transport intensive (62). In line with this, various activity-travels have become increasingly popular, such as biking in Toscana or skiing in Japan, which is clearly not sustainable. Also, a strong materialization has occurred, meaning enhanced demand for specialized equipment and clothing (62), which probably applies for other Western countries as well. Nonetheless, no population spend more money on sport clothing and equipment than Norwegians; about 3300 NOK (350 EURO) annually per capita, a share which is likely to be explained partly by the Norwegian climate with clearly divided seasons (63). Hence, PA could potentially decrease carbon footprint, if conducted for instance as active transportation replacing car use, while on the contrary, it could increase climate gas emissions significantly if being equipment- and transport-intensive (62). Naturally, calculations of the carbon footprint of different types of PA are complex since numerous factors affect the estimations, such as type of foods from which the energy required for being physically active is obtained, and type of car used for transportation (64). However, in light of the ambitious goal stated in the Paris Agreement (37), PA habits should be considered from a sustainability perspective in addition to the traditional health perspective. Such an exploration of sustainable PA in a broader sense than active transportation is previously undone.

1.4 Dietary patterns, dietary scores and physical activity monitoring

1.4.1 Dietary patterns

Traditionally, nutritional epidemiology has explored diet-health relations through focusing on specific nutrients or other food compounds (65). This approach has been useful for establishing nutrient-specific dietary recommendations (66), and for developing dietary supplements and functional foods, among others. Nevertheless, the complexity of diet-health associations advocates multiple approaches (65). Dietary patterns, representing a broader picture of people's diet, have often been more successful and consistent in predicting chronic disease than separate dietary elements, whether nutrients or foods (67). Systematic reviews have reported supplementation with omega 3 fatty acids (68, 69) and antioxidants (70) to show no clear health effects, or even adverse effects. Hence, dietary pattern analysis has been established as a complementary method for investigating diet-health associations, entailing advantages like capturing more of diet complexity, and possible synergistic effects of foods eaten in combination (67, 71, 72). Besides, dietary patterns in individuals seem to be rather consistent over time (73). The traditional Mediterranean Diet is probably the most studied dietary pattern within nutritional epidemiology, and there is convincing evidence regarding its protective effects on disease (74-76) and mortality (75). It could be considered a mainly, yet not exclusively, plant based dietary pattern, characterized by rich amounts of fruits and vegetables, legumes, nuts and seeds, unprocessed cereals and olive oil, moderate intake of fish and red wine, and low intake of dairy and meat (77). Nonetheless, despite broad promotion of the Mediterranean diet, adherence was never high outside its traditional geographic regions (78). Suggested explanations for lack of compliance are limited access to ingredients, cultural differences in taste and the general difficulty of changing dietary patterns (79-81), resulting in an increased focus on other regional diets with potential inherent health promoting effects. Among the proposed ones are the Japanese diet (75, 82) and the Peruvian diet (83), and such diets based on local foods could entail the additional benefit of preserving cultural diversity in eating habits (84).

The New Nordic Diet

In the Nordic countries the concept of a New Nordic Diet (NND) was presented as a regional alternative to the Mediterranean Diet, possibly promoting health, but also environmental sustainability and Nordic food traditions and culture (85). Incorporating locally appropriate foods entailed the advantage of a diet being culturally familiar and

potentially more environmentally friendly, as clearly expressed through the suggested criterias for foods to be included in the NND:

1. Ability to be produced locally over large areas within the Nordic countries without usage of external energy e.g. for the production in greenhouses.
2. A tradition as a food source within the Nordic countries.
3. Possessing a better potential for health-enhancing effects than similar foods within the same food group.
4. Ability to be eaten as foods, not only in small amounts or as dietary supplements (such as spices).

In total six ingredients, available or potentially available in Norway, were included as a main example of a Nordic diet: (i) native berries; (ii) cabbage; (iii) native fish and other seafood; (iv) wild (and pasture-fed) land-based animals; (v) rapeseed oil; and (vi) oat/barley/rye (85). The concept of a NND was further expanded as part of the Danish research project OPUS; an interdisciplinary collaboration aiming to develop a meal system incorporating the principles of health, environmental sustainability, Nordic identity and gastronomic potential (86). Three fundamental guidelines formed the basis for the NND: (i) more calories from plant foods and fewer from meat; (ii) more foods from the sea and lakes; and (iii) more foods from the wild countryside (55). Combining these guidelines with the overarching principles, specific dietary composition and nutrient content of the NND was further described (87). In short, the NND is characterized by a high content of locally produced and seasonally relevant fruits, vegetables, berries and whole grains, and less meat of better quality, i.e. smaller amounts of meat, preferably from free-range livestock (including pigs and poultry) and game (87).

1.4.2 Dietary scores

Dietary patterns cannot be measured directly, they must be operationalized. This is commonly done by summarizing overall diet by a single index or score, resulting from a combination of certain selected food components, whether nutrients, foods or food groups, or a combination of these (88). Included components are chosen either a-priori based on current scientific evidence, or a-posteriori derived through the use of statistical techniques such as factor analysis or cluster analysis (65). Several dietary scores have been constructed for measuring adherence to predefined healthy diets, often evidence-based dietary guidelines (88, 89), while other summary indexes aim to assess compliance with specific regional diets (89-93). In addition to assessing diet-health relations, such dietary scores can assist in population monitoring, guiding

nutrition interventions and measuring the effectiveness of interventions and programs, further informing policy makers and other relevant stakeholders (94). Some dietary scores are more widely used and referred to than others (88, 89), such as Healthy Eating Index (HEI) (95), Diet Quality Index (DQI) (96), Healthy Diet Indicator (HDI) (97), and the Mediterranean Diet Scale (MDS) (98). Also, several indices have been developed as revisions of these, e.g. Healthy Eating Index-2005 (HEI-05) (94) and Diet Quality Index revised (DQI-R) (99), both constructed due to revisions of the US dietary recommendations, while a modified version of the MDS was published in 2003, including fish as an additional component (100). More recently, as other regional diets than the traditional Mediterranean diet have gained increased attention, dietary scores have been constructed in the Nordic countries in order to explore adherence to different aspects of the Nordic diets with expected health-promoting effects (90, 92, 101). Table 1 provides an overview of selected dietary scores in their original version, score components and scoring system, in addition to main findings from studies applying these specific dietary scores.

Table 1 Description of selected dietary scores with main findings related to dietary quality and health outcomes

Authors (year)	Score	Score components	Number of partitions and scoring system	Range of index	Main findings
Kennedy et al. (1995) [95]	Healthy Eating Index (HEI)[a]	10 components Nutrients, food groups and variety	Each component contributes 0-10 points	0-100	No or low association with risk of chronic diseases, no association with risk of cancer [102, 103]. High correlation with nutrients [95].
Patterson et al. (1994) [96]	Diet quality Index (DQI)[a]	8 components Nutrients and food groups	3 partitions (0-2 points)	0-16 (inverse scoring)	Reflects diet quality [96]. Correlation with overall and cardiovascular mortality, no association with cancer mortality [104]. Significant association with indicators of inflammation in post-menopausal women (non-significant after adjusting for BMI) [105].
Huijbregts et al. (1997) [97]	Healthy Diet Indicator (HDI)[b]	9 components Nutrients and food groups	2 partitions (0-1 point)	0-9	Inverse relationship with mortality [97].
Trichopoulou et al. (1995) [98]	Mediterranean Diet Scale (MDS)[c]	8 components Food groups and diet composition in lipids	2 partitions (0-1 point)	0-8	Reflects diet quality and associates with less body fat, non-smoking and higher PA levels [106]. Inverse relationship with overall mortality [98, 107-109]. No association with BMI or waist-to-hip ratio [110].
Olsen et al. (2011) [90]	Healthy Nordic Food Index (HNFI)	6 components Food items	2 partitions (0-1 point)	0-6	Lower mortality [90, 111]. Lower incidence of colorectal cancer in women [112]. Lower risk of type 2 diabetes [113].
Kanerva et al. 2013 [101]	Baltic Sea Diet Score (BSDS)	9 components Food groups and nutrients	4 partitions (0-3 points) 2 partitions (0-1 point)	0-25 0-9	Lower risk of obesity [91, 114] and obesity related markers of inflammation [115].
Hillesund et al. 2014 [92]	New Nordic Diet score (NND score)	10 components Meal frequency, foods and food groups	2 partitions (0-1 point)	0-10	Positive associations with optimal gestational weight gain and improved fetal growth [92]. Lower risk of preeclampsia and preterm delivery [116].

[a]Based on US dietary recommendations.
[b]Based on 1990 WHO dietary recommendations.
[c]Based on the traditional Mediterranean Diet.

1.4.3 Physical activity monitoring

The use of summary indexes has, to the authors' knowledge, not been established as an alternative method for summing up PA habits, like it has for dietary patterns. Both dietary and PA habits are complex behaviors, making monitoring challenging. A common focus in epidemiological studies is long-term habitual patterns, yet self-reports are susceptible to measurement error caused by day-to-day variations and reliance on participants' memory and estimations (73). Unlike dietary assessments targeting types of nutrients, foods or food groups, PA assessment has mainly been concentrated on frequency, intensity and duration of the activity, and to a lesser extent type of activity other than the broad PA-domains (occupational, transportation, household and leisure-time). While self-reports is the most commonly applied method for assessing habitual dietary intake, objective measures has emerged during the past 10 years for recording PA in free-living subjects (10). The main advantage is that device-based methods overcome some of the limitations of self-reports (73), e.g. social desirable responding (117, 118). Still, if aiming for contextual information about type and purpose of the PA, self-reports could play a complementary role (119). International Physical Activity Questionnaire (IPAQ) should however be mentioned, representing a common instrument to obtain internationally comparable data on health-related PA. The IPAQ short form "last 7 days" measure is the most widely used and recommended version of the questionnaire due to its feasibility, and equal reliability and validity as long IPAQ forms (120). IPAQ short form incorporates 9 items assessing time spent walking, time in moderate- and vigorous- intensity physical activity (MVPA), and sedentary time (120).

1.5 Broader summary scores and inclusion of sustainability considerations

Summary scores could aim broader than diet-health relations, as exemplified by the Healthy Lifestyle Index (HLI); a crude lifestyle score targeting potential associations between diet, exercise, stress and smoking habits as a totality, with cardiometabolic risk (121). The HLI was found to associate inversely with elements of metabolic syndrome and cardiovascular health profile across adherence groups, hence it may function as a low cost motivational tool for facilitating health promoting behaviors and prevention strategies in large populations (121). In Finland, a Climate-Friendly Diet Score (CFDS) was developed, entailing inclusion of sustainability perspectives in a dietary score (122). The CFDS was constructed for being a novel measure addressing potential correlates of climate-friendly dietary choices, incorporating seven climate-friendly food items and seven non-climate-friendly food items. The climate-

friendliness of the foods was determined by information on the GHG-emissions generated during their lifecycle, and individuals were ranked according to frequency of consumption of the selected foods. The CFDS gave an approximation of the climate-friendliness of the total diet, revealing that concern for climate change was related to climate-friendlier food choices, especially in women (122). Moreover, acknowledging the interrelations between diet, health and environmental sustainability, an Environmental Nutrition Model (ENM) was newly proposed, including three dimensions of nutrition sciences; human nutrition, community nutrition, and environmental nutrition (123). The ENM aimed to clarify the interaction between current food systems, public health and the environment, and the fact that the nutrition of individuals and communities can only be maintained within an environmentally sustainable context. In turn, increased understanding of these relations could result in modifications required to achieve sustainable food systems (123).

1.5.1 The NND score

In accordance with the CFDS and the ENM, the NND score reflects a more extensive approach aiming to capture adherence to the concept of NND, meaning an inclusion of not only health properties, but also environmental sustainability and food traditions (85), as well as palatability (55). The NND score was previously developed in order to operationalize adherence to the NND in observational studies (92, 116) and comprises ten subscales selected *a priori* to summarize meal pattern and habitual intake of typical Nordic foods (92). The ten subscales and the rationale for each are as follows:

Meal pattern, or meal frequency, was included in the NND score as an indicator of eating regular meals, since meal regularity may increase dietary quality (124) and associate with healthier dietary patterns (125). Also, an irregular meal pattern in general has been found to associate with increased likelihood for overweight and obesity (126), while irregular breakfast consumption specifically has been reported to associate with enhanced risk for diabetes type 2 in both females (127) and males (128), as well as increased likelihood for overweight and obesity (129).

Typical *Nordic fruits* (apples, pears and plums) contain plenty of dietary fiber and antioxidants (19), and are generally low in climate impact (52). In order to reduce the carbon footprint additionally, locally grown types in season should be chosen (52, 55, 85), as this would exclude usage of external energy for transportation and cooling underway, and for heating of greenhouses (52).

Root vegetables (e.g. carrots, rutabaga, and onions) and *cabbages* (e.g. cauliflower, broccoli, Brussels sprouts and kale) have tradition as a food source within the Nordic countries, and have a lower carbon footprint than imported vegetables (52). Like most fruits and vegetables, root vegetables are rich in dietary fiber, flavonoids, plant sterols, vitamins, minerals and trace elements, yet having relatively low energy content. The latter could decrease the energy density of the diet, which in turn is likely to reduce the risk of overweight, obesity, and further development of several chronic diseases.

Potatoes are among the foods with the lowest climate impact (87, 130), hence being more environmentally friendly than both rice and pasta, which are common alternatives to potatoes. Potatoes are also richer in dietary fiber (52), entailing a great satiety potential relative to energy contribution, when boiled or baked (55, 87). Traditionally, potatoes have provided essential nutrients such as vitamin C, folate, B6, magnesium, potassium and iron into the Nordic diet.

Whole grain breads and *oatmeal* are traditional staple foods with low environmental impact (52, 130). Choosing whole grain breads and oats at the expense of refined breads results in a diet containing greater amounts of dietary fiber, antioxidants, B-vitamins, minerals and trace elements (19). Both intervention trials and cohort studies have found whole grains to reduce the risk of chronic diseases such as cardiovascular disease, type 2 diabetes, and some cancer types (131). Moreover, large prospective cohort studies have reported whole grain intake to associate with lower total mortality and cardiovascular mortality, in both men and women (132). Also, there seem to be an inverse relationship between consumption of dietary fiber and increased body weight (133).

Foods from the wild countryside such as native berries, fish, seafood and game were merged into one subscale due to their complete reliance on soil and local vegetation (92). Wild berries, e.g. blueberries, cowberries and cloudberries, are highly accessible in the Nordic countries as they grow in ample amounts in large areas, and are free to pick. Nutritionally these berries are rich in dietary fiber, and berries are among the plant foods with some of the greatest amounts of antioxidants (134). Besides, relative to energy content wild berries are comparable to fish regarding levels of alpha-linolenic acid, and more than fifteen times richer in this n-3 fatty acid than the three most commonly eaten fruits in Norway (135). Furthermore, they contain high levels of vitamin E, calcium and iron, i.e. nutrients not commonly associated with berries (135). High-quality fish are abundant in the Nordic region, yet the majority of the catch is

exported. Wild fish and seafood are normally protein rich and lean, while fatty fish like mackerel, wild salmon and herring contribute with long chain polyunsaturated fatty acids being vital for instance for neural development and also prevention of cardiovascular disease, in addition to vitamin D. Seafood is also a great source of protein and vitamin B12, and minerals like selenium and iodine, which are not naturally present in many other foods. However, especially related to pregnancy health and neural development in the fetus, potential detrimental effects from contaminants in fish and seafood have been debated, yet it is concluded that for the majority the health benefits of eating fish far outweigh the risk from contaminants (136). Besides, a varied intake of fatty and lean species with different origins would minimize the risk from contaminants and heavy metals (86). In terms of game, large areas within the Nordic countries are not appropriate for agricultural production, yet wild animals thrive there. And, compared to most other European countries, the Nordic countries possess a greater potential for domesticated pasture-fed animals due to large areas of land relative to number of people (85). Nutritionally, meat from wild birds, deer, moose and wild sheep is nutritionally favorable compared to meat from domestic cattle, since it is usually lean and contains a higher proportion of polyunsaturated fats relative to saturated fats (137). In addition, all meat is a great source of protein, iron and vitamin B12, as well as several other essential nutrients (85).

Unsweetened *milk* has been a staple in the traditional Nordic diet, and it contains numerous vital nutrients, while simultaneously having lower carbon footprint than most animal foods (52). Exchanging fruit juices with milk entails higher intake of high quality protein, calcium, phosphate, iodine, zinc, B-vitamins and vitamin B12. Moreover, a protective effect from milk and dairies on myocardial infarction has been reported (138), as well as decreased mortality in those with the highest milk consumption, primarily whole milk (139). The issue of fat-reduced milk and other fat-reduced dairy products is highly debated, yet lean milk and dairy products are the recommended types (19, 20). In line with this, most Norwegians report to choose low fat or semi-skim milk ($\leq$ 1.5% fat) (140).

Choosing *water* at the expense of sugar-sweetened beverages could decrease the amount of total sugar and energy in the diet. In addition to increased energy intake, systematic reviews have reported consumption of sugar-sweetened beverages to be associated with long-term weight gain, lower intake of several nutrients as well as development of type 2 diabetes and related metabolic conditions (141, 142). Furthermore, a randomized controlled intervention study in overweight and obese

adults concluded that daily intake of one liter regular soda enhanced ectopic fat accumulation and lipids, and thus the risk of cardiovascular and metabolic diseases, compared with equal amounts of diet soda, milk and water (143). Last but not the least; tap water contributes with the lowest environmental impact of all beverages (52).

Together with enhanced recognition of the interconnections between diet, human health and environmental sustainability, the need for a feasible dietary assessment method to accurately measure individual's healthy and sustainable dietary behaviors has been highlighted, as one potential mean to increase the awareness among consumers and policymakers regarding inherent benefits of such dietary behaviors (144). A recent Australian initiative attempted to address this gap in the literature by proposing a feasible method for assessing multiple elements of a healthy and sustainable diet (145). The method entails using a food record application for collecting images of five selected indicators; ultra-processed foods and beverages, individually packaged foods and beverages, fruit and vegetables (including seasonality), dairy, eggs and meat, in addition to plate waste. Further, images collected by this mobile application should be summarized into a Healthy and Sustainable Dietary Index as a proxy of healthy and sustainable dietary behaviors. Still, as claimed by the authors, the method is not yet tested (145).

1.6 Socio-demographic correlates of dietary and physical activity habits

Numerous underlying factors influence lifestyle behaviors like food consumption (146), dietary patterns (71), and participation in PA (10, 147, 148). According to the literature socioeconomic disadvantaged individuals are less likely to engage in health enhancing behaviors (149), and more likely to suffer from poorer health and higher mortality rates than groups with higher social status (150). Different behavioral theories and models emphasize various influences, and those focusing on individual psychological factors and social factors, like Theory of Planned Behavior and Social Cognitive theory (151), have traditionally been the dominant ones (152). Ecological models, on the other hand, stress individual's interaction with their sociocultural and physical surroundings, and are characterized by inclusion of variables on multiple levels, i.e. the intrapersonal, interpersonal/cultural, organizational, environmental, and policy levels (152). Multilevel interventions are likely to be effective and result in sustained behavioral change, yet they are also highly resource-intensive and challenging due to their complexity. Enhanced understanding regarding socio-demographic correlates of dietary and PA habits, such as sex, age, ethnicity and educational level, is relevant in order to tailor interventions to important target groups

or to explore time trends. In turn, such adapted schemes could improve the interventions, potentially increasing adherence to the targeted behaviors (147). Although correlates vary according to PA domain, it has been shown that for PA in general, educational level, age, sex, health-status, self-efficacy and motivation are rather consistent correlates at the intra-personal level (10, 147, 148). Furthermore, urban location seems to represent one of the environmental correlates being positively associated with PA level (147, 148). Also, adherence to overall healthier dietary patterns seem to relate to indicators of socio-economic status and urban location, both in high-income countries (146) and in low-and middle income countries (153). Likewise, higher income or education, in addition to female gender and older age, tend to be predictors of generally better scores on diet scales (71). Notable, most previous studies address specific behaviors individually, hence little is known about socio-demographic correlates of a combined approach including both dietary and PA habits with inherent health and sustainable properties (i.e. more a lifestyle approach). Increased knowledge would be essential in order to develop relevant and adapted public health interventions targeting such a broader perspective.

1.7 Knowledge gaps

The interactions between diet, PA, health and the environment, together with contemporary challenges related to public health and environmental sustainability, advocates a shared route for promotion and protection of both human and environmental health. To the authors' knowledge, there is currently no summary score targeting both dietary and PA habits that may cause minimal environmental damage and promote healthy eating and healthy levels of PA. Such a combined index may distinguish subjects according to degree of compliance with the aspects of interest, and function as a crude measurement tool capturing relations between degree of adherence and different outcomes in future observational or intervention studies. Also, it could be used for monitoring trends over time. Moreover, although dietary scores are gaining ground as a complementary approach for exploring relations between dietary patterns and various health outcomes, there is a general lack of methodological examinations related to such scores, for instance regarding the reliability (65, 72), i.e. the degree to which repeated measurements in the same subjects provide similar results (73). This applies for the NND score as well, as it has not been tested for reliability. Besides, former studies addressing predefined healthy Nordic diet scores revealed coexistence of healthy and less healthy dietary aspects among adherers (92, 101, 154), yet they all used the same FFQ for constructing the diet score as for calculating intakes of foods

and nutrients, which may be questioned from a methodological point of view. Furthermore, in light of upcoming resource issues and the fact that various types of PA could provide equal health benefits yet different environmental impacts, types of PA should be taken into account, in addition to the traditional focus on frequency, duration and intensity of different PAs. In other words, the topical issues of sustainability and PA should be bridged, as this is previously undone in a broader sense than for active transportation.

2 Aims

Based on these knowledge gaps, the overarching aim of this thesis was to develop a combined summary score capturing the interrelations between diet, PA, health and environmental sustainability. Further, the overarching aim was specified into the following specific aims, addressed in four separate papers:

1. To assess the test-retest reliability of the NND score.
2. To assess the association between adherence to the NND and diet quality, comparing NND with food intake using a separate method (24-h recall).
3. To introduce the concept of sustainable PA and to suggest certain PA habits due to their potentially sustainable properties.
4. To create a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, and to assess potential socio-demographic correlates of this score.

3 Design and methods

3.1 Study design

3.1.1 The methodological study (paper I and II)

Paper I and paper II are based on data collected in a methodological study conducted between March and August 2014, as part of this PhD-project; Healthy and Sustainable Lifestyle (HSL), lasting from June 2013 until June 2016. A web-based questionnaire (appendix 1) was developed in order to assess lifestyle behaviors, self-perceived health and quality of life among parents of toddlers, in addition to basic demographic and socioeconomic variables. Participants completed the questionnaire survey twice, prior to conducting two 24-hour dietary recalls by telephone, seven consecutive days of PA monitoring, and anthropometric measurements, i.e. height and body mass. A convenience sample consisting of parents of toddlers was recruited from kindergartens in the county of Vest-Agder, Southern Norway. Based on dropout rates and sample sizes reported in previous methodological studies we calculated that a sample size of approximately 100 parents should be sufficient (155, 156), yet to account for expected dropouts, we aimed to recruit 120 parents from the target population (157). The leader of each kindergarten was asked to distribute the study invitation to eligible parents by e-mail, entailing parents whose children were born between 2008 and 2011, and who were able to speak and read Norwegian. For each child, either the mother or the father could participate. Parents were provided additional information about the purpose and implications of the study through a web-page, and via e-mail distribution.

3.1.2 The test-retest reliability study (paper I and IV)

To assess the reliability of the questionnaire, a test-retest design was used. The reliability study aimed to assess within-subject measurement error in the questionnaire by investigating the test-retest reproducibility, and was carried out between March and June 2014 among the parents participating in the methodological study. The main focus for the reliability study was to assess the test-retest reliability of the NND score (paper I), yet the questions forming the basis for the three additional scales included in the HSDPA score (paper IV) were also addressed. Hence, we constructed the NND score in total and the ten subscales from the FFQ at time 1 (test) and time 2 (retest) respectively, prior to assessing the correlation between the NND score and the ten subscales at both time points, in addition to the test-retest agreement of categorization for the dichotomized subscales and the trichotomized NND score. Likewise, we constructed the subscales Local and sustainable foods, Active transportation, and Non-

exercise outdoor activities (see paragraph 5.1.2 below and paper IV for the rationale for including these selected aspects) at time 1 and time 2, in addition to HSDPA score in total, prior to exploring the correlation between the scales at both measurement points. The time period between the test and the retest distribution of the questionnaire was 14 days.

3.1.3 The cross-sectional study (paper IV)

Paper IV is based on cross-sectional data collected in collaboration between HSL and the Preschoolers' Food Courage project (158) from October 2014 to January 2015, applying the web-based questionnaire developed prior the methodological study. In line with previous studies investigating health behaviors in both children and their parents (159, 160) we aimed for a sample of at least 1000 participants, as this should be adequate for analyzing the associations between the selected HSL-behaviors, correlates and outcomes, also in relevant subsamples (e.g. males vs. females, low educated vs. high educated), and for taking the clustering of participants into kindergartens into account. Parents of toddlers born in 2012, residing in Southern Norway, were recruited through kindergartens.

3.1.4 The discussion paper (paper III)

For paper III no original data was collected. Based on a literature review we introduced the novel concept of sustainable PA, and suggested a definition. Further, on the grounds of this definition we discussed certain PA aspects due to their potential sustainability qualities; active transportation, locally-based PA, decreased use of appliances and equipment for everyday tasks and leisure activities, and energy balance.

3.2 Study sample

3.2.1 The methodological study (paper I and II)

In total, 1191 parents from 19 kindergartens were invited to participate. Also, we targeted parents directly through an advertisement in Fædrelandsvennen, the largest newspaper in Southern Norway, resulting in 86 parents (7%) signing up. Out of these, 56 parents (65% of those signing up) completed all measurements, i.e. the electronic questionnaire twice, two dietary recalls, the PA assessment and the body composition measures. Furthermore, 65 parents (76%) completed the questionnaire and two dietary recalls, 75 parents (87%) completed the questionnaire at time point 1 (test), while 67 parents (78%) completed the questionnaire at both occasions (test and retest).

3.2.2 The cross-sectional study (paper IV)

All kindergartens (*n*=351) in the counties of Vest-Agder and Aust-Agder fulfilling the inclusion criteria, i.e. having children born in 2012 whose parents were able to speak and read Norwegian, were invited to participate. Out of these, 309 kindergartens signed up, entailing provision of information to eligible parents by hard copy and by e-mail. For each child, either the mother or the father could take part. A total of about 3100 parents were invited to participate, of whom 605 parents (20%) from 207 kindergartens signed up. Consent was signed electronically through the project's web page, followed by distribution of the questionnaire survey by e-mail. In total 530 participants (17%) filled in the electronic questionnaire from which all variables were assessed.

3.3 Instruments and measures

3.3.1 The electronic questionnaire

We developed a web-based questionnaire (appendix 1) using the software SurveyXact (Rambøll Management Consulting, Århus, Denmark). Literature reviews were conducted, and questionnaire items were constructed mainly on the basis of items previously tested for reliability and validity, used in cross-European studies like the ENERGY-project (159), national studies like MoBa (161) and the KAN1 ("Kartlegging Aktivitet Norge") study (162), as well as regional studies like Fruit and Vegetables Makes the Mark (FVMM)(163), and Fit For Delivery (FFD)(164). If no previous items were found appropriate, new questions were developed based on theory and knowledge within the field of interest. Translation and back-translation of English items into Norwegian was conducted by fluent speakers of both languages, and the questionnaire was pilot tested in seven subjects from a corresponding population of parents of toddlers.

The NND score (paper I, II and IV) and the HSDPA score (paper IV)

Parental adherence to certain aspects, i.e. NND, Local and sustainable foods, Active transportation, and Non-exercise outdoor activities, was assessed through selected indicator questions in the electronic questionnaire. A food frequency questionnaire (FFQ) was incorporated, assessing participants' habitual frequency of intake of selected foods, without specification of portion sizes or amounts consumed. Among the foods assessed were foods included in the previously developed NND score (92). In the present study, number of items forming the basis for each of the ten NND-subscales ranged from 1 to 5, in total 24 questions. Question formulation was as

follows: “How often do you eat….” or “How often do you drink...” with 10 response options ranging from “Never” (coded 0) up to “Several times a day” (coded 10). Each subscale was dichotomized by the sex- specific median and assigned values of “0” if the intake was below the median, or “1” if the intake was above the median. All subscales were assigned equal weighting, thus adding the subscales yielded a score ranging from 0-10, with increasing score indicating higher compliance with the NND. In accordance with methods applied in previous epidemiological studies (90, 93), the total score was trichotomized grouping participants into “low” (0-3 points), “medium” (4-5 points), and “high” (6-10 points) adherence to the NND (92), with cut-offs determined to obtain the most equally sized groups.

In addition to NND, the HSDPA score included the aspects Local and sustainable foods, Active transportation, and Non-exercise outdoor activities (see paragraph 5.1.2 below and paper IV for the rationale for including these specific aspects). Parental compliance with these aspects was assessed through items such as “To what extent do you agree in the following statements:” (i) “I often buy foods produced locally”, (ii) “I often buy foods when they are in season”, with responses indicated on a five-point Likert-scale from 0 (“fully disagree”) to 4 (“fully agree”), “How do you usually travel to/from in the *summer* season when you are:” (i) “going to work/studies?”, (ii) “shopping groceries?”, with the response alternatives: (i) “by car/motorcycle/moped/scooter”, (ii) “by public transportation”, (iii) “by foot”, or (iv) “by bike/e-bike”, and “How often do you engage in outdoor activities in the *summer* season (e.g. gardening, bathing/swimming, playing, working with firewoods etc.)?”, with responses ranging from 0 (“never”) to 4 (“more than once a week”). Details on the items, response options and calculations underlying the construction of the subscales and the total HSDPA score are described in paper IV (table appendix 1 and table appendix 2). Number of indicator questions for each aspect/subscale ranged from 8 (Non-exercise outdoor activities) to 24 (NND, total score), in sum 53 questions. Like for the NND score, each subscale was assigned equal weighting, meaning that possible scoring for all four scales was adjusted to 0-10. Further, the subscales were collapsed into the HSDPA score, potentially ranging from 0-40. Higher HSDPA score indicated increased compliance with the selected aspects as a totality.

3.3.2 Potential correlates

The questionnaire assessed socio-demographics (sex, age, height, weight, ethnicity, and educational attainment) as well, in addition to distance to workplace/study site, the kindergarten, the nearest grocery shop and the nearest city center. Participants were

asked to identify their sex, while age was determined from date of birth and date of filling in the questionnaire, and further dichotomized by the sample specific median (32 years). Participants' BMI (kg/m^2) was computed from self-reported height and weight and further collapsed into a binary variable; not overweight/obese (BMI <25 kg/m^2) and overweight/obese (BMI ≥25 kg/m^2) (50). Ethnicity was assessed by two questions; if their mother was born in Norway or not, and if their father was born in Norway or not, and dichotomized into non-native or native (both parents born in Norway). Educational attainment was assessed by asking participants to mark their highest level of completed education, with the following options: less than 10 years of primary education; primary education; 3 years of secondary education; <4 years of college/university education; ≥4 years of college/university education. Education was further merged into a binary variable; low education (not having attended college or university) and high education (having attended college or university). In order to obtain information on distance to workplace/study site, the kindergarten, the nearest grocery shop and the nearest city center, participants reported distance in kilometers (km) from their residence to each destination. The four variables were trichotomized (range 0-2 points) and summed up in order to create a proxy for centrality potentially ranging from 0-8 points, which in turn was dichotomized by the median to enable comparison of "high" centrality vs. "low" centrality.

3.3.3 24-hour dietary recall interviews (paper II)

After completing the test-retest reliability study, the participants conducted two unannounced 24-hour dietary recalls collected by telephone 2-4 weeks apart, by two trained interviewers. Each interview lasted for approximately 20-30 minutes, aiming to obtain detailed information on all foods and beverages consumed by the participant in the period between waking up on the preceding day and waking up on the interview day. In order to facilitate the quantitative estimation of food and beverage consumption, a booklet (165) was available on the project's web-page. The booklet contained photos of standard sizes of glasses, cups and plates, in addition to photos of four different portion sizes for 33 common foods. Also, a checklist of commonly forgotten food items was gone through. Next, dietary information was converted into daily energy and nutrient intakes using the food calculation software KBS V 7.0, linked directly to the food composition database N3. The Norwegian food composition table from 2006 (166) forms the basis for this food composition database, which is also supplemented with additional food items from reliable sources. Regarding the calculations, meat products such as meatballs and sausages were considered 100% red

meat although other ingredients may have been added. This approach was chosen because such products are normally regarded as one unit. For composite dishes, like pizza, the dish was broken down into its main constituents, e.g. pizza crust (grouped as bread), meat, tomato sauce, vegetables, and cheese. Moreover, due to features of the food calculation software (KBS V 7.0), 40% of the product weight of whole grain products was accounted for as whole grains, for muesli/mixed cereals 50% of the product weight was included, and for processed fish products 40% of the product weight was accounted for (165). Nutritional supplements were excluded from the calculations, as food intake per se was that of interest in this study, and what corresponds with the concept NND. The 24-hour recall functionality of the KBS program was developed specifically for the Norkost 3 study, which represents the latest national dietary survey conducted among a representative sample of Norwegian adults (165), and is part of the "Nordic monitoring of diet, physical activity and overweight" project, initiated by The Nordic Council of Ministers (167).

Specific foods and nutrients for assessing dietary quality across NND adherence were selected based on the Norwegian food based dietary recommendations as an indicator of a healthy diet (20). Foods assessed were "Vegetables (fresh and frozen)", "Fruits and berries (fresh)", "Fruit juice", "Whole grain products", "Refined grain products", "Fish", "Meat", "Low fat dairy products", "Fatty dairy products", "Vegetable oils", "Margarines", "Butter", "Chocolate, candies and sugar sweetened beverages", and "Water". Selected nutrients were fiber, added sugar, and sodium. In addition, we assessed energy intake across NND groups. Also, the proportion from each NND adherence category meeting the following quantitative Norwegian food recommendations was calculated; "Eat at least five portions of vegetables, fruits and berries every day" (>500 g/day), "Eat whole grains every day" (>70 g/day for women and >90 g/day for men), "Eat fish for dinner two to three times a week and preferably also as sandwich spread", "Choose lean meat and lean meat products. Limit the amount of processed meat and red meat", "Choose foods containing little salt, and limit the use of salt for cooking" (<6 g NaCl/day), and "Avoid sugar rich foods and beverages for everyday use"(<10 E%). Recommendations for fish intake and meat consumption were operationalized into daily intake, as recommended weekly amounts are 300-450 g of fish (ready to eat), and <500 g of red and processed meat (ready to eat), for both females and males. Due to features of the food calculation software (KBS V 7.0) the recommended commodity weight of meat (750 g/week) (168) represented the cut-off for compliance with the guidelines.

3.3.4 Physical activity measurements and anthropometrics (paper II)

In the present study the monitor SenseWear Armband Mini (SWA; BodyMedia, Pittsburgh, Pennsylvania, USA) was used for estimating participants' level of MVPA and energy expenditure. The cut-off defining MVPA was 3 metabolic equivalents (METs) (169). SWA includes a 3-axis accelerometer, a heat-flux sensor, a skin temperature sensor, and a near-body ambient temperature sensor (170). Data from these sensors are combined with sex, age, body weight and height to estimate PA intensity and energy expenditure using algorithms developed by the manufacturer. Participants were instructed to wear the monitor on the upper left arm (on the triceps, at midhumerus point) for seven consecutive days, only removing it for bathing purposes, or any other water activity. Those with nickel allergy (n=5) were discouraged to participate, as wearing the monitor may cause skin rashes due to 8% nickel content. Data were downloaded using SenseWear Professional V.8.1 (BodyMedia, Pittsburgh, Pennsylvania, USA). In order to be included in the analyses participants needed at least four valid days, i.e. minimum 80% (19.2 hours) wearing time, with at least one weekend day (171, 172). Data were calculated and reported as mean values per day. Participants were classified as meeting recommended level of PA (20, 173), i.e. being physically active, if they exceeded 21.5 min/day of MVPA in bouts of at least 10 minutes duration (20).

Anthropometric measurements were obtained by trained staff with subjects barefoot and dressed in light clothes. Height was measured using a portable stadiometer with the head in the Frankfort plane. Two measurements were taken, yet added with a third if the first two differed by >1%. The mean of the closest two measurements was calculated. Weight was measured as part of a segmental multi-frequency bioelectrical impedance analysis (BIA), conducted with InBody 720 (Biospace Co., Ltd., Seoul, Korea). According to the literature, compared with reference methods, bioelectrical impedance analyses are sufficiently valid for measuring body composition in the general adult population (174, 175). Further, BMI was computed (from the objectively measured height and weight), and participants with a BMI $\geq$25 kg/m^2 were categorized as overweight/obese (50). According to the measurement protocol, participants were instructed to abstain from exercise and food within two hours of testing, and immediately prior to the measurement to avoid showering and sauna, and to empty their bladder. Pregnant women (n=1) were excluded from the body composition measurements.

3.4 Ethics of human participation

The study was conducted according to the guidelines laid down in the Declaration of Helsinki, and research clearance was obtained from the Norwegian Social Science Data Services (appendix 2). All participants provided informed consent electronically (appendix 4 and appendix 7).

3.5 Statistical analyses

The statistical analyses were performed using the statistical software package IBM SPSS Statistics version 22.0 (IBM Corp., Somers, New York, USA). A two-sided p-value of <0.05 was considered statistically significant.

Paper I

In paper I test-retest reliability of the final NND score and incorporated subscales was investigated through bivariate correlations. As the distributions of the subscales were skewed, correlations were calculated with Spearman's rank correlation coefficient, while the final NND score was assessed with Pearson's correlation coefficient, due to a normal distribution of scores. Furthermore, cross tabulation and Kappa measure of agreement (*k*) were applied for assessing the test-retest agreement of classification into the trichotomized NND score, as well as into the dichotomized subscales.

Paper II

In paper II differences in sample characteristics across NND adherence categories were explored using Chi-square test for independence (χ^2). Food consumption variables were skewed, hence Kruskal-Wallis test was applied for assessing differences in food, nutrient and energy intakes, and energy expenditure, across NND categories. Results were presented as median and quartiles. Differences in compliance with the Norwegian quantitative food-based dietary guidelines according to NND adherence group were assessed with Chi-square (χ^2).

Paper IV

In paper IV descriptive analyses were conducted to assess distribution of the socio-demographic correlates in the study sample. Further, crude associations between the HSDPA score in total and the subscales separately, with the dichotomous correlates, were assessed using One-Way ANOVA. Results were presented as mean values with 95% confidence intervals (CIs) for the total HSDPA score and the continuous subscales (NND, Local and sustainable foods and Non-exercise outdoor activities). The subscale Active transportation was dichotomized due to highly skewed data, thus results were presented as proportions with 95% CIs. Multilevel linear mixed models,

including kindergartens as random effects due to the clustering of participants within kindergartens, were conducted with the total HSDPA score and the four subscales as dependent variables (176), i.e. five separate models. Sex, age, ethnicity, educational level and centrality were included as binary correlates (fixed effects) in all models. Mean values with 95% CIs were presented for the HSDPA score in total and the continuous subscales, and as proportions with 95% CIs for the dichotomized Active transportation scale.

4 Main results

4.1 Paper I – "An assessment of the test-retest reliability of the New Nordic Diet score"

In the test-retest reliability study described in paper I, a total of 67 participants (89% of those answering the first questionnaire, mean age 34.5 years (SD±5.3)) completed the questionnaire at both occasions. Out of these, 57 participants (85%) were females, 60 participants (90%) were native Norwegians, and 36 participants (54%) reported higher education.

The correlation coefficients between test and retest were r=0.80 (Pearson) for the NND score, and r=0.54-0.84 (Spearman's rank correlation coefficient) for the different subscale scores, all p<0.001. The highest correlations were observed for the subscales "oatmeal porridge" and "milk vs. juice" (r=0.84), while the lowest correlation was found for the subscale "cabbages" (r=0.54). Further, 69% of participants were correctly classified into low, medium, or high adherence to the total NND score on the retest distribution, compared with the test-distribution (k=0.50), whereas 1.5% (n=1) were grossly misclassified, moving from high to low compliance. For the dichotomized subscales, test-retest agreement ranged from 67% to 88% (k=0.32-0.76). In accordance with the bivariate correlations, the highest agreement from test to retest was found for "milk vs. juice" (88%, k=0.76), whereas the lowest agreement was observed for the subscale "cabbages" (67%, k=0.32).

4.2 Paper II – "The association between adherence to the New Nordic Diet and diet quality"

A total of 65 participants (76% of those signing up) were included in the final analyses for paper II. Mean age was 35.2 years (SD±5.0 years), 55 participants (85%) were females, 58 participants (89%) were native Norwegians, and 37 participants (57%) reported higher education. Moreover, 13 participants (20%) were overweight or obese, while 46 participants (82%) met the national recommendations for PA (20). No significant differences were observed in sample characteristics across NND categories. Participants were categorized according to their NND score into low (26%), medium (35%) or high (39%) adherence to the NND.

Different consumption of selected foods across NND groups was observed for meat (p=0.004), fruits and berries (p=0.004) and margarines (p=0.05), in the direction that those classified as "low" NND adherers reported the highest consumption of meat and

margarines, while "high" NND adherers reported the largest intake of fruits and berries. No significant differences were found for the other foods assessed, i.e. fresh and frozen vegetables, fruit juice, whole grain products, refined grain products, fish, low fat dairy products, fatty dairy products, vegetable oils, butter, chocolate, candies and sugar sweetened beverages, and water. Relative intake of dietary fiber (E%) differed significantly across NND groups; fiber contributed with 2.7 E%, 2.4 E% and 2.1 E% (p=0.02), in "high", "medium" and "low" NND adherers, respectively. For added sugar and sodium, and for energy intake and energy expenditure, no differences according to NND classifications were found.

Regarding compliance with the quantitative Norwegian food recommendations, a greater proportion of "high" NND adherers complied with the guideline to "Choose lean meat and lean meat products. Limit the amount of processed meat and read meat", than "low" NND adherers (68% vs. 29%, p=0.04). For the remaining five recommendations of interest, i.e. "Eat at least five portions of vegetables, fruits and berries every day", "Eat whole grains every day", "Eat fish for dinner two to three times a week and preferably also as sandwich spread", "Choose foods containing little salt, and limit the use of salt for cooking", and "Avoid sugar rich foods and beverages for everyday use", no significant differences between NND adherence groups were found.

4.3 Paper III – "Is there such a thing as sustainable physical activity?"

In paper III we aimed to bridge the topical issues of sustainability and PA through introducing and discussing the concept of sustainable PA, and further suggesting certain PA habits due to their potentially sustainable properties. Inspired by FAO's holistic definition on sustainable diets, and the close interconnection between diet and PA as lifestyle behaviors, we defined sustainable PA as "*those activities that are conducted with sufficient duration, intensity and frequency for promoting health, yet without excessive expenditure of energy for food, transportation, training facilities or equipment. Sustainable PAs have low environmental impact and they are culturally and economically acceptable and accessible*". Moreover, in light of upcoming resource challenges and major public health issues, we suggested that the following types of PA should be considered:

- *Active transportation*, as it represents a carbon-friendly mean of transportation and a potential to increase PA levels as part of daily living.
- *PA conducted in the local community*, since such activities would reduce carbon emissions related to the use of cars and other motorized transportation.

- *Going "back to basic" using less equipment and appliances* for everyday tasks and leisure activities, due to its possible contribution to increased PA levels, and also decreased resource use.
- *Balancing energy expenditure and energy intake,* as energy balance could favor both human and environmental health as a result of a healthy body weight and a declined strain on food production. Weighting up resource demands, food production, and human biology, it could be assumed that a level of PA meeting the minimum requirements for health would be the most sustainable one.

4.4 Paper IV – "The Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score and socio-demographic correlates - a cross-sectional study"

In paper IV we constructed the HSDPA score (see paragraph 5.1.2 below and paper IV for more details on the rationale); a combined summary scoring including certain aspects due to inherent traits potentially favoring both health and the environment: (I) NND, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities. Based on indicator questions each aspect was operationalized into separate subscales prior being merged into the HSDPA score, in order to be assessed both separately and as a totality. Test-retest correlation (Pearson's correlation coefficient) of the NND score was previously tested and found to be r=0.80 (p=<0.001) (177), while for the additional subscales (using the same study sample as presented in paper I), i.e. Local and sustainable foods, Active transportation and Non-exercise outdoor activities, test-retest correlations (Spearman's rank correlation coefficient) were r=0.84, 0.92 and 0.74, respectively (all p=<0.001). For the HSDPA score in total, test-retest correlation was r=0.85 (p=<0.001).

In total 530 participants (mean age 32.2 years (SD±4.7 years)) completed the cross-sectional survey, and were thus included in the analyses for paper IV. Out of these, 453 participants (90%) were females, 267 (53%) were older than 32 years, 419 (83%) were native Norwegians, and 349 (69%) reported higher education. In addition, 202 participants (40%) were classified as overweight or obese, while 285 (56%) were categorized as living centrally.

Multilevel linear mixed models, taking the clustering of participants within kindergartens into account and adjusting for sex, age, ethnicity, educational level and centrality as binary correlates, revealed that mean rating on the total HSDPA score was significantly higher for participants with higher education (mean (95%CI): 18.2 (17.4-

19.0)), compared to those with lower education (16.8 (15.8-17.7), *p*=0.002), and for participants living centrally (18.4 (17.6-19.2)), compared to those living less centrally (16.5 (15.6-17.4), *p*=<0.001). No differences in HSDPA score were observed for the variables sex, ethnicity or age. Those highly educated achieved significantly greater scoring on the NND subscale separately (4.5 (4.1-4.9)) than participants with lower education (4.0 (3.5-4.4), *p*=0.01). No differences were detected for sex, ethnicity, age, or centrality. For Local and sustainable foods we found higher scoring for those with higher education (4.7 (4.4-5.0)) compared to those with lower education (4.2 (3.8-4.5), *p*=0.001), and for participants ≥32 years (4.6 (4.3-4.9)) in comparison with those <32 years (4.3 (3.9-4.6), *p*=0.02). Scoring did not otherwise differ according to sex, ethnicity or centrality. For the dichotomized Active transportation scale a higher proportion of non-natives (% (95%CI): 56 (45-67)) than natives (44 (37-52), *p*=0.03) were categorized into Active transportation, and a larger proportion of participants living centrally (71 (62-79)) compared to those living less centrally (30 (21-39), *p*=<0.001). Proportions did not differ relative to the variables sex, education or age. Considering the subscale Non-exercise outdoor activities, females (mean (95%CI): 7.3 (7.0-7.6)) scored higher than males (6.8 (6.3-7.2), *p*=0.04), natives (7.3 (7.1-7.6)) scored higher than non-natives (6.7 (6.3-7.1), *p*=0.001), and participants living centrally (7.2 (6.9-7.4)) scored higher than those living less centrally (6.9 (6.6-7.2), *p*=0.05). For education and age, categories did not differ significantly from another.

5 Discussion

5.1 Diet, physical activity, sustainability and operationalization of the HSDPA score

On the grounds of contemporary issues related to public health and environmental sustainability, together with the interrelations between diet, PA, health and the environment, the overarching aim of this thesis was to develop a combined summary score capturing all these aspects, resulting in the HSDPA score. The reasoning for this objective was that such a combined index may distinguish subjects according to degree of compliance with selected dietary and PA habits, and could potentially function as a measurement tool capturing relations between degree of adherence and different outcomes in future observational or intervention studies. Also, it may be used for monitoring trends over time. Due to the rather ambitious nature of this aim there were several pitfalls. Firstly, although we believe that the rationale for selecting the specific four aspects was well grounded (see paragraph 5.1.2 below and paper IV for the argumentation for including these constructs (and not others), and details on the scales), we cannot be certain that NND, Local and Sustainable foods, Active transportation and Non-exercise outdoor activities are the most beneficial diet and PA habits for promoting health and environmental sustainability. Secondly, the subjectivity introduced by the numerous choices related to construction of summary scores (e.g. choice of indicator items, cut-offs for scoring, and weighting of the different aspects making up the score) (72, 88), together with social desirability response bias related to self-reported data (117, 118), threatens construct validity of the HSDPA score, i.e. if the score accurately measures or covers the aspects that it intends to cover (178). The greatest challenge of such an integrative approach was the operationalization of the included aspects, that is, transforming NND, Local and sustainable foods, Active transportation, and Non-exercise outdoor activities into concrete and measurable constructs. It may be that we aimed too broad at two levels; firstly regarding the incorporation of four aspects, and secondly related to the number of indicator items for each aspect. Therefore, it is reasonable to question the applicability of such a broad and complex summary score, and its ability to measure the selected constructs.

The NND score, being one of the four incorporated subscales in the HSDPA score, was previously developed (92). We had the opportunity to revise it; still we chose to keep the scale in its initial form, since the NND score has shown capability of

discriminating adherence groups according to food and nutrient intakes (92), and higher ratings on the NND score has shown to associate with favorable health outcomes (92, 116). The fact that we also found increased intake of healthy dietary aspects among high NND adherers, yet not higher intake of less healthy foods and nutrients (paper II), supported the decision to refrain from adaptations of the score. Contrary to the NND score, the three additional subscales, i.e. Local and sustainable foods, Active transportation and Non-exercise outdoor activities, were novel. Indicator items were selected weighting up relevance and the comprehensiveness of the questionnaire, as the latter determined respondent burden. Yet, all subscales turned out rather broad and comprehensive, especially the subscale Local and sustainable foods incorporating locality, seasonality, organic foods, share of plant foods vs. animal foods, recycling and food waste, self-growing, and gathering. Furthermore, number of indicator items for each subscale ranged considerably (from 8 (Non-exercise outdoor activities) to 24 (NND, total score)), question formulation and response options differed across the subscales, yet each subscale was assigned equal weighting. In addition, not all terms were clearly defined. For instance "local" foods; at present there is no agreed definition in the literature (179), and we did not explicitly explain in the questionnaire what we meant by "local" foods, which could result in different interpretations across respondents. Besides, as the questionnaire was constructed prior the literature review forming the basis for paper III, the aspect Non-exercise outdoor activities (paper IV) was slightly less scrutinized than the aspect PA conducted in the local community (paper III). Therefore, it might be that the latter aspect is the one that should have been included into the HSDPA score, rather than Non-exercise outdoor activities. Besides, it may be that a simpler score, constructed from fewer and more precise indicator items, would function better than the score we ended up with. If the HSDPA score violates construct validity (178), the reported associations between the incorporated dietary and PA habits and potential correlates (as investigated in paper IV), or different health parameters, would be biased (88, 89). Nevertheless, a simple unitary index constructed from self-reports assessing diet, exercise and psychological stress, was newly reported to associate with elements of metabolic syndrome and cardiovascular health profile across adherence groups (121). This express that a crude summary score, aiming to serve as a proxy for a healthy lifestyle, could possibly distinguish subjects according to degree of compliance with the aspects of interest, and further capture relations between adherence and health outcomes. Consequently, the HSDPA score might entail such a capacity as well, potentially allowing it to function as a measurement tool in future studies.

5.1.1 Sustainable physical activity

In light of the ambitious goals of the Paris Agreement, and the fact that various types of PA could provide equal health benefits yet widely different environmental impacts, one specific aim of this thesis was to bridge the topical issues of sustainability and PA through introducing, defining and discussing the novel concept of sustainable PA. Therefore, in paper III we introduced and defined sustainable PA, and suggested certain PA habits based on their sustainability properties; *Active transportation* is one mean of transportation entailing less carbon emissions, as well as being an opportunity for increased PA levels, contrary to car use and other forms of motorized transportation (see additional argumentation in chapter 5.1.2 below, as part of the rationale for choosing the specific aspects included in the HSDPA score). Moreover, *PA conducted in the local community* is likely to favor sustainability as it makes motorized transportation redundant, resulting in less use of fossil fuel and decreased emissions of climate gases. Some forms of exercise, like running and walking, could for many be conducted just as well from the home instead of driving to the gym in order to use a treadmill. Also in terms of children's leisure activities, those conducted locally and in sport clubs in the neighborhood would be advantageous, allowing children and adolescents to walk or bike to their activities. Hence, attributes of the physical environment promoting locally-based PA throughout the life course would be of outmost importance for both PA level in all age groups and amount of GHGs emitted. *Going "back to basic" using less equipment and appliances* for everyday tasks and leisure activities could contribute towards energy balance through increased PA, and could also decrease resource use. Although daily tasks are accomplished more time efficiently due to these appliances, and physical disabilities caused by continuous heavy labor have been reduced (10), the price to pay is likely to be increased sedentariness due to lower levels of everyday activity, in addition to enhanced emissions of GHGs related to the use of household equipment, and to production, distribution and disposal of goods (180). The strong materialization of leisure activities that has taken place more recently should also be considered, as it entails increased demand for specialized equipment and clothing (62). In this regard, activities requiring less equipment and amenities would be more carbon friendly (181) and thus preferable. Finally, *balancing energy expenditure and energy intake* could favor both human and environmental health. Yet, if PA increases to recommended levels for the population as a whole, it will also increase total energy expenditure. Since long-term increased energy expenditure seems to relate to increased basal hunger (182), overall energy intake may be higher (182), which in turn is likely to entail demand for

enhanced food production. Worldwide dietary energy supply for the years 2014-2016 is calculated to be 12 146 kJ per person per day, which should be sufficient for meeting energy requirements for the current world population (183). Still, approximately one billion people live in chronic hunger (36), while about 1.9 billion adults are overweight or obese (50), illustrating global imbalance in energy distribution.

If putting these possibly sustainable PAs in context, they may be considered to comply with the recently proposed Environmental Nutrition Model (ENM) (123), yet targeting PA rather than nutrition. The ENM includes three dimensions; human nutrition, community nutrition, and environmental nutrition, emphasizing the interaction between current food systems, public health and the environment, and the fact that the nutrition of individuals and communities can only be maintained within an environmentally sustainable context (123). If adapting the principles of Sabate et al.(123), corresponding dimensions would be human PA, community PA and environmental PA, highlighting the relevance of a broader approach in order to meet the interrelations between PA, human health and environmental sustainability.

5.1.2 Rationale for the HSDPA score

Going one step back, prior to the operationalization of the four selected aspects in the HSDPA score, the rationale for choosing these specific dietary and PA habits ought to be described more thoroughly. In accordance with current knowledge regarding foods potentially inhibiting the global burden of disease (16), and foods with lower environmental impact (44, 45), the concept of *NND* is characterized by a high content of vegetables, fruits, berries and whole grains (85, 87). Health benefits of plant-based diets are well documented (14, 16), whereas intake of processed meat appears to be a major dietary risk factor for cardiometabolic diseases (184), and colorectal cancer (185). Intervention trials investigating a designed, healthy Nordic diet in at-risk populations have reported beneficial effects on inflammatory markers and lipid profile (186), a decrease in cholesterol and body weight (187), and lowered diastolic blood pressure and mean arterial pressure (188). Concerning the NND more specifically, a 6-month trial assessing possible health effects in centrally obese adults showed that NND, when given ad-libitum, resulted in weight loss and reductions in both systolic and diastolic blood pressure (189), and a 12-month follow-up revealed higher dietary satisfaction and reduced body weight regain when compared with an average Danish diet (190). Moreover, observational studies have found compliance with Nordic diets

to be associated with lower mortality (90, 111) and reduced risk of non-communicable diseases (91, 112-115). Also, positive associations between adherence to the NND and optimal gestational weight gain and improved fetal growth has been reported (92), as well as lower risk of preeclampsia and preterm delivery (116). Still, other investigations failed to demonstrate associations between Nordic diets and breast cancer (191), colorectal cancer (192), or diabetes type 2 (193), and found equivocal relations with cardiometabolic risk factors (194).

The sustainability principle of the NND concerns food security without harming the environment (55), through focusing on locally grown, organic foods, wild game, foraged wild plants and fungi, in addition to reducing meat intake and minimizing food waste (55). The NND seem to cause lower environmental impact mainly due to the reduced meat content and exclusion of most of the long distance imports (130). In general, the NND could be considered an importation of the principles behind the traditional Mediterranean diet, i.e. more plant food, less meat, harvesting of nature, less processed foods and thus more local, natural foods (12). Likewise, other regions have the potential of health promoting and sustainable diets based on local foods, possibly preserving cultural diversity in eating habits (84, 85). Despite the inherent focus of the NND on Nordic identity and seasonally relevant plant foods (87), the NND score does not capture if incorporated foods really are sustainably produced or of Nordic origin (195).

Thus, *Local and sustainable foods* constitutes a separate topic emphasizing local produce, and preservation of traditional food culture, the latter on grounds of its intrinsic value. Inspired by FAOs definition of sustainable diets (36), we define "sustainable foods" as foods that promote health, protect biodiversity and ecosystems, and are culturally and economically acceptable and accessible. The environmental impact of dietary patterns depends on numerous factors like food production method and share of plant foods vs. animal foods (4, 43, 44, 196), yet reduction in meat consumption is considered the most relevant aspect (45). Still, choosing local and seasonal foods would reduce climate gas discharges related to transportation and cooling underway (51), and local produce is relevant for food and nutrition security. Moreover, sustainable food production should focus on combating food waste, as roughly 30% of all foods produced are either discarded or lost (43). Also, as a result of using organic fertilisers and less use of pesticides, as well as accounting for animal welfare (54, 55), organic produce is assumed to cause lower environmental impact than conventional agriculture (53). Total environmental footprint is however unclear

because of lower production per unit of land, differences across food types (51), and use of external energy e.g. for greenhouses (12). Regarding health benefits, locally produced foods may be fresher and provide higher nutritional quality due to short time between harvest and consumer access to foods, and less intensive processing (197). Despite controversy whether organic produce result in greater concentrations of potentially beneficial compounds, a recent meta-analysis reported that organic crops, on average, have higher concentrations of antioxidants, lower concentrations of cadmium and a lower incidence of pesticide residues than conventional crops (198).

In order to curb the increased carbon emissions from the transportation sector, a scenario combining infrastructure development, land-use policies and behavioral interventions has been suggested, including a shift to low carbon intensity modes such as *active transportation* (57). Active transportation is possible to a large degree in many regions, and could be conducted not only to school or work, but also to various destinations during leisure time such as to the store, the city centre, and for transporting children to the kindergarten. Supposing that transport is a necessity on most days for the majority of people, not the least parents of toddlers, active transportation may be a feasible and time efficient way to increase PA levels (24). Being active while travelling to and from daily tasks may save time otherwise needed to be scheduled for additional structured exercise (199). Active transportation has shown inverse associations with cardiovascular risk (24, 28, 32), type 2 diabetes (24, 32), obesity (24, 26, 27, 32), and also breast cancer and colon cancer (24), while positive associations have been reported for physical fitness (24). Moreover, cycling for transportation has been reported to decrease mortality risk by approximately one third, due to higher levels of PA (29, 30). In total, increased active transportation is likely to favor public health for the commuters themselves through greater amounts of PA, but also for the population in general as a result of reduced exposure to air pollution (24) and decreased carbon emissions (5, 35). Noteworthy, e-bikes may represent an unexploited potential in terms of increased bicycle use, i.e. more frequent biking and longer trips (200-202) possibly favoring both public health and the environment through increased levels of PA (203, 204) and decreased emissions of climate gases (205, 206). Still, total emissions is influenced by aspects such as local electricity mix, infrastructure characteristics and mode-shift behaviors (206).

Like for active transportation, *Non-exercise outdoor activities* conducted in the local community, e.g. playing, gardening, cycling, or walking in the neighbourhood, could decrease carbon emissions related to motorized transportation. Further, non-exercise

physical activities have shown to associate positively with cardiovascular health and longevity in older adults, independent of regular exercise (207). Exposure to natural or "green" environments may possess its own intrinsic value, as relations with lower stress level, decreased blood pressure, and physiological and psychological restoration have been reported (208), in addition to increased well-being, also when controlling for level and type of activity (209). In the Nordic countries hiking in the nature and outdoor life have long traditions, but research on potential health effects of outdoor life as such, is scarce (210). Still, a Norwegian study showed that parents in which the families go for hiking in the nature at least once a week were less overweight than parents in other families (211). Nevertheless, values, preferences and content related to outdoor life could be culturally dependant (210). For instance, immigrant women tend to prefer trips in the local community for economical, practical and social reasons (212), which is likely to be true for other populations as well. Car dependence, however, is naturally influenced by place of residence- if living in an urban area hiking would in most cases entail motorized transportation to and from, while from a rural location picking berries and hiking may be conducted more or less from home. In turn, degree of accessibility may influence individual preferences for outdoor life. The importance of the built environment for engagement in PA in urban areas was recently documented by Sallis et al.(213), concluding that individuals living in PA-friendly neighborhoods, i.e. neighborhoods with high park density, net residential density, intersection density, and public transport density, conducted 10 minutes more of moderate-intensity PA per day compared with those living in the least PA-friendly neighborhoods. In turn, 10 additional minutes of PA daily would make two-thirds of inactive persons adhere to current international PA guidelines (214).

When we operationalized these potentially healthy and sustainable diet and PA habits into four separate subscales, further merged them into the total HSDPA score, and addressed potential socio-demographic correlates, we found that higher educated participants and those living more centrally seemed to comply with such an integrative approach to a larger degree than participants with lower education and those living less centrally. Our findings agreed with current literature regarding relations between socioeconomic status and overall dietary quality (146), adherence to healthier dietary patterns (71), and increased engagement in PA in general (10, 147, 148). Nonetheless, when we addressed the subscales separately, our results were partly differing from the results reported in earlier studies, which could be related to sample characteristics, to questionnaire items and construction of the HSDPA score, or to the general issue of

misreporting when subjects self-report PA and dietary intake (73, 215, 216) (see paper IV for a thorough result discussion). Despite these potential methodological explanations for our findings, it should be questioned if the HSDPA score represents an elitist approach, based on the relatively low scoring in all subgroups. That is, we could have chosen behaviors potentially promoting health and environmental sustainability, yet behaviors failing to meet sustainability issues in a broader sense, entailing acceptability and accessibility for all (36). On the other hand, our findings may be considered to support current knowledge that those with lower socioeconomic status are less likely to engage in health related behaviors (149), and underpin the importance of tailoring interventions to individuals who are in the greatest needs of more favorable lifestyle habits. If so, the results of our study indicated that interventions could be tailored to low educated groups and to those living in non-central areas, in order to facilitate increased adherence to dietary and PA habits potentially promoting public health and environmental sustainability.

5.2 Methodological issues related to summary scores

Summary scores, targeting either dietary patterns or a broader approach, are composite tools aiming to assess and quantify constructs being difficult to measure quantitatively and accurately (89). Such indices are widely used, especially within nutritional epidemiology, for operationalizing dietary patterns as a single exposure and investigating overall diet in relation to health (89). Dietary scores entail advantages like capturing more of the overall diet and possible synergistic effects of foods eaten in combination (67, 71, 72). Also, dietary scores could overcome the issue with multicollinearity and further decreased accuracy of predicted associations, which often occurs when highly correlated components are included into the same model (65). Besides, such scores could control for possible confounding from the overall diet when examining relations between specific nutrients or foods with health outcomes (65). Moreover, from a public health perspective dietary scores may function as easily applied tools communicating a clear message, considering that a cluster of foods may appeal more to the public than information regarding individual nutrients and foods (90). There are, however, limitations related to the use of summary scores. Firstly, inclusion of selected aspects only could confound potential associations between the score and the parameters under investigation, that is, increase the likelihood of residual confounding. Thus, in order to isolate the relations between the variables of interest as far as possible, possibly confounding lifestyle and dietary factors not included in the score need to be taken into account. Nevertheless, summary scores cannot be specific

about the separate contribution of each included component, meaning that inferences about more precise etiological associations requires investigation of each separate component (65). Also, subjectivity is introduced related to selection and scoring of included components, cut-off values, and weights that should be assigned to each component (72, 88). Based on the literature, there is currently no superior approach to determine cut-offs. For illustration, when cut-offs are applied for dichotomizing subscales within a dietary score, the full range and variability of food consumption is not considered, which could affect observed associations between dietary adherence and health (89). Subjects with rather widely differing intakes could be classified into the same category, while subjects with relatively similar intakes could be categorized into different groups, if their scoring is close to the cut-off point. Moreover, it is not certain that the median reflects a healthy level of intake per se, and when items or subscales are dichotomized by the group median, dietary behavior required for scoring will differ between populations and samples, which in turn may lead to different strength or magnitude of diet-disease associations in other populations. On the other hand, a dichotomization will ensure that each item or subscale distinguishes well and in the same way between subjects in the study under investigation (88). Regarding the contribution of each component to the total score, equal weighting is the most common approach, assuming that all dietary components are of comparable importance. This may be questioned as the specific impact of the various dietary components would differ according to the outcome. Hence, a weighting could increase the predictive potential of the total score, depending on the outcome of interest (89). Summary scores constructed to capture adherence to a regional diet, i.e. Mediterranean diet scores, have shown to be more predictive of diet-disease relations than scores constructed on the basis of dietary guidelines (89). Nevertheless, dietary scores seem to measure diet quality adequately (89), and is generally considered more successful in predicting chronic disease and mortality than separate dietary elements (67).

5.2.1 The NND-score

Perspectives related to the NND score exemplify some of the issues in the general discussion above; The NND score included mainly low-processed and apparently beneficial foods, and to a lesser extent highly processed or less healthy convenience foods. For use in epidemiological studies, this likely limits its ability to capture associations between diet and diseases more strongly related to the consumption of less healthy foods. Also, less beneficial foods not included in the score and consumed in different amounts across NND adherence groups could attenuate environmental

advantages theoretically related to increased adherence to the NND (195). In light of current knowledge regarding increased risk of cardiometabolic diseases (184) and colorectal cancer (185) related to intake of red and processed meat, as well as adverse environmental effects (4, 43-45, 196), meat is one dietary aspect that might strengthen the predictive potential of the score if included. Moreover, incorporation of a subscale on the consumption of oils and fats, and maybe spreads and cheese, could have resulted in a wider distribution of fat quality across NND adherence, and further stronger associations with some of the outcomes previously addressed (92, 116). Like discussed above for summary scores in general, this is a matter of construct validity; if the dietary score actually captures what it intends to capture. Considering the contribution of each component to the total score, the dietary factors were apparently assigned equal weighting since all subscales accounted for one point. Yet in reality there was a weighting, as four subscales concerned fruits and vegetables (Nordic fruits, root vegetables, cabbages, and potatoes) and two subscales addressed consumption of whole grains (whole grain breads and oatmeal). Additionally, four subscales (i.e. the subscales concerning potatoes (no.5), whole grain breads (no.6), milk (no.9), and water (no.10)) were constructed based on the ratio between the typical Nordic foods/beverages and alternative foods/beverages not part of the concept NND, to capture a favorable composition of the diet independent of energy intake. In other words; to ensure that participants did not obtain scoring due to higher food intake per se. Noteworthy, the aim of the NND score was not to achieve maximal predictive power, nor to measure the exact influence of separate constructs, or to reflect the healthiest diet possible. Rather, the NND score aims to reflect the broader aspects of eating behavior, and compliance with a realistic regional dietary pattern with some degree of expected health benefits (92).

Even though dietary scores are established as a complementary approach for exploring relations between dietary patterns and various health outcomes, and the use of broader summary scores seems to emerge as well, few studies have examined methodological examinations related to such scores. For instance regarding the reliability (65, 72), i.e. the degree to which repeated measurements in the same subjects provide similar results (73). This applied for the NND score as well, hence one specific aim of the present study was to test its reliability (paper I). In light of commonly reported reproducibility of nutrient intakes and other real-life biological measurements (73), and compared with previous studies addressing test-retest reliability of dietary indices through correlation coefficients (217-220) and percentage correct classification (221,

222), we concluded that the NND score showed acceptable test-retest reliability (see paper I for a more thorough result discussion). It should be mentioned, however, that if more items were included in the FFQ from which the NND score was derived, the reliability of the score could potentially be additionally increased, and the FFQ may be strengthened as such. For illustration, if the FFQ segregated different types of Nordic fruits, root vegetables and cabbages, instead of assessing these foods by one item only as in the current version, it would enable more detailed responses, which in turn could reduce random error. Besides, more items would provide a wider distribution of scores, and result in greater inter-subject variation. On the other hand, additional items would imply a more time consuming form and thus increased participant burden.

In addition to reliability concerns, there may be issues related to the methodological approach applied for assessing dietary quality associated with degree of adherence to selected dietary patterns. More specifically, former studies addressing predefined healthy Nordic diet scores revealed coexistence of healthy and less healthy dietary aspects among adherers (92, 101, 154), yet they all used the same FFQ responses for constructing the diet score as for calculating intakes of foods and nutrients, which may be questioned from a methodological point of view (discussed in paper II). Hence, we aimed to explore the association between adherence to the NND, derived from a FFQ, and diet quality, determined from two 24 hour dietary recall interviews (paper II), i.e. using two separate methods. In compliance with the three earlier studies (92, 101, 154) examining dietary composition and nutrient intake related to three different Nordic diet scores, we found that "high" NND adherers reported a more favorable diet in general, and higher intake of fruits (92, 154), and dietary fiber (92, 101, 154). Contrasting previous findings (92, 154), however, higher intake of meat or sweets was not observed among "high" NND adherers in our study, nor higher energy intake or higher physical activity levels (92, 101, 154). Potential reasons for these partly differing results between the current study and the previous studies are carefully described in paper II. In short, it could reflect a possible methodological advantage related to the approach in our study, i.e. applying two separate methods, or it may be explained by the several limitations of our study, or by the characteristics of our study sample, including collection of recent data. Regarding the latter, or findings may indicate timeliness of the NND score, i.e. that it captures a healthy diet to a larger degree when applied in more contemporary samples. Nonetheless, we believe that scrutiny regarding potential methodological bias is of importance, as such bias may

result in false inferences concerning diet-disease associations, or other relations under investigation.

5.3 General methodological discussion

5.3.1 Study design

The test-retest reliability study
In the reliability study (paper I) conducted as part of the methodological study, the time period between the test and the retest distribution of the HSL questionnaire was 14 days, considered to be long enough to avoid increased reliability due to memory. Still, we cannot entirely rule out that some participants were capable of recalling their own answers in the test-form, when filling in the retest-form (73). If so, the true reliability of the NND score could have been overestimated in the present study. On the other hand, it is likely that a period of one year between the test and the retest administration of the questionnaire, as used in former studies (217-220), may result in decreased correlations because of true changes in dietary intake rather than poor questionnaire performance. Nevertheless, a great range of time intervals between administrations have been used in previous studies (157), also two weeks (155).

Exploring the associations between NND adherence, dietary quality and level of PA
In paper II we addressed the associations between adherence to the NND and dietary quality using two separate methods, which is likely to entail less correlated errors than if the same method was applied for both operations (73). Unlike previous studies using FFQ data for both deriving the dietary score and for calculating intakes of foods and nutrients (92, 101, 154), we did not reveal a coexistence of healthy and less healthy dietary aspects among "high" NND adherers. An inherent assumption for the rationale of this study was that the observed healthy associations were the expected ones, yet in light of the methodological principles discussed in paper II (e.g. artificial covariance), we cannot be certain if the healthy associations are "truer" than the less healthy ones. Nevertheless, since the different Nordic diet scores (92, 101, 154) all include health as one of the foundational principles, we believe it is more reasonable to expect intake of healthy foods and nutrients among high adherers, than dietary elements considered less healthy. It may support our assumption that Benitez-Arciniega et al. (223), when assessing the construct validity of two FFQ-derived Mediterranean diet indices, hypothesized that both indices would be associated with a favorable nutrient intake profile, which they also did find. However, the authors stated that comparing FFQ

responses with 24 hour recall data could imply correlated errors, since both methods are dependent upon participants' memory, which in turn would apply to our study as well. And, naturally the two studies cannot be directly compared, since we did not conduct a validation study, and our study was impaired by a limited number of dietary recalls, a small and homogenous sample, and not accounting for seasonal variations in dietary intake. Besides, a potential disadvantage related to the use of separate methods, is that we did not measure entirely the same dietary aspects across the measurements, in contrast to the previous studies on Nordic diet scales (92, 101, 154).

The cross-sectional study

A cross-sectional design does not allow for drawing inferences regarding cause and effect since exposures and outcome are measured at the same time point, i.e. one cannot rule out if the exposures are consequences of the perceived outcomes, rather than real exposures (224). On the other hand, cross-sectional studies are suitable for obtaining prevalence data at a given specified time, for monitoring time-trends, for generating hypothesis, and not the least for exploring associations between potential correlates and the outcome of interest (224). Thus, as investigating relations between the HSDPA score and socio-demographic correlates was the main aim of the present study (paper IV), the cross-sectional design was appropriate.

Sustainable physical activity- a discussion paper

In paper III we introduced and discussed the novel concept of sustainable PA. No original data was collected; rather we explored relevant literature within the fields of interest, i.e. active transportation, locally-based PA, decreased use of appliances and equipment for everyday tasks and leisure activities, and energy balance. Yet, we did not apply a structured approach, that is, we conducted a literature review, not a systematic review. Hence, the likelihood of missing some relevant aspects was increased, and we cannot be sure that the included PA habits are the most reasonable and relevant ones.

5.3.2 Study samples

A family approach was chosen for the current project, targeting dietary and PA habits among parents of toddlers. Parents are important facilitators of healthy and sustainable eating (225) and PA habits in their kids, and parental lifestyle behaviors are crucial for both their own and their children's health. Also, lifestyle behaviors such as diet and PA track from childhood into adulthood (226, 227), and overweight and obese children are more likely to become overweight and obese adults than normal weight children

(228, 229). Therefore, prevention at an early stage is of outmost importance. Nevertheless, most parents with children in kindergarten-age are very busy, and lack of time is repeatedly reported to correlate inversely with levels of PA (148), and to represent a common barrier to food preparation, which in turn relates to increased fast-food use (230). Accordingly, perceived time pressure has been found to affect home-cooking negatively (231). Thus, parents of toddlers are an important target group, yet likely also challenging to recruit for participation in research projects due to perceived time scarcity. This may partly explain the low participation rate in the methodological study (7%), resulting in a small sample size and the majority being females, native Norwegians, and highly educated, i.e. likelihood of selection bias. Therefore, it is reasonable to believe that participating parents were more health-conscious and more likely to adhere to a favorable lifestyle than parents of toddlers in general (paper II), and maybe also to provide more reliable and repeatable answers due to higher motivation (paper I), which in turn precludes the generalizability of study results. Although the primary objective of methodological studies seldom is generalizability, this limitation should be accounted for when interpreting the findings.

Moreover, like for the methodological study the participation rate in the cross-sectional study was low (20%), and the sample was somewhat biased towards females, native Norwegians, and those highly educated, again limiting the generalizability of results. Besides, the different sizes of sub-groups, e.g. females (90%) vs. males (10%), could have decreased statistical power and hampered significant outcomes. It should also be mentioned that the inclusion criteria requiring capability of reading and understanding Norwegian and having a child in kindergarten, which applied for both the methodological and the cross-sectional studies, likely contributed to selection bias and non-representative samples.

Recruitment of participants

Considering the low participation rates, the approach for recruiting participants should be discussed. In consultation with the regional leader of the kindergartens from which parents were recruited for the methodological study, we decided to invite parents by e-mail only; no hard copies were handed out. Additionally, we were not in direct contact with the leader of each kindergarten, the regional leader communicated all required information. In retrospect, one may question if a more advantageous approach would be to communicate directly with all the leaders, to inform parents through both e-mail and hard copies (like done in the cross-sectional study), and to utilize potential possibilities provided by social media such as Facebook; the latter applying for the

cross-sectional study as well. Through use of social media for marketing the study and distribution of information, we would be less dependent on the goodwill of the leaders; i.e. that they actually did distribute the information to the parents, as agreed. The mismatch between number of kindergartens signing up (*n*=309), and number of kindergartens from which parents enrolled (*n*=207), may give reason to question if all parents actually were provided information, yet this is only speculation. Also, it could be that an easier procedure for signing up the kindergartens in the cross-sectional study would result in more leaders to do so, e.g. through e-mail instead of filling in a short form using the software SurveyXact. Nonetheless, recruitment of participants would still be challenging, and there are several considerations to account for, not at least ethical perspectives. Besides, one should bear in mind that many kindergartens are frequently requested for participation in surveys and research projects; hence the leaders need to prioritize strictly what to engage in. Although our study did not entail other strain than signing up the kindergarten and providing eligible parents with information, it is still an additional task to accomplish in an already hectic schedule. In this regard, the principle of beneficence (232) is relevant, expressing the importance of accounting for fundamental ethical principles (discussed in chapter 5.4 below).

5.3.3 Measurement instruments

The web-based questionnaire

At the population level questionnaire surveys are efficient for measuring the given parameters; they can be implemented on a large scale, they are relatively inexpensive, and they do not alter the behaviors under investigation (233). According to Statistics Norway, virtually all households with children have internet access (234). In order to maximize accessibility, the web-based questionnaire in the present study was compatible with smart boards and smartphones as well. The drawback, however, by questionnaire surveys and other self-reports in general, is that they are somewhat time consuming, and prone to measurement error caused by day-to-day variations and reliance on participants' memory and estimations (73). Misreporting, especially underreporting of foods considered unhealthy and over reporting of PA levels, are common challenges when data are self-reported (73, 235) . There could be several possible reasons for such misreporting, e.g. social desirability response bias (117, 118), misinterpretation of questionnaire formulation, or recall bias. The tendency to give social desirable responses has been estimated to explain from 10% to 75% of the variance in participants' responses, expressing the validity issue related to self-reports (236). Social desirability is however multidimensional, affected by the nature of the

questions asked, personality traits, as well as the test situation (118). If the test-situation does not generate strong motivation the likelihood of providing expected responses is reduced (118), making the use of a web-based questionnaire a potential advantage due to the absence of the researcher. Supporting this, it has been claimed that there is less social desirability bias in mail surveys than in personal or telephone interviews (236). Nevertheless, the HSL-questionnaire was not tested for validity. Due to the lack of a perfect reference method for dietary measurements (73), and since doubly labelled water, recognized as reference method for assessing total energy expenditure (237) entails feasibility issues (170), validation studies are generally difficult to carry out for questionnaires assessing dietary and PA aspects. Also, since we addressed behaviors rather than more specific measures such as absolute dietary intake, validation becomes extra challenging. One example is the FFQ-part of the questionnaire, which assessed frequencies only, not amounts. Besides, if the included indicator items were sufficient for measuring the constructs we intended to measure, still ought to be questioned. Because of the cooperation with the Preschoolers' Food Courage project (158) selection of items needed to be strict; only items considered the most relevant were included in the questionnaire. However, the comprehensiveness of the form, meaning increased participant burden, was still a limitation.

24-hour dietary recall interviews

Repeated 24-hour recall interviews have been quality tested and recommended as a relatively simple and low-cost method for collecting representative data on a population or group level (167, 238), which applied to the present study as participants were grouped into low, medium or high NND-adherence (paper I and II). Nonetheless, due to the limited sample in the methodological study, more than two 24 hour recall interviews should ideally have been conducted to reduce the influence of day-to-day variations in food consumption. Moreover, as both FFQs and 24-hour recalls are retrospective methods, there could be more common errors than if dietary records were applied as the reference method (73). Besides, seasonal variations in dietary intake were not recorded, since our data was collected during springtime only. Like for increased number of recall interviews, a wider distribution across all seasons would enlarge the likelihood of recording habitual dietary intake, further strengthening the methodological approach.

Physical activity measurements and anthropometrics

There is a general consensus that under field conditions, accelerometry-based devices provide a reliable, valid and accepted indicator of PA level, measuring frequency,

duration and intensity of the activity (239). The monitor SWA has been reported to correlate sufficiently with reference methods regarding measurement of daily energy expenditure, and also regarding recorded time in MVPA, in free-living adults (240). Still, the monitor does not fully capture static activities such as bicycling and strength training (119), and slight underestimations of total energy expenditure, in addition to overestimations of time engaging in MVPA have been reported (170, 240). Contrary, in our sample we recorded that all groups (i.e. "low", "medium" and "high" NND adherence) expended far more energy than they reported to consume. Possible explanations for this discrepancy could be increased PA levels caused by awareness of being observed, i.e. the Hawthorne effect (241), or low energy intake as a result of misreporting or underreporting of food consumption (235). Besides, like for the dietary assessments, we could neither account for seasonal variations in PA level, since PA measurements were conducted in springtime only as well. Season has been identified as one factor influencing PA level, especially if there are large variations in temperature and daylight (242), which applies for Norway. Nonetheless, observed seasonal effects in PA levels were small in a large sample of the adult Norwegian population, entailing somewhat lower PA levels during the winter (243).

When addressing participant's body mass (paper II), we chose to use BMI (calculated from measured height and weight, not self-reports) instead of fat percentage as an indicator, although data on both fat percentage and visceral fat were available from the bioelectrical impedance analysis (InBody 720). The main argument for this choice of method was that, unlike for BMI, there are no internationally accepted cut-offs linking fat percentage to health risks due to a lack of appropriate prospective studies (244). In addition, the basis for comparison with previous studies is increased when applying BMI results, since fewer studies have reported fat percentage. And, despite that bioelectrical impedance analysis are considered sufficiently valid for assessing body composition (174, 175), it does not represent a "gold standard" reference method, hence entailing sources of error . It should also be noted that body composition was not a study outcome, rather a relevant sample characteristic. Nevertheless, in hindsight it is reasonable to question this methodological choice, as abdominal fat is recognized to be highly associated with metabolic disorders, hence being a stronger predictor of health risk than BMI (245).

5.4 Ethical perspectives

The Regional Committee for Medical and Health Research Ethics (REK) was applied for ethical approval for the HSL project, in collaboration with the Preschoolers' Food

Courage project. Yet, as the projects were not comprised by the Health Research Act, it was sufficient to obtain research clearance from the Norwegian Social Science Data Services (NSD) (appendix 2). All research involving human subjects needs ethical justification regarding its importance and how to be conducted according to participants' best interest. Research on health-related behaviors such as diet and PA habits does involve some burden, but it also provides knowledge relevant for monitoring current situation in the population of interest. In turn, this knowledge could inform future interventions, policies and practices favouring both public health and the environment. Minimizing risks of harm or discomfort to study participants is one main responsibility for the researcher, and must be strived for (232). As stated in the Declaration of Helsinki, protection of individuals is more important than the purpose of generating new knowledge and utility of the society as such (246). Diet, PA and body composition are sensitive issues for some individuals, and not complying with the perceived social norm related to these aspects may contribute to a feeling of failure, and disturbed feelings.

The overarching aim of the present thesis was to construct a crude summary score capturing the interrelations between diet, PA, health and environmental sustainability. To enable this, the HSL project included development of a novel questionnaire. In order to assess its quality, the questionnaire was tested against reference methods in the methodological study. The project did not contradict a normal set of ethical values (246) and it did not involve any risks; pregnant women were excluded from the InBody analysis, and participants with nickel allergy were advised to refrain from the SWA measurements. In line with the requirement of voluntary informed consent (232), all participants were given detailed information regarding the purpose and implications of the study (appendix 3 and appendix 6), and their right to withdraw from the study at any time without any consequences, prior providing consent electronically. Potential sensitive measures were the questionnaire items assessing ethnicity and certain health aspects, in addition to the 24-hour dietary recall interviews, as well as the InBody and anthropometrics measurements. Yet, participants could wear light clothes during all measures, the measures were rapidly completed, and a careful appearance (247) was strived for. Also, sensitive questionnaire items were left "open" in the web-based questionnaire, meaning that participants could progress in the questionnaire without answering these. Attempting to meet the principle of beneficence (232), participants in the methodological study were offered a free trial session at the fitness center Spicheren, in addition to a "health report" (appendix 5)

including a summary of their own results, and a comparison with national recommendations and data from representative samples of the adult Norwegian population (162, 165). Furthermore, staff from included kindergartens were offered an evening lecture on relevant topics concerning diet and PA. For the cross-sectional study participants were in the draw for two vouchers (5000 NOK each) on healthy foods, while included kindergartens were in the draw for one voucher designated kitchenware (5000 NOK). The amount aimed to balance incentive and truly voluntary participation. The data collected in the present project were not likely to result in severe adverse consequences for the subjects, yet confidentiality was secured through de-identification, providing only the research leader access to the identification key connecting the subjects with the data. Although potential negative consequences of participating in the HSL study could not be completely ruled out, we believe that potential benefits outweighed potential harms. One current drawback, however, is that due to a focus shift during the project some collected data has not yet been analyzed, mainly from the physical activity and the body composition measures. Still, we aim to process these additional data in the near future, and disseminate the results.

5.5 Implications

In the present thesis we aimed to develop a novel measurement tool for use in future observational or intervention studies, in the forms of a combined summary score capturing the interrelations between diet, PA, health and environmental sustainability. Considering the limitations of such a broad score, thoroughly discussed herein, it is reasonable to question what the HSDPA score actually measures, and thus its applicability. Nevertheless, a simple unitary index serving as a proxy for a healthy lifestyle, was newly found to associate with elements of metabolic syndrome and cardiovascular health profile across adherence groups (121), expressing a capacity potentially applying for the HSDPA score as well. Still, even if "expected" associations are found, one cannot rule out that the score may be a proxy of something else, e.g. social status. Therefore, due to the current uncertainties related to the validity of the HSDPA score, it is likely more realistic to consider it an instrument suitable for descriptive purposes and for monitoring time-trends, rather than for use in epidemiological studies. For instance, the score may be used for assessing degree of adherence to selected diet and PA habits across subgroups, like conducted in the present study (paper IV).

On the other hand, the NND score and the ten subscales appeared to have acceptable test-retest reliability when tested in the current study. Also, we found that in a recent

sample, higher NND adherence was associated with higher intake of selected healthy foods and nutrients, yet not higher intake of meat, sweets, and energy in general, as earlier reported in adherers to predefined healthy Nordic diets. On the basis of these observations, together with previous study results, the NND score tends to be capable of ranking and segregating subjects according to degree of adherence, and to associate with a generally healthy diet. Moreover, in the light of former findings, the NND score seems qualified for detecting potential associations between degree of compliance with various health outcomes, hence it is plausible to assume that it could function as a crude measurement tool also in future epidemiological studies.

This discussion, however, illustrates the importance of methodological perspectives and scrutiny related to both the development and testing of complex summary scores. Bias related to scores as measurement instruments could preclude inferences regarding diet-disease relations, or other aspects under investigation. At present, one may propose two main approaches for assessing such associations: (i) summary scores, or (ii) single dietary or PA aspects. The score-approach quantifies constructs which are difficult to measure quantitatively and accurately (89), and records the broader picture, while the more detailed approach measures the association between separate elements and the outcome of interest. In total, we believe that also combined summary scores could be applicable for use within epidemiological studies, and for measuring effect of interventions, if accounting for the limitations discussed herein as far as possible. Besides, advocating usage of simple, unitary indices does not exclude the more detailed approach; the two approaches could possibly favor from supplementing each other.

Considering our introduction of sustainable PA, and further discussion of certain PA habits, we feel confident that the proposed sustainable PA habits are reasonable choices, i.e. that they do represent PAs with an inherent sustainable potential. Hence, it may be sensible to question if sustainability issues should be incorporated into official PA recommendations, like it has been done for food-based dietary guidelines in four countries (38). Such an inclusion would be one important step signaling that governments commit to a more sustainable and healthy future through increased focus on PA aspects as well. In turn, such extended guidelines could form the basis for policies seeking to foster PA patterns with potential inherent sustainability traits. Next, there would be a need for appropriate measurement tools to be developed, in order to evaluate the recommendations and monitor PA trends over time in the population. However, active transportation, locally-based PA, decreased use of appliances and

equipment, and energy balance, are most likely not exclusive, rather a foundation for further investigation of other PAs entailing sustainability properties. Most importantly, due to the contemporary challenges facing both public health and environmental sustainability, we are convinced that sustainable PA is a concept deserving increased attention in the time ahead.

6 Conclusions

In order to meet the main objective of this thesis we constructed the HSDPA score; a combined summary score comprising selected aspects chosen on the grounds of their potentially health and sustainable properties; (I) NND, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities. The HSDPA score may potentially function as a crude measurement tool for monitoring time-trends regarding adherence to the selected aspects in different sub-groups of the population.

The NND score and the ten subscales appear to have acceptable test-retest reliability when tested in a Norwegian sample of parents of toddlers. Together with previous study results, it seems that the NND score is qualified for ranking and segregating subjects according to degree of adherence, and for detecting potential associations between degree of compliance with various health outcomes. We found that higher NND adherence, measured with FFQ, was associated with higher intake of selected healthy foods and nutrients, measured with dietary recalls. However, a higher intake of meat, sweets, and energy in general, as earlier reported in adherers to predefined healthy Nordic diets, was not observed. Nonetheless, due to methodological limitations, inferences cannot be drawn at this point.

Moreover, higher education and centrality were found to be significant correlates of selected dietary and physical activity habits, expressed through ratings on the HSDPA score. These findings indicate that interventions could be tailored to low educated groups and to those living in non-central areas in order to facilitate lifestyle habits potentially promoting public health and environmental sustainability.

Finally, considering that various types of physical activity could provide equal health benefits yet widely different environmental impacts, active transportation, physical activity conducted in the local community, less use of equipment in general, and energy balance, could potentially represent more sustainable PA habits. One may question if sustainability issues should be embedded into official PA recommendations, representing one significant step towards governmental commitment to increased focus on sustainable PA. In turn, such extended guidelines could form the basis for policies seeking to foster PA patterns with potential inherent sustainability traits.

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Paper I

An assessment of the test-retest reliability of the New Nordic Diet score

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ORIGINAL ARTICLE

An assessment of the test–retest reliability of the New Nordic Diet score

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Abstract

Background: There is a growing interest in the New Nordic Diet (NND) as a potentially health promoting, environmentally friendly, and palatable regional diet. Also, dietary scores are gaining ground as a complementary approach for examining relations between dietary patterns and various health outcomes. A score assessing adherence to the NND has earlier been published, yet not tested for reliability.
Objective: To assess the test–retest reliability of the NND score in a sample of parents of toddlers, residing in Southern Norway.
Design: A questionnaire survey was completed on two occasions, approximately 14 days apart, by 67 parents of toddlers [85% females, mean age 34 years (SD = 5.3 years)]. The NND score was constructed from 24 items and comprised 10 subscales that summarize meal pattern and intake of typical Nordic foods. Each subscale was dichotomized by the median and assigned values of '0' or '1'. Adding the subscales yielded a score ranging from 0 to 10, which was further trichotomized. Test–retest reliability of the final NND score and individual subscales was assessed by Pearson's correlation coefficient and Spearman's rank correlation coefficient, respectively. Additionally, cross tabulation and kappa measure of agreement (k) were used to assess the test–retest agreement of classification into the NND score, and the subscales.
Results: Test–retest correlations of the NND score and subscales were $r = 0.80$ (Pearson) and $r = 0.54$–0.84 (Spearman), respectively, all $p < 0.001$. There were 69% ($k = 0.52$) and 67–88% ($k = 0.32$–0.76) test–retest correct classification of the trichotomized score and the dichotomized subscales, respectively.
Conclusion: The NND score and the 10 subscales appear to have acceptable test–retest reliability when tested in a sample of parents of toddlers.

Keywords: *New Nordic Diet*; *health*; *dietary pattern*; *adherence*; *diet score*; *test–retest reliability*

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During the last decades, numerous studies have highlighted associations between adherence to a Mediterranean dietary pattern and health status (1). Despite broad promotion, adherence to this diet is still low outside its traditional geographic regions (2). Suggested barriers for adherence are limited access to ingredients, cultural differences in taste and preferences, and the general difficulty of changing established dietary patterns (3–5). Thus, there is at present a growing interest in whether other regional diets could provide similar health benefits.

The New Nordic Diet (NND) has been proposed as an example of a palatable regional diet, potentially promoting health, environmental sustainability, and preservation of cultural diversity in eating habits (6). The concept NND consists of healthy foods native to the Nordic climate or foods that can be produced in the Nordic climate, such as whole grains, root vegetables, cabbages, berries, certain fruits, wild fish and game, potatoes, and rapeseed oil (6, 7). Intervention studies have reported that adherence to a designed Nordic diet is inversely associated with several cardiovascular risk factors (8), inflammatory markers, and serum lipids (9), as well as positively associated with greater weight loss, blood pressure reduction (10), less body weight regain, and higher dietary satisfaction (11), in at-risk populations. Observational studies have shown that adherence to dietary patterns comprising selected aspects of the Nordic diet is associated with lower total

mortality (12), reduced risk of colorectal cancer (13), lower abdominal obesity (14, 15), less body fat (15), and reduced obesity-related markers of inflammation (16). Adherence to the NND has also been associated with optimal gestational weight gain during pregnancy (17), improved fetal growth (17), and lower risk of preeclampsia and spontaneous preterm delivery (18).

Dietary pattern analysis has emerged as a complementary approach for examining the relationship between diet and health status, entailing conceptual and methodological advantages, for example capturing a larger part of overall diet complexity and potential synergistic effects of foods eaten in combination (19–21). Overall, diet is summarized by a single index or score resulting from the combination of included food components. Roughly, score components are selected either *a priori*, based on previous knowledge or scientific evidence, or *a posteriori* using data-driven statistical techniques like factor analysis or cluster analysis (22). Several dietary scores have been constructed for measuring adherence to predefined healthy diets, often evidence-based dietary guidelines (23), whereas others are developed in order to assess compliance with specific regional diets (12, 14, 17, 24). The NND score was constructed *a priori* in order to explore associations between NND adherence with various pregnancy-related health outcomes in women participating in the Norwegian Mother and Child Cohort Study (MoBa) (17, 18, 25). However, there is a lack of studies examining the reliability of such scores (20, 22). Previous studies have assessed the reliability of *a posteriori* derived dietary patterns among adults (26–30), or *a priori* among children (31). Thus, the purpose of the present study was to assess the test–retest reliability of the NND score in a sample of parents of toddlers, residing in Southern Norway.

Methods

Design and study sample

An appropriate method for assessing longer-term, habitual dietary intake is the food frequency questionnaire (FFQ), as it is rather inexpensive, can be implemented on a large scale, and implies a modest burden on study participants (32). In the current study, data are derived from the project Healthy and Sustainable Lifestyle (HSL), which in 2014 collected data in collaboration with the Child Food Courage project (33). As part of these projects, an electronic questionnaire was developed for assessing lifestyle behaviors, self-perceived health and life quality among parents of toddlers, and food and eating behaviors among their children. A convenience sample, consisting of parents with children born between 2008 and 2011, was recruited through kindergartens. Parents were informed about the purpose and implications of the study by email and through a web page. For each child, either the mother or the father could participate. In total 1,191 parents from 19 kindergartens in the county of Vest-Agder, Southern Norway, were invited to participate, and 86 parents signed up. Parents provided consent electronically, followed by distribution of the questionnaire survey by email. The time period between the test and the retest distribution was approximately 14 days. In total 75 parents completed the first survey and 67 parents completed the questionnaire at both occasions.

The NND score

The electronic questionnaire incorporated a FFQ assessing participants' habitual intake of selected foods, among them typical Nordic foods. Only frequency of consumption was assessed, the items did not specify portion sizes or amount. The NND score was previously constructed in order to capture adherence to the concept of the NND (17), where health, sustainability, gastronomic potential, and Nordic identity are fundamental principles (34); and it comprises 10 subscales summarizing meal pattern and intake of typical Nordic foods. Table 1 describes the components underlying the construction of the 10 subscales, including related questionnaire items and response options. Meal pattern was included in the score due to the potentially favorable impact of routine consumption of meals on dietary quality (35, 36). Furthermore, meat from game (moose, reindeer, deer), wild fish, other seafood, and berries were collapsed into one subscale ('Foods from the wild countryside'), as these foods are characterized by a common reliance on soil and local vegetation (17). Also, such a combination of foods is in line with one of the specific guidelines of the concept NND: 'More foods from the wild countryside' (34). In the present study, the number of indicator questions for the subscales ranged from 1 to 5, in total 24 questions. Question formulation was as follows: 'How often do you eat…', or 'How often do you drink…', with 10 response options ranging from 'Never' (coded 0), up to 'Several times a day' (coded 10). Each subscale was dichotomized by the median and assigned values of '0' or '1', with '1' indicating a more frequent consumption of main meals (subscale 1), or a more favorable intake of the relevant foods (subscale 2–10). Adding the subscales yielded a score ranging from 0 to 10, implying that each subscale was given equal weighting. Increasing score expressed higher compliance with the NND. This procedure is in line with methods applied in previous studies exploring relations between adherence to the Mediterranean diet (24) and selected healthy aspects of the Nordic diet (12) with health parameters. The score was further trichotomized, grouping participants into 'low' (0–3 points), 'medium' (4–5 points), and 'high' (6–10 points) adherence to the NND. The cut-offs were determined to obtain the most equally sized groups.

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Table 1. The components underlying the construction of the subscales within the NND score ($n = 67$)

Subscale	Related question(s)	Response alternatives and coding	Calculations (min–max)	Median = cut-off	Dietary behavior associated with scoring
1: Meal pattern	How often do you eat - breakfast - lunch - dinner - evening meal/supper	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7	Sum of answers to the four questions (0–28)	Test: 24.0 Retest: 24.0	Test: ≤24.0 = 0 ≥25.0 = 1 Retest: ≤24.0 = 0 ≥25.0 = 1
2: Nordic fruits	How often do you eat typical Nordic fruits (apple, pear, plum)	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7 Several times a day = 10	No calculation (0–10)	Test: 4.0 Retest: 4.0	Test: ≤4.0 = 0 ≥5.0 = 1 Retest: ≤4.0 = 0 ≥5.0 = 1
3: Root vegetables	How often do you eat root vegetables (e.g. carrot, rutabaga, onion)?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Test: 5.0 Retest: 4.0	Test: ≤5.0 = 0 ≥6.0 = 1 Retest: ≤4.0 = 0 ≥5.0 = 1
4: Cabbages	How often do you eat cabbages (e.g. cauliflower, broccoli, brussel sprouts, kale)?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Test: 3.0 Retest: 3.0	Test: ≤3.0 = 0 ≥4.0 = 1 Retest: ≤3.0 = 0 ≥4.0 = 1
5: Potatoes vs. rice/pasta	How often do you eat - potatoes - rice - pasta	Never = 0 up to Several times a day = 10	Frequency of eating potatoes relative to eating rice and pasta combined: potatoes/(rice + pasta) (0–100)	Test: 0.49 Retest: 0.49	Test: <0.49 = 0 ≥0.49 = 1 Retest: <0.49 = 0 ≥0.49 = 1
6: Whole grain breads vs. white breads	How often do you eat - white breads/bread rolls - whole grain breads - whole grain hard breads	Never = 0 up to Several times a day = 10	Frequency of eating whole grain breads and hard breads combined relative to eating refined breads: (whole grain breads + whole grain hard breads)/refined breads (0–200)	Test: 14.67 Retest: 12.00	Test: ≤14.67 = 0 >14.67 = 1 Retest: ≤12.0 = 0 >12.0 = 1

Table 1. (*Continued*)

Subscale	Related question(s)	Response alternatives and coding	Calculations (min–max)	Median = cut-off	Dietary behavior associated with scoring
7: Oatmeal porridge	How often do you eat oatmeal porridge?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Test: 1.0 Retest: 0.5	Test: < 1.0 = 0 ≥ 1.0 = 1 Retest: ≤ 0.5 = 0 > 0.5 = 1
8: Foods from the wild countryside	How often do you eat - game (e.g. moose, reindeer, deer) - lean fish (e.g. cod, caley, haddock) - fatty fish (e.g. mackerel, herring, halibut) - other seafood (e.g. shrimps, crabs, mussels) - berries	Never = 0 up to Several times a day = 10	Sum of answers to the five questions (0–50)	Test: 4.5 Retest: 4.5	Test: ≤ 4.5 = 0 ≥ 5.0 = 1 Retest: ≤ 4.5 = 0 ≥ 5.0 = 1
9: Milk vs. juice	How often do you drink - milk - fruit juice without added sugar	Never = 0 up to Several times a day = 10	Frequency of drinking milk relative to drinking fruit juice: milk/juice (0–100)	Test: 1.37 Retest: 0.99	Test: ≤ 1.37 = 0 > 1.37 = 1 Retest: ≤ 0.99 = 0 > 0.99 = 1
10: Water vs. sugar/artificially sweetened beverages	How often do you drink - water - sugar sweetened beverages - artificially sweetened beverages	Never = 0 up to Several times a day = 10	Frequency of drinking water relative to drinking sugar sweetened beverages and artificially sweetened beverages combined: water/(sugar sweetened beverages + artificially sweetened beverages) (0–100)	Test: 4.76 Retest: 4.38	Test: ≤ 4.76 = 0 > 4.76 = 1 Retest: < 4.38 = 0 ≥ 4.38 = 1

NND, New Nordic Diet.

Statistical analysis

Statistical analyses were performed using the statistical software package IBM SPSS Statistics version 22.0 (IBM Corp., Somers, NY, USA). Test–retest reliability of the subscales and the final NND score was investigated through bivariate correlations. As the distributions of the subscales were skewed, correlations were computed with Spearman's rank correlation coefficient, whereas the final NND score was presented with Pearson's correlation coefficient, due to a normal distribution of scores. Furthermore, cross tabulation and kappa measure of agreement (k) were applied for assessing the test–retest agreement of classification into the trichotomized NND score, as well as into the dichotomized subscales. A two-sided p-value of <0.05 was considered statistically significant.

Results

The questionnaire survey was completed on both occasions by 67 participants (89% of those answering the first questionnaire), mean age 34.5 years (SD = 5.3). In total 57 participants (85%) were females, 60 participants (90%) were native Norwegians, and 36 participants (54%) reported 4 years or more of university or college education. Table 2 presents details for the results from the test–retest analyses. The correlation coefficients between test and retest were $r = 0.80$ (Pearson) for the NND score, and

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Table 2. Test–retest reliability of the 10 subscales and of the total NND score ($n = 67$)

The 10 subscales constituting the NND score	Spearman's rank order correlation	Kappa measure of agreement (dichotomized subscales)	Percent agreement between test and retest (dichotomized subscales)
1: Meal pattern	0.78	0.70	85
2: Nordic fruits	0.76	0.60	81
3: Root vegetables	0.71	0.63	82
4: Cabbages	0.54	0.32	67
5: Potatoes vs. rice/pasta	0.70	0.67	84
6: Whole grain breads vs. white breads	0.62	0.52	76
7: Oatmeal porridge	0.84	0.67	84
8: Foods from the wild countryside	0.70	0.51	76
9: Milk vs. juice	0.84	0.76	88
10: Water vs. sugar/artificially sweetened beverages	0.79	0.43	72
NND score	0.80[a]	0.52[b]	69[b]

NND, New Nordic Diet.
P-values for all analyses were <0.001.
[a]Pearson correlation coefficient is used for the NND score.
[b]Trichotomized score.

$r = 0.54$–0.84 (Spearman's rank correlation coefficient) for the different subscale scores, all $p < 0.001$. The lowest correlation was seen for the subscale 'cabbages' ($r = 0.54$), whereas the highest correlations were observed for the subscales 'oatmeal porridge' and 'milk vs. juice' ($r = 0.84$). Regarding the test–retest agreement of the trichotomized NND score, 69% of participants were correctly classified into low, medium, or high adherence on the second occasion, compared with the first one ($k = 0.50$), whereas 1.5% ($n = 1$) were grossly misclassified, moving from high to low compliance. For the dichotomized subscales, test–retest correct classification ranged from 67 to 88% ($k = 0.32$–0.76). In line with the results from the bivariate correlations, the lowest agreement from test to retest was observed for the subscale 'cabbages' (67%, $k = 0.32$), whereas the highest agreement was detected for 'milk vs. juice' (88%, $k = 0.76$).

Discussion

In the present study, we found acceptable test–retest reliability of the previously developed NND score (17). The test–retest correlation coefficients for the subscales ranged from 0.54 to 0.84, while the test–retest correlation for the total NND score was 0.80, all highly significant. This result can be considered acceptable, as correlation coefficients in the order of 0.50 to 0.70 appear typical for reproducibility of nutrient intakes, and is comparable with that of several biological measurements in subjects under real-life conditions (32). In the context of previous studies, Hu et al. (26) assessed the test–retest reliability of two dietary patterns (the 'prudent' and 'western') defined by factor analysis, based on dietary data from a FFQ administered twice 1 year apart, in a subsample of 127 men from the Health Professionals Follow-up Study. This latter mentioned study, reported correlation coefficients from test to retest ranging from 0.36 to 0.92 for the individual foods, 0.70 for the 'prudent' pattern, and 0.67 for the 'western' pattern. Using the same dietary data as the study by Hu et al. (26), Newby et al. (27) computed two Dietary Quality Index Revised (DQI-R) scores, and reported the reliability correlation (Pearson) for the two FFQ scores to be 0.72. Furthermore, Khani et al. (28) defined three dietary patterns using factor analysis on data derived from a FFQ, also completed twice 1 year apart, in a subsample of 212 women participating in the Swedish Mammography Cohort. In this study, Spearman correlation coefficients for the patterns 'healthy', 'western', and 'drinker' were reported to be 0.63, 0.68, and 0.73, respectively. In a sample of Japanese men ($n = 244$) and women ($n = 254$), Nanri et al. (29) explored test–retest reliability of three Japanese dietary patterns (the 'prudent', 'westernized', and 'traditional', identified by principal component analysis) and found that Spearman correlation coefficients ranged from 0.55 to 0.77. Although not entirely comparable due to methodological differences (such as *a posteriori* defined patterns, 1 year instead of approximately 2 weeks between questionnaire administrations, and larger samples), these correlation coefficients are somewhat lower than the ones presented in our study. One possible explanation could be the time interval between administrations. A time period of 1 year may reduce the reproducibility as a result of true changes

in dietary intake, as well as variation in response, and not necessarily express poor questionnaire performance (32).

In addition to performing bivariate correlation analyses for exploring test–retest reliability, we applied kappa measure of agreement, combined with observed percentage agreement, as a measure of chance-corrected proportional agreement. According to Altman (37), values of kappa above 0.80 express very good agreement, 0.61–0.80 good agreement, 0.41–0.60 moderate agreement, 0.21–0.40 fair agreement, and <0.20 poor agreement. Thus, 67–88% correct classification of the subscales from test to retest, and kappa measures of agreement of $k=0.32$–0.76, suggests acceptable test–retest reliability. Regarding the total NND score, 69% correct classification, a kappa value of 0.52, and less than 2% grossly misclassified, supports the indication of an acceptable test–retest reliability (38). For comparison, Beck et al. (30) investigated the reliability of iron-related dietary patterns, derived from an FFQ administered twice, 4 weeks apart, in a convenience sample of 115 young women, applying correlation coefficients, cross-classification, and weighted kappa (k^w). Beck and colleagues reported correlations from test to retest to be 0.76 for both dietary patterns identified, the 'healthy' and 'sandwich and drinks', whereas 63% ($k^w=0.57$) and 71% ($k^w=0.65$) were correctly classified into the same tertile, and less than 2% were grossly misclassified, into the 'healthy' or 'sandwich and drinks' patterns, respectively. Furthermore, Huybrechts et al. (31) tested the reliability of a diet quality index for children, assessed with an FFQ filled in twice, 5 weeks apart, by parents of 58 preschoolers. This study reported Pearson correlation to be 0.88 from test to retest; 62% of the subjects were correctly classified from test to retest, and 3% were classified in extreme categories (31). These two latter studies present results much in line with our findings, yet direct comparisons should be made with caution because of different methodological approaches. However, considering the time period between questionnaire administrations, the study of Beck et al. (30), as well as the study of Huybrechts et al. (31), were relatively comparable to our study. Although a definite answer to an ideal time interval may not exist, a time period as long as 1 year could disrupt evaluation of true questionnaire performance (32).

Regarding the subscales in the present study, 4 out of 10 were based on one questionnaire item only, providing few response alternatives and hence a skewed distribution. Consequently, the dichotomization by the median resulted in slightly different sized groups for some subscales. Still, considering previous study results (17, 18), we feel confident that the method is sufficient for ranking and segregating participants according to adherence to the NND. Besides, the total NND score, which was the main outcome in the present study, was normally distributed. Another study limitation is that neither the questionnaire, from which the NND score is derived, nor the score itself, has been validated. However, regarding FFQs, validity studies are generally difficult to carry out because of the lack of a perfect standard reference method (32), and difficulties of obtaining sufficiently large and representative samples of the population to which the FFQ may be applied. In addition, the NND score inquires dietary behavior rather than absolute intake, making validation even more challenging. Although quantification of foods in the questionnaire probably would result in greater accuracy, it would also increase participant burden.

In terms of the study sample, number of participants is a limitation because approximately 100 subjects, as used in other studies, would have been preferable (32, 39, 40). Moreover, the generalizability is limited due to the low response rate, and further characteristics of the parents who signed up, the majority of whom were female, ethnic Norwegian, and higher educated. Also, because the participants were relatively young and well-educated parents of small children, they could be more motivated than other populations regarding diet, nutrition, and health issues in general, which may result in reliable and repeatable answers, and thus an overestimation of the true reliability of the NND score. Considering previous study results (30, 31), and the general difficulties of measuring dietary intake (32), we believe that the misclassification of 31% of the participants from test to retest reflects the sources of error that are likely to be an inevitable part of dietary research. Nevertheless, such errors represent limitations that need to be taken into account when interpreting study results. The aforementioned characteristics of our study sample may entail that the sources of error could be more pronounced than what we have captured in the present study. Regarding the time interval between the test and the retest administrations of the questionnaire, 2 weeks is relatively short, implying that the participants might remember what they answered in the first questionnaire, which in turn would increase reliability due to memory, and not necessarily as a result of questionnaire performance. Nevertheless, a great range of different time intervals between administrations has been used in previous studies (41). It should also be mentioned that not all foods typical for the NND are included in the score, for example, nuts and seeds, legumes, rapeseed oil, free-range livestock, fresh herbs, and wild plants and mushrooms (34), because of some limitations of the availability of food data. However, the score comprised most food items captured by the concept of NND.

Conclusion

Based on the acceptable test–retest reliability of the total NND score and its subscales revealed in the present study, together with previous study results, we believe that the NND score is qualified for ranking and segregating subjects according to degree of adherence with the NND, and for detecting potential associations between degree of

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compliance with various health outcomes. Yet, the reliability of the NND score should be tested in a larger sample and among different subgroups of the Nordic population.

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Conflict of interest and funding

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Authorship

EB, MKT, NCØ, and THS designed the present study; ERH, EB, and NCØ constructed the initial NND score; HBB, EB, MKT, and NCØ developed the HSL-questionnaire; HBB and EB prepared the dataset; HBB analyzed the data and wrote the paper; HBB and EB had primary responsibility for final content. All authors read and approved the final manuscript.

Ethical standards disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and research clearance was obtained from The Norwegian Social Science Data Services. Written informed consent was obtained from all subjects.

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Paper II

The association between adherence to the New Nordic Diet and diet quality

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ORIGINAL ARTICLE

The association between adherence to the New Nordic Diet and diet quality

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Abstract

Background: Previous studies have reported a positive association between scoring on healthy Nordic diet scales and the intake of healthy foods and nutrients, and also with higher intake of meat, sweets, cakes, and energy in general. These studies have used the same food frequency questionnaire (FFQ) responses for constructing the diet score as for calculating intakes of foods and nutrients. Thus, it is not clear whether the coexistence of healthy and less healthy dietary aspects among adherers to Nordic diets would occur even though separate methods were applied for exploring these relations.
Objective: To assess the association between adherence to the New Nordic Diet (NND), derived from an FFQ, and diet quality, determined from two 24-h dietary recall interviews.
Design: In total, 65 parents of toddlers in Southern Norway answered the NND FFQ and two 24-h dietary recall interviews. NND adherence was determined from the FFQ and categorized into low, medium, and high adherence. The two 24-h recalls provided data for the intake of specific foods and nutrients, selected on the basis of the Norwegian food-based guidelines as an indicator of a healthy diet. The Kruskal–Wallis test was used for assessing differences in food and nutrient intake across NND groups.
Results: High NND adherence derived from FFQ was associated with a high intake of fruits ($p = 0.004$) and fiber ($p = 0.02$), and a low intake of meat ($p = 0.004$) and margarines ($p = 0.05$), derived from recalls. A larger proportion of high NND adherers (68%) complied with the national dietary recommendation targeting meat intake compared with low NND adherers (29%) ($p = 0.04$).
Conclusion: The present study showed that higher NND adherence measured with FFQ was associated with a higher intake of selected healthy foods and nutrients, measured with recalls. However, a higher intake of meat, sweets, and energy, as earlier reported, was not observed.

Keywords: *New Nordic Diet*; *diet score*; *Norwegian food-based guidelines*; *dietary intake*; *nutrient intake*

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As a result of the demonstrated protective effects of the Mediterranean diet on disease (1–3) and mortality (2), the possible protective effects of other regional diets have gained attention. In the Nordic countries, dietary scores have been constructed in order to explore adherence to different aspects of the Nordic diets with expected health-promoting effects (4–6). Recently, observational studies have reported that compliance with Nordic diets is associated with lower mortality (4, 7) and a reduced risk of non-communicable diseases (5, 8–13). However, the evidence is not quite consistent, as other studies have failed to demonstrate associations between Nordic diets and breast cancer (14), colorectal cancer (15), or type 2 diabetes (16) and have reported equivocal associations with cardio-metabolic risk factors (17).

Three studies have examined dietary composition and nutrient intake related to three different Nordic diet scores, concluding that high scores were associated with an increased intake of healthy foods (5, 18) and essential nutrients (5, 6, 18). In a sample of Swedish women (18), higher scores on the Healthy Nordic Food Index (HNFI) were associated with a higher intake of the six food groups included in the score, that is, apples/pears, cabbage, root vegetables, whole grain bread, oatmeal, and fish/shellfish, in addition to fiber and higher micronutrient density. Likewise, participants in the Norwegian Mother and

Child Cohort Study (MoBa), who attained higher ratings in the New Nordic Diet (NND) score, reported a higher consumption of healthy foods like whole grains, fish, fruits, and vegetables, and thus increased fiber intake and overall higher nutrient density (5). In a representative sample of the Finnish population, increased compliance with the Baltic Sea Diet Score implied a higher intake of fiber, iron, vitamin D, and folate, and a decreased intake of saturated fatty acids (SFAs) and alcohol (6). Moreover, high diet scores were associated with being more physically active (6, 18) and more likely to exercise (5).

Nevertheless, not all reported associations between diet scores and food intake have been in a healthier direction. In Norway, 'high' NND adherers were reported eating slightly more meat, cakes, and desserts than 'low' NND adherers (5), while Swedish women with high scores on the HNFI also reported a higher intake of less healthy foods such as processed meat and sweets (18). Moreover, in the Finnish sample higher intake of sodium and lower intake of polyunsaturated fatty acids (PUFAs) was observed among adherers to the Baltic Sea Diet Score (6). In all three studies, a high score was positively associated with energy intake (5, 6, 18).

These three studies, examining the association between adhering to Nordic diets and food/nutrient intake, all used the same food frequency questionnaire (FFQ) for constructing the diet score as for calculating intakes of foods and nutrients. Therefore, based on the previously reported coexistence of healthy and less healthy dietary aspects among adherers to predefined healthy Nordic diets, the aim of the current study was to assess the association between adherence to the NND score, derived from an FFQ, and diet quality, determined from two 24-h dietary recall interviews.

Methods

Design and study sample

The present data originate from the project Healthy and Sustainable Lifestyle, which in 2014 collected data in collaboration with the Child Food Courage project (19). As part of these projects, a web-based questionnaire was constructed to explore lifestyle behaviors, self-perceived health and quality of life, as well as basic demographic and socioeconomic variables (e.g. sex, age, height, weight, ethnicity, and educational attainment) among parents of toddlers. For the current methodological study, a convenience sample, consisting of parents of toddlers born between 2008 and 2011, was recruited through kindergartens. The leader of each kindergarten was asked to distribute the study invitation to eligible parents who were able to speak and read Norwegian. For each child, either the mother or the father could participate. Parents were informed about the purpose and implications of the study through a web page and via e-mail distribution. In total, 1,191 parents from 19 kindergartens in the county of Vest-Agder, Southern Norway, were invited to participate. A total of 86 (7%) parents signed up. Parents provided consent electronically, followed by administration of the questionnaire survey by e-mail. Subsequently, two 24-h dietary recalls were conducted by telephone 2–4 weeks apart, level of physical activity was recorded objectively for seven consecutive days, and anthropometric measurements were undertaken (height and body mass). Data collection was conducted between March and August 2014. In total, 56 parents (65% of those who signed up) completed all measurements, that is, the electronic questionnaire, two dietary recalls, and the physical activity assessment, while 65 parents (76%) completed the questionnaire and two dietary recalls, and 75 parents (87%) completed the questionnaire only.

Measures

The New Nordic Diet score

The electronic questionnaire incorporated an FFQ assessing participants' habitual frequency of intake of selected foods, without specification of amounts consumed. The foods assessed included foods that are part of the concept of a NND, which has been suggested due to its inherent properties that potentially promote health, environmental sustainability, and food traditions (20), without compromising palatability (21). The NND consists of healthy foods native to the Nordic climate or foods that can be produced or cultivated in the Nordic climate, like certain fruits, berries, root vegetables, cabbages, whole grains, wild fish and game, potatoes, and rapeseed oil (20, 22). The NND score was previously developed to capture adherence to the NND in observational studies (5), and has recently shown acceptable test–retest reliability (23). The NND score comprises 10 subscales selected to summarize meal pattern and habitual intake of typical Nordic foods. Appendix 1 describes the components underlying the construction of the 10 subscales in the present study, including questionnaire items and frequency options. In the present study, the number of items forming the basis for each subscale ranged from 1 to 5, a total of 24 questions. Each subscale was dichotomized by the sex-specific median and assigned values of '0' or '1', with '1' indicating a more frequent consumption of main meals (subscale 1) or a more favorable intake of selected foods (subscale 2–10). Each subscale was assigned equal weightage, and adding the subscales yielded a score ranging from 0 to 10, with increasing scores indicating higher compliance with the NND. The total score was trichotomized grouping participants into 'low' (0–3 points), 'medium' (4–5 points), and 'high' (6–10 points) adherence to the NND (5), with cutoffs for groupings determined to obtain the most equally sized groups.

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24-Hour dietary recall interviews

Two unannounced 24-h dietary recalls were collected by telephone, 2–4 weeks apart by two trained interviewers, after completion of the FFQ. Each interview lasted for approximately 20–30 min, aiming to obtain detailed information on all foods and beverages consumed by the participants in the period between waking up on the preceding day and waking up on the interview day. A booklet containing photographs of various portion sizes for common foods and standard sizes of glasses, cups, and plates (24) was available on the project's web page to ease the estimation of portion sizes from memory. Dietary intake was reported for one weekday and one weekend day by 21 participants (32%), of whom 18 participants (86%) reported for a Sunday, while 3 participants (14%) reported for a Saturday. The remaining 44 participants (68%) reported dietary intake for two weekdays, due to feasibility. Dietary information was converted into daily energy and nutrient intakes using the food calculation software KBS V 7.0, linked directly to the food composition database N3. The Norwegian food composition table from 2006 (25) forms the basis for this food composition database, which is also supplemented with additional food items from reliable sources. The 24-h recall functionality of the KBS program was developed specifically for the Norkost 3 study, which represents the latest national dietary survey conducted among a representative sample of Norwegian adults (24). Nutritional supplements were excluded from the calculations, as food intake per se was that of interest in this study, and what corresponds with the concept NND.

In order to assess diet quality across NND adherence, specific foods and nutrients assessed by the two 24-h dietary recalls were selected, based on the official Norwegian food-based guidelines (26) as an indicator of a healthy diet. Foods assessed were 'Vegetables (fresh and frozen)', 'Fruits and berries (fresh)', 'Fruit juice', 'Whole grain products', 'Refined grain products', 'Fish', 'Meat', 'Low fat dairy products', 'Fatty dairy products', 'Vegetable oils', 'Margarines', 'Butter', 'Chocolate, candies and sugar-sweetened beverages', and 'Water'. Selected nutrients were fiber, added sugar, and sodium. In addition, we assessed energy intake across NND groups. Also, the proportion from each NND adherence category meeting the following quantitative Norwegian food recommendations was calculated; 'Eat at least five portions of vegetables, fruits, and berries every day', 'Eat whole grains every day', 'Eat fish for dinner two to three times a week and preferably also as sandwich spread', 'Choose lean meat and lean meat products. Limit the amount of processed meat and red meat', 'Choose foods containing little salt, and limit the use of salt for cooking', and 'Avoid sugar rich foods and beverages for everyday use'. Calculations were performed in line with the methodology of the Norkost 3 study (24), entailing that for whole meal bread, 40% of the product weight was accounted for as whole grains, while for muesli/mixed cereals, 50% of the product weight was included. Further, cut-offs for compliance were set at 70 g whole grain/day for women and 90 g/day for men. Recommendations regarding fish intake and meat consumption were operationalized into daily intake, as recommended weekly amounts are 300–450 g of fish (ready to eat), and <500 g of red and processed meat (ready to eat), for both females and males. Consequently, due to the features of the food calculation software used (KBS V 7.0), 40% of the product weight of processed fish products was included (24), and for meat intake the recommended commodity weight (750 g/week) (27) represented the cut-off.

Moreover, the habitual frequency of consumption of selected foods (i.e. vegetables, fruits and berries, fruit juice, whole grain products, refined grain products, fish, meat, and sweet pastries, candies, and sugar-sweetened beverages) across NND adherence groups was assessed using FFQ data. Although amounts were not specified, frequencies would allow for an examination of tendencies across groups, using the same FFQ data for determining NND adherence as for assessing dietary intake, in line with the methodology applied in the earlier studies (5, 6, 18).

Physical activity and anthropometric measurements

To enable exploration of the physical activity level in the present sample, as one relevant sample characteristic, and also the relation between energy intake and energy expenditure, the monitor SenseWear Armband Mini (SWA; BodyMedia, Pittsburgh, Pennsylvania, USA) was used. SWA includes a 3-axis accelerometer, a heat-flux sensor, a skin temperature sensor, and a near-body ambient temperature sensor (28). Data from these sensors were combined with sex, age, body weight, and height to estimate physical activity intensity and energy expenditure using algorithms developed by the manufacturer. Participants were instructed to wear the monitor on the upper left arm (on the triceps, at mid humerus point) for seven consecutive days, only removing it for bathing, or any other water activity. Those with a nickel allergy were discouraged from participating ($n=5$), as wearing the monitor may cause skin rashes due to 8% nickel content. Data were downloaded using SenseWear Professional V.8.1 (BodyMedia, Pittsburgh, Pennsylvania, USA). A valid day was defined as at least 80% (19.2 h) wearing time, and a minimum of four valid days with at least one weekend day was required for participants to be included in the analyses (29, 30). Data were calculated and reported as mean values per day. Participants exceeding 21.5 min/day with moderate and vigorous physical activity, in bouts of at least 10 min duration, were classified as meeting the recommendations for physical activity (26, 31). The cut-off defining moderate to vigorous intensity was 3 metabolic equivalents (METs) (32). Anthropometric

measurements were obtained by trained staff, with subjects barefoot and dressed in light clothes. Height was measured using a portable stadiometer with the head in the Frankfort plane, two measurements were taken and added with a third if the first two differed by >1%. The mean of the closest two measurements was calculated. Body mass was measured by a segmental multi-frequency bioelectrical impedance analysis (BIA), conducted with In Body 720 (Biospace Co., Ltd., Seoul, Korea). Body mass index (BMI) was computed, as this represents one significant and commonly included sample characteristic, and participants with a BMI ≥ 25 kg/m^2 were categorized as overweight/obese (33). In compliance with the measurement protocol, participants were instructed to abstain from exercise and food within 2 h of testing, and immediately prior to the measurement to avoid showering and sauna, and to empty their bladder. Pregnant women were excluded from the body composition measurements ($n=1$).

Statistical analysis

Statistical analyses were performed with the statistical software package IBM SPSS Statistics version 22.0 (IBM Corp., Somers, New York, USA). To explore differences in sample characteristics across NND adherence categories, Chi-square test for independence (χ^2) was used. Food consumption variables were skewed, thus the Kruskal–Wallis test was applied for assessing differences in food, nutrient and energy intakes, and energy expenditure, across NND categories. Results are presented as median and quartiles. Differences in compliance with the Norwegian quantitative food-based dietary guidelines according to NND adherence group was assessed with Chi-square. A two-sided p-value of <0.05 was considered statistically significant.

Results

A total of 65 participants were included in the final analyses. Mean age in the study sample was 35.2 years (SD $\pm$ 5.0 years), 55 participants (85%) were females, 58 participants (89%) were native Norwegians, and 37 participants (57%) reported four or more years of university or college education (Table 1). Furthermore, 13 participants (20%) were overweight or obese, while 46 participants (82%) met the national recommendations on physical activity (26). No significant differences were observed in sample characteristics across NND categories (Table 1). Participants were categorized according to the NND score into low ($n=17$), medium ($n=23$), or high ($n=25$) NND adherence, representing 26, 35, and 39% of the sample, respectively. Among the 21 participants (32%) reporting dietary intake for one weekday and one weekend day, distribution across NND adherence groups was: low ($n=5$), medium ($n=6$), and high ($n=10$), representing 24, 28, and 48%, respectively.

Table 1. Selected characteristics of the study sample in total ($n=65$), according to NND adherence

	Degree of NND adherence				
	Whole sample ($n=65$)	Low ($n=17$)	Medium ($n=23$)	High ($n=25$)	
	n (%)	*n* (%)	*n* (%)	*n* (%)	*p**
Sex					
Female	55 (85)	14 (82)	20 (87)	21 (84)	0.92
Age (yrs)					
20–34	31 (48)	8 (47)	12 (52)	11 (44)	
≥35–47	34 (52)	9 (53)	11 (48)	14 (56)	0.85
Ethnicity					
Native Norwegian†	58 (89)	16 (94)	21 (91)	21 (84)	0.54
Educational attainment					
Higher education‡	37 (57)	13 (77)	9 (39)	15 (60)	0.06
Weight status					
Overweight/obese§	13 (20)	4 (24)	5 (22)	4 (16)	0.81
Physical activity level					
Physically active‖	46¶ (82)	11 (73)	16 (80)	19 (91)	0.40

NND, New Nordic Diet. **p*-values calculated from Chi-square test for independence (χ^2). †Both parents born in Norway. ‡≥4 years of university or college education. §Body mass index ≥25 kg/m^2. ‖>21.5 min/day with moderate and vigorous physical activity, in bouts of at least 10 min duration, measured by the activity monitor SenseWear Armband Mini. ¶For physical activity level $n=56$; 15, 20, and 21 parents categorized into low, medium, and high NND, respectively.

Different consumption of selected foods (Table 2) across NND groups was detected for meat ($p=0.004$), fruits and berries ($p=0.004$), and margarines ($p=0.05$), entailing that those classified as 'low' NND adherers reported the highest consumption of meat and margarines, while 'high' NND adherers reported the largest intake of fruits and berries. For the other foods assessed, that is, fresh and frozen vegetables, fruit juice, whole grain products, refined grain products, fish, low-fat dairy products, fatty dairy products, vegetable oils, butter, chocolate, candies and sugar-sweetened beverages, and water, no significant differences were observed. The relative intake of dietary fiber (E%) differed significantly across NND groups; fiber contributed with 2.7 E%, 2.4 E%, and 2.1 E% ($p=0.02$), in 'high', 'medium', and 'low' NND adherers, respectively. For added sugar and sodium, no differences according to NND classifications were found. Likewise, energy intake and energy expenditure did not differ across NND groups (Table 2).

Regarding the frequency of habitual food intake (results not shown) measured with FFQ, significant differences across NND adherence groups were found for all foods except from fruit juice. 'High' NND reported to eat vegetables, fruits and berries, whole grain products,

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Table 2. Daily energy expenditure, energy intake, and consumption of fiber, added sugar, sodium (Na), and selected foods, according to NND adherence

	Degree of NND adherence						
	Low ($n=17$)		Medium ($n=23$)		High ($n=25$)		
	Median†	(Q1, Q3)	Median	(Q1, Q3)	Median	(Q1, Q3)	p*
Energy expenditure (kJ)‡	11,026	(10,041, 12,203)	10,621	(10,040, 11,870)	11,456	(10,074, 12,436)	0.65
Energy intake (kJ)	9,361	(7,762, 12,200)	8,308	(7,418, 10,992)	8,883	(7,225, 10,961)	0.46
Fiber (g)	24.5	(21.8, 27.7)	26.4	(22.0, 32.0)	30.2	(23.0, 40.3)	0.07
Fiber (E%)	2.1	(1.6, 2.6)	2.4	(2.1, 2.7)	2.7	(2.2, 3.1)	0.02
Added sugar (g)	38.1	(17.8, 60.4)	27.8	(10.7, 40.4)	21.1	(12.7, 36.2)	0.19
Added sugar (E%)	6.9	(3.4, 8.8)	4.7	(2.5, 7.5)	4.4	(2.7, 6.7)	0.17
Na (mg)	2738.0	(2214.5, 3795.0)	2786.0	(1828.0, 3860.0)	2789.0	(1984.5, 3778.5)	0.92
Vegetables (fresh and frozen)	139.9	(86.8, 218.6)	140.6	(76.0, 198.5)	164.4	(110.6, 243.5)	0.56
Fruits and berries (fresh)	102.5	(60.8, 207.8)	150.0	(120.5, 305.0)	267.5	(187.6, 348.8)	0.004
Fruit juice	93.8	(0.0, 312.5)	0.0	(0.0, 187.5)	0.0	(0.0, 122.5)	0.15
Whole grain products	57.7	(33.6, 110.0)	53.7	(30.1, 117.6)	67.2	(34.0, 136.0)	0.60
Refined grain products	130.2	(52.7, 169.7)	86.2	(51.3, 166.0)	74.9	(38.7, 162.7)	0.67
Fish‖	21.3	(0.0, 60.1)	5.0	(0.0, 85.3)	38.5	(0.0, 86.8)	0.53
Meat¶	167.4	(134.6, 233.8)	116.5	(54.2, 189.6)	102.0	(60.8, 128.8)	0.004
Low fat dairy products	110.0	(12.0, 283.15)	142.5	(62.5, 320.3)	125.0	(49.8, 406.3)	0.60
Fatty dairy products	146.0	(71.7, 187.3)	75.2	(40.0, 154.9)	88.0	(57.0, 155.4)	0.20
Vegetable oils	1.1	(0.0, 5.1)	0.0	(0.0, 3.0)	0.3	(0.0, 2.3)	0.63
Margarines	7.5	(0.7, 19.6)	5.5	(2.5, 11.6)	1.1	(0.0, 7.9)	0.05
Butter	5.6	(3.2, 12.1)	5.0	(1.6, 10.2)	6.8	(2.2, 16.7)	0.50
Chocolate, candies, and sugar-sweetened beverages	42.0	(6.3, 205.0)	24.5	(1.0, 163.1)	4.0	(0.0, 64.5)	0.15
Water	1000.0	(601.9, 1297.0)	1215.0	(812.5, 1893.8)	1120.0	(795.0, 1452.5)	0.33

NND, New Nordic Diet. *Kruskal–Wallis test was used to derive p-values. †Median and quartiles were calculated from two 24-h dietary recalls. ‡For energy expenditure (measured by the activity monitor SenseWear Armband Mini) and energy intake (assessed by two 24-h dietary recalls). $n=56$; 15, 20, and 21 parents categorized into low, medium, and high NND, respectively. ‖Includes lean fish, fatty fish, fish products, and selected fish toppings. ¶Includes poultry, pork, beef, game (all unprocessed), ground meat, and processed meat (salted meat, minced meat, sandwich meat, and liver paste).

and fish more frequently than 'low' NND, while 'low' NND recorded more frequent consumption of refined grain products, meat, and sweet pastries, candies, and sugar-sweetened beverages than 'high' NND.

Table 3 shows that a greater proportion of 'high' NND adherers complied with the guideline to 'Choose lean meat and lean meat products and limit the amount of processed meat and read meat', than 'low' NND adherers (68% versus 29%, $p=0.04$). For the remaining five recommendations of interest, no significant differences between NND adherence groups were found.

Discussion

In the present study, the association between adherence to the NND, derived from an FFQ, and diet quality, determined from two 24-h dietary recall interviews, was assessed. In line with former findings, the trend was that 'high' NND adherers reported a more favorable diet in general (5, 6, 18), and a higher intake of fruits (5, 18) and dietary fiber (5, 6, 18). Contrasting previous findings (5, 18), neither higher intake of meat or sweets, nor higher energy intake or higher physical activity levels was observed among 'high' NND adherers (5, 6, 18).

The previously observed coexistence of healthy and less healthy dietary elements among adherers to predefined healthy Nordic diets could have different explanations. First, it may be real, that is, that those who achieve high scoring on the Nordic scales have higher intakes of a wide variety of foods, which may be characterized as both healthy and less healthy. High intake of healthy foods and beverages will most likely have positive health effects, in spite of unhealthy elements in the diet. This aspect may partly explain previous results, especially as higher scoring on the Nordic scales was associated with being more physically active, or more likely to exercise, as well. Dietary factors not included when constructing a specific diet score could confound true associations between the healthier aspects of the diet and relevant outcomes. An example is meat, which has been reported to associate positively with colorectal cancer (34), and also with

Table 3. Proportions meeting the quantitative recommendations incorporated in the official Norwegian food-based dietary guidelines, according to NND adherence

		Degree of NND adherence			
		Low ($n=17$)	Medium ($n=23$)	High ($n=25$)	
Quantitative dietary recommendations	Behavior required for scoring	% adhering to recommendation	% adhering to recommendation	% adhering to recommendation	p*
3: 'Eat at least five portions of vegetables, fruits, and berries every day'[†]	>500 g/day	29	35	48	0.43
4: 'Eat whole grains every day'	>70 g/day (women) >90 g/day (men)	35	35	40	0.92
5: 'Eat fish for dinner two to three times a week and preferably also as toppings'[‡]	>43 g/day	29	39	48	0.48
6: 'Choose lean meat and lean meat products. Limit the amount of processed meat and read meat[§]'	<107 g/day	29	61	68	0.04
9: 'Choose foods containing little salt, and limit the use of salt for cooking'.	<6 g salt (NaCl) per day	24	39	36	0.56
10: 'Avoid sugar rich foods and beverages for everyday use'.	<10 E% sugar/day	88	87	96	0.51

NND, New Nordic Diet. *Proportions were calculated using chi-square. [†]For those with an average intake of at least 100 g of fruit juice, 100 g of juice were included. [‡]Includes lean fish, fatty fish, fish products, and selected fish toppings. [§]Includes lean, red meat (unprocessed), ground meat, and processed meat (salted meat, minced meat, sandwich meat, and liver paste).

compliance to the HNFI (18). These relations may partly explain the lack of an inverse association between greater scoring on the HNFI, and colorectal cancer (15). Second, the scales assessing adherence to the different Nordic diets might be biased as a result of *the consistency motif* (35), that is, participants falling into a pattern of similar responses when answering comparable questions, which is a tendency that could apply to FFQs. Those reporting to eat more of the healthy Nordic foods might also erroneously report eating more of certain less healthy foods. If so, it may be debatable whether the dietary scores actually capture what they intend to capture. Third, artificial covariance (35) could have biased the earlier reported associations, due to using the same questionnaire responses for deriving the dietary score and for calculating food and nutrient intakes. In turn, such false associations could result in invalid inferences regarding diet-health relations. Since measurement errors would be less correlated if applying separate methods for these two operations (36), it may be favorable to construct the diet score from an FFQ, while using dietary recalls for estimating intake of foods and nutrients.

The FFQ was unfortunately not tested for validity, and misreporting, especially the underreporting of foods generally considered unhealthy, is a common challenge when data are self-reported (36, 37). However, if randomly distributed, misreporting should still allow the ranking of participants into groups according to intake. Besides, although the underlying concept of interest was NND adherence at the group level, the limited sample size in this study ideally calls for more than two 24-h recall interviews to reduce the influence of day-to-day variations in food consumption. This uncertainty seems to be reflected through the lack of a consistent trend in the results, and especially foods eaten more seldom, like fish, are the most sensitive for day-to-day variations. Moreover, all groups reported considerably lower energy intake than the objectively measured energy expenditure. Possible explanations might be increased activity levels caused by awareness of being observed (38), low energy intake as a result of the misreporting or underreporting of food consumption, or poor repeatability (37), due to the wide variations in food intake from one day to another.

On the other hand, our findings concerning the frequency of habitual food consumption, determined from the FFQ, revealed the same trend as when using separate methods. Hence, although frequencies are not the same as amounts, different observations in the current study compared with the earlier studies on Nordic scales might be related to sample characteristics. A homogenous and selective sample in the present study, in addition to recently collected data, could possibly imply a sample following a healthier diet than parents of toddlers in general, and therefore reduced generalizability. And, since dietary patterns are likely to change over time, the Nordic scales may capture other dietary aspects today, than when exploring data collected 10–20 years ago. In other words, the present results might indicate that the NND score, and similar Nordic scores, capture healthy diets to a larger degree when applied in more contemporary samples.

The results of the current study should be interpreted in the context of several limitations. As mentioned above,

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the study sample was selective and homogenous, that is, the majority being females, native Norwegians, and highly educated, probably caused by a very low response rate (7%). Together with a small sample size, these characteristics restricted study power, eligible statistical analyses (e.g. sub-group analyses), and generalizability to the population in general. A notably larger amount of the present sample complied with the recommended physical activity level (26), and fewer were overweight or obese, compared with a representative sample of the Norwegian adult population (39), that is, 82% versus 32%, and 20% versus 48%, respectively. Participating parents might have been more health-conscious and more likely to adhere to a favorable lifestyle, including a healthier diet. Unlike the former studies exploring the HNFI (18), the NND (5), and the Baltic Sea Diet Score (6), differences across NND adherence categories were not detected concerning age, educational level, BMI, physical activity level, or energy intake, expressing the homogeneity of the sample. Yet, lack of differences could also be a result of the limited sample size.

Regarding dietary scores as a method for quantifying adherence to dietary patterns, subjectivity is introduced related to the selection and scoring of included components, cut-off points, and so on (40, 41). Importantly, although reflecting a larger part of the overall diet, diet scores do not cover all aspects of diet, meaning that other food items not incorporated into the scale could bias the associations under investigation. Also, as cut-offs for the NND score were determined by the median, dietary behavior required for scoring is sample specific, and caution must be exercised when generalizing the results. In light of the sample characteristics, it is plausible that the diet underlying 'low', 'medium', or 'high' NND adherence entailed higher diet quality in the present sample compared to a more representative sample. Still, this procedure for determining cut-offs is in line with the methods applied in previous studies exploring relations between predefined dietary patterns and various health parameters (4–6, 42).

In addition to the use of separate methods for determining NND adherence and calculating intakes of foods and nutrients, it may be a study strength that the questionnaire was recently developed, and thus provided contemporary data. Previous studies derived dietary scores from data collected between years 1991 and 1999 (18), 2002 and 2008 (5), and in 2007 (6), implying that dietary patterns might have changed. On the other hand, it could be a disadvantage if NND adherers in the current study were familiar with the proposed favorable characteristics of the foods included in the NND, and gave the anticipated most desirable answers to the questions. Moreover, repeated 24-h recall interviewing is considered one appropriate method for collecting representative dietary data at group level, entailing less participant burden than dietary records (36, 43).

Unequal methodological approaches, or a selective and more recent sample, might partly explain discrepancies in the present findings as compared with earlier studies (5, 6, 18), that is, the previously observed associations between adherence to healthy Nordic diets and the intake of less healthy foods not part of the diets under investigation (21, 22). Nevertheless, considering the limitations of the current study, these associations should be further explored in larger and more heterogeneous samples in order to draw conclusions. Also, when applied in epidemiological studies, potential confounding lifestyle and dietary factors not included in the dietary score should be accounted for, since residual confounding could distort explored associations. Increased knowledge concerning potential methodological bias, as discussed in the present study, would be of importance, due to the fact that such bias may result in false inferences regarding diet-disease relations.

Conclusions

The present study assessed the association between adherence to the NND measured with FFQ and diet quality measured with two 24-h dietary recall interviews, and showed that higher NND adherence was associated with a higher intake of selected healthy foods and nutrients. However, a higher intake of meat, sweets, and energy in general, as earlier reported in adherers to predefined healthy Nordic diets, was not observed, whether assessed by FFQ or 24-h dietary recall. Nonetheless, the methodological limitations in the current study imply replications in larger and more representative samples before inferences can be drawn regarding explanations for these partly differing results.

Authors' contributions

EB, MKT, NCØ, THS and HBB designed the present study; ERH, EB, and NCØ constructed the initial NND score; HBB, EB, MKT, NCØ, and LFA developed the HSL-questionnaire; HBB and EB prepared the dataset, SBS directed the physical activity assessments; HBB analyzed the data and wrote the paper; HBB and EB had primary responsibility for final content. All authors read and approved the final manuscript.

Disclosure

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and research clearance was obtained from The Norwegian Social Science Data Services. Written informed consent was obtained from all subjects.

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Conflict of interest and funding

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Appendix 1. The components underlying the construction of the 10 subscales within the NND score ($n = 75$)

Subscale	Related question(s)	Response alternatives and coding	Calculations (min-max)	Median = cut-off	Dietary behavior associated with scoring
Meal pattern	How often do you eat -Breakfast -Lunch -Dinner -Evening meal/supper	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7	Sum of answers to the four questions (0–28)	Women: 25.0 Men: 25.0	Women: < 25.0 = 0 ≥ 25.0 = 1 Men: ≤ 25.0 = 0 > 25.0 = 1
Nordic fruits	How often do you eat typical Nordic fruits (apple, pear, plum)	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7 Several times a day = 10	No calculation (0–10)	Women: 4.0 Men: 3.5	Women: ≤ 4.0 = 0 > 4.0 = 1 Men: ≤ 3.5 = 0 > 3.5 = 1
Root vegetables	How often do you eat root vegetables (e.g. carrot, rutabaga, onion)?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Women: 5.0 Men: 4.5	Women: ≤ 5.0 = 0 > 5.0 = 1 Men: ≤ 4.5 = 0 > 4.5 = 1
Cabbages	How often do you eat cabbages (e.g. cauliflower, broccoli, Brussels sprouts, kale)?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Women: 3.0 Men: 3.0	Women: ≤ 3.0 = 0 > 3.0 = 1 Men: < 3.0 = 0 ≥ 3.0 = 1
Potatoes vs. rice/pasta	How often do you eat -Potatoes -Rice -Pasta	Never = 0 up to Several times a day = 10	Frequency of eating potatoes relative to eating rice and pasta combined: potatoes/(0.1 + rice + pasta) (0–100)	Women: 0.49 Men: 0.39	Women: ≤ 0.49 = 0 > 0.49 = 1 Men: < 0.39 = 0 ≥ 0.39 = 1
Whole grain breads vs. white breads	How often do you eat -Refined breads/bread rolls -Whole grain breads -Whole grain hard breads	Never = 0 up to Several times a day = 10	Frequency of eating whole grain breads and whole grain hard breads combined relative to eating refined breads: (whole grain breads + whole grain hard breads)/(0.1 + refined breads) (0–200)	Women: 15.0 Men: 9.6	Women: ≤ 15.0 = 0 > 15.0 = 1 Men: ≤ 9.6 = 0 > 9.6 = 1

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Appendix 1 (*Continued*)

Subscale	Related question(s)	Response alternatives and coding	Calculations (min-max)	Median = cut-off	Dietary behavior associated with scoring
Oatmeal	How often do you eat oatmeal?	Never = 0 up to Several times a day = 10	No calculation (0–10)	Women: 1.0 Men: 0.75	Women: < 1.0 = 0 ≥ 1.0 = 1 Men: ≤ 0.75 = 0 > 0.75 = 1
Foods from the wild countryside	How often do you eat -Game (e.g. moose, reindeer, deer) -Lean fish (e.g. cod, Pollock, haddock) -Fatty fish (e.g. mackerel, herring, halibut) -Other seafood (e.g. shrimps, crabs, mussels -Berries	Never = 0 up to Several times a day = 10	Sum of answers to the five questions (0–50)	Women: 4.5 Men: 4.5	Women: < 4.5 = 0 ≥ 4.5 = 1 Men: ≤ 4.5 = 0 > 4.5 = 1
Milk vs. juice	How often do you drink -Milk -Fruit juice without added sugar	Never = 0 up to Several times a day = 10	Frequency of drinking milk relative to drinking fruit juice: milk/(0.1 + juice) (0–100)	Women: 1.29 Men: 2.5	Women: ≤ 1.29 = 0 > 1.29 = 1 Men: ≤ 2.5 = 0 > 2.5 = 1
Water vs. sugar/ artificially sweetened beverages	How often do you drink -Water -Sugar-sweetened beverages -Artificially sweetened beverages	Never = 0 up to Several times a day = 10	Frequency of drinking water relative to drinking sugar-sweetened beverages and artificially sweetened beverages combined: water/(0.1 + sugar-sweetened beverages + artificially sweetened beverages) (0–100)	Women: 6.25 Men: 2.8	Women: ≤ 6.25 = 0 > 6.25 = 1 Men: ≤ 2.8 = 0 > 2.8 = 1

NND, New Nordic Diet.

Paper III

Is there such a thing as sustainable physical activity?

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Is there such a thing as sustainable physical activity?

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There is a global need to diminish climate gas emissions, and a simultaneous call for enhanced levels of physical activity. Increased physical activity entails reduced risk for overweight and chronic diseases, as well as a potential to reduce transport's major contribution to global CO_2 emissions. However, increased physical activity level also implies increased energy expenditure. Therefore, we aim to introduce the concept of sustainable physical activity, and to suggest certain physical activity habits due to their potentially sustainable properties. Worldwide, a third of adults and four fifths of adolescents ought to be more physically active in order to comply with current physical activity recommendations. Yet, considering upcoming resource challenges, types of physical activity should be taken into account. Active transportation represents carbon-friendly means of transportation as well as an opportunity for enhanced physical activity. Physical activity conducted in the local community is likely to favor sustainability through less use of fossil fuel, as it makes transportation redundant. Moreover, going "back to basic", using less equipment and appliances for everyday tasks could contribute toward energy balance through increased physical activity, and could decrease resource use. Finally, balancing food intake and energy expenditure would require less food production with accompanying energy savings.

At present there is a global need to reduce climate gas emissions, and at the same time there is a global call for increased physical activity. Increased physical activity level implies reduced risk for overweight and chronic diseases (WHO, 2010), and a potential to reduce transport's major contribution to global CO_2 emissions (Woodcock et al., 2009). However, increased physical activity means increased energy expenditure, and most likely enhanced food consumption (Blundell et al., 2015). Although a considerable amount of research has focused on sustainable diets, including aspects like local foods, few studies have focused on aspects of sustainability related to physical activity. The ambitious goal of the Paris Agreement adopted by 195 countries in December 2015, entailing carbon neutrality before the end of the century (COP21, 2015), demands that initiatives need to be generated within all areas of society. In light of the historic Paris agreement, we believe that sustainable physical activity holds a potential that should be introduced and addressed. Thus, the aim of this discussion paper was to introduce the concept of sustainable physical activity.

In today's society, food procurement no longer depends upon energy expenditure, thus removing the biological drive for subsistence physical activity (Peters et al., 2002). Physical activity and exertion have largely been separated from daily tasks due to labor-saving devices, motorized transportation, and increasingly sedentary recreational pursuits (Booth et al., 2008). For illustration, prehistoric hunter-gatherers spent the equivalent of 19-km walking, or approximately 24 000 steps daily (Cordain et al., 1998), while in Colorado, one of the "leanest" states in the United States, men and women have reported about 7000 and 6600 steps per day, respectively (Wyatt et al., 2005). In Norway, recent published data show that men and women walk about 8005 and 8307 steps per day, respectively (Helsedirektoratet, 2015). Moreover, acculturation from a traditional hunting/fishing lifestyle to a largely Western way of living, i.e., a sedentary lifestyle, has shown to occur in parallel with increased body mass index (BMI), as well as decreased muscular strength and aerobic fitness (Cordain et al., 1998), and increased rates of chronic diseases (Katzmarzyk & Mason, 2009).

Lifestyle behaviors strain the environment, e.g., through transportation habits (de Nazelle et al., 2011), production and processing of food (FAO,

2012), and our consumer society in general. These pursuits are largely responsible for increased emissions of greenhouse gases. Currently, transportation activities produce about 23% of global climate gas discharges (de Nazelle et al., 2011), highlighting the relevance of active transportation as a potential means to decrease carbon footprint (Woodcock et al., 2009; Abagnale et al., 2015). Regarding foods, about 35% of man-made climate gas discharges are related to food production (Foley et al., 2011), with 18% caused by livestock alone (Steinfeld et al., 2006). The situation is aggravated by the fact that roughly 30% of all foods produced are either discarded, spoiled, lost, or crops are consumed by pests (Foley et al., 2011). In addition to the environmental footprint caused by transportation habits and food choices, the consumer mentality in affluent societies entails major energy consumption. For large parts of the population within Western countries, leisure consumption often entails abundance of clothes and equipment, transport intensive activities, various electronic appliances for the home, and holiday journeys by air, all adding significantly to the carbon emissions (Aall et al., 2011). In light of expected global population figures, i.e., approximately 9 billion people in 2050, it is calculated that food production will need to be doubled by that time (Foley et al., 2011). As a result, the term sustainable diets have gained ground, concerning the fact that what we eat affects not only our health but also our environment, economy, and culture. The complexity of the term is captured in a recent definition introduced by the Food and Agriculture Organization of the United Nations (FAO):

> Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. (FAO, 2012)

Is there such a thing as sustainable physical activity?

Implications for general health and cardiorespiratory fitness have formed the basis for World Health Organization's physical activity guidelines (WHO, 2010). From a health perspective, frequency, intensity, and duration of the activity are the most important factors, not type of activity. Nevertheless, various types of physical activity might provide equal health benefits, but have very different environmental impact. For instance bicycling from our home instead of driving to a fitness center to attend a spinning class, would favor the environment by reducing vehicle-related carbon emissions. Although the link between physical activity and food procurement has been diminished, our genes are mainly the same as 40 000 years ago. Thus, humans have evolved to engage in physical activity in order to develop and function optimally (Cordain et al., 1998), and to prevent non-communicable diseases (Eaton et al., 2002; Mathers et al., 2009). Inspired by FAO's holistic definition on sustainable diets, and the close interconnection between diet and physical activity as lifestyle behaviors, we introduce the concept of sustainable physical activity defined as:

> Sustainable physical activity includes those activities that are conducted with sufficient duration, intensity and frequency for promoting health, yet without excessive expenditure of energy for food, transportation, training facilities or equipment. Sustainable physical activities have low environmental impact and they are culturally and economically acceptable and accessible.

Based on this definition, we will discuss if there is such a thing as sustainable physical activity, and suggest certain physical activity habits due to their potentially sustainable properties.

Discussion

Active transportation

Trend data for high-income countries indicate that occupational (work-related) physical activity has decreased while leisure physical activity has increased in the past 20–30 years (Hallal et al., 2012; Borodulin et al., 2015). Also, there are major differences in active transportation habits across countries, even where geography, population density, and climate are apparently similar (Hallal et al., 2012). Strong policies and effective urban designs are needed in order to increase the safety, appeal, and acceptability of walking and bicycling through creation of environments facilitating active transportation (Woodcock et al., 2009; Das & Horton, 2012). Assuming that transportation is necessary in everyday life, it is likely that active transportation could represent a time-efficient and thus feasible approach for increasing levels of physical activity (de Nazelle et al., 2011). Active transportation incorporating both walking and bicycling has shown to associate with an overall 11% reduction in cardiovascular risk (Hamer & Chida, 2008). Accordingly, active transportation has been reported to relate inversely with metabolic risk factors for cardiovascular disease, prevalence of diabetes type 2, obesity, and cancer, and positively with physical fitness (de Nazelle et al., 2011). Moreover, prospective studies have found that using a bicycle for transportation

decreases the mortality risk by approximately one third (Andersen et al., 2000; Matthews et al., 2007), and in some countries obesity rates tend to increase in tandem with a decrease in active transportation (Saunders et al., 2013). Yet, the causal pathways of obesity are complex, and current literature provides little robust evidence for the effectiveness of interventions targeting active transportation, on obesity reduction (Saunders et al., 2013). In total, it is proposed that increased active transportation may benefit public health mainly through more physical activity for the commuters themselves, and also for the population in general due to a decrease in air pollution (de Nazelle et al., 2011). Also, a lesser demand for and thus less production of motor vehicles, would result in decreased carbon emissions (Berners-Lee, 2010).

Close to 23% of current global greenhouse gas emissions result from transport activities (de Nazelle et al., 2011). Predictions regarding changes in emissions due to mode shifts are complex and uncertain, and there are currently few real-world examples (de Nazelle et al., 2011). Still, it was estimated in a transport scenario for year 2030 that a combination of active transportation and lower emission motor vehicles could reduce annual CO_2 emissions in London and Delhi with 38% and 48%, respectively, entailing major health benefits (Woodcock et al., 2009). Numerous factors affect calculations of carbon footprint, not the least food choices. For example, if one obtains the energy required for cycling one mile from asparagus transported by aircraft from afar, the carbon emissions would be about the same as if driving a mile with a large sport utility vehicle (SUV) (Berners-Lee, 2010). The carbon impact from driving one mile is suggested to range from 344 g CO_2e to 2240 g CO_2e, depending on what car one drives, where, and how one drives it (Berners-Lee, 2010). Large pickups are estimated to cause about five times the global warming costs per mile, as compared with a small hybrid vehicle (Lemp & Kockelman, 2008). Nevertheless, bicycling is generally far more carbon-friendly than driving, independent of car type. Different energy sources would naturally entail different energy impact, yet even if all cars were powered by electricity, it would still demand considerably more energy to move the mass of a car than the mass of a bicycle. Also, electric bicycles are becoming more widely used, and emissions of regulated pollutants may be significantly reduced if electric bikes gradually replace cars and mopeds (Abagnale et al., 2015).

Community-based physical activity

Physical activity conducted in the local community makes motorized transportation redundant, favoring the environment through less use of fossil fuel and decreased emissions of climate gases. Some forms of exercise, like running and walking, may be conducted equally well from where we live, instead of driving to the gym in order to use a treadmill. The opposite of community-based physical activity is the trend that many people travel all over the world to be physically active, e.g., snorkeling the reefs of Belize, or skiing in the Alps, which does clearly not represent a sustainable lifestyle. Results from a Norwegian study has shown that the most energy-intensive forms of leisure consumption, e.g., holiday journeys by air, seem to increase the most (Aall, 2011). Additionally, leisure activities in general have become more transport intensive, and the share of private car use for long-distance transportation to outdoor recreation areas has expanded (Aall et al., 2011).

Children and youth

Regarding youth leisure activities, those conducted locally and in sport clubs in the neighborhood, allowing children and adolescents to walk or bicycle to their activities, would be advantageous. This in turn highlights the importance of the building and spatial planning facilitating physical activity in the local community, as a means to increase daily levels of physical activity. Nevertheless, building environments providing features expected to facilitate children's play and walking have shown to influence younger children's moderate-vigorous activity negatively, whereas small to moderate positive effects for adolescents' activity levels were reported (McGrath et al., 2015).

Adults and elderly

Access to nature within the living environment tend to be associated with more physical activity and active lifestyles, yet individual characteristics and environmental barriers are likely to impact the relationship (Calogiuri & Chroni, 2014). Despite the lack of a consistent pattern, some studies have reported positive associations between objectively measured physical activity and access to parks (Bancroft et al., 2015). Also, living in neighborhoods with higher street connectivity, land use mix and residential density, referred to as neighborhood walkability, has been associated with nearly 800 more steps per day in adults, i.e., nearly 8% of the recommended daily amount of steps (Hajna et al., 2015). Concerning elderly, studies investigating associations between the physical environment and total physical activity, and also specific physical activity domains, reveal inconsistent results (Van Cauwenberg et al., 2011). Although methodological limitations could distort

observed associations, the conflicting results also express the challenge and significance of creating environments promoting physical activity throughout the life course.

Equipment

Various equipment and labor-saving devices have gradually replaced manual work, both in private homes and at workplaces. Less effort, and to a certain degree less time, is spent to accomplish everyday tasks, and physical disabilities caused by continuous heavy labor have been reduced (Hallal et al., 2012). Yet, there is a price to pay for this drive for productivity and convenience in the shape of a more sedentary lifestyle, and thus enhanced prevalence of non-communicable diseases (Lee et al., 2012). Furthermore, the proliferation of electronics and various household devices in the average home has caused a rapid increment in electricity expenditure, especially in OECD countries (Cabeza et al., 2014). In non-OECD countries experiencing income growth, procurement of household appliances is expected to cause significant carbon footprints due to the carbon intensive electricity production in several of these countries (Cabeza et al., 2014). In addition to the direct emissions related to the use of household equipment, the indirect emissions are remarkable, i.e., energy required for production, distribution, and disposal of goods (Kok et al., 2006). Clearly it would not be realistic or desirable to expect people to refrain from basic appliances like washing machines and refrigerators which represent an improved standard of living from which we have benefitted for decades. Instead we could question our need for devices and gadgets invented mainly for convenience. Although less use of equipment and a higher degree of manual labor might result in a more time-consuming lifestyle, it would entail both decreased carbon emissions and increased physical activity, and may therefore be worth considering. For example, shoveling snow by hand is estimated to require twice as much energy as riding a snow blower (Ainsworth et al., 2000). Moreover, a recent pilot study assessing the physical activity level during bread baking showed that on average the 10 participants obtained 16.2 min of moderate physical activity, out of in total 28 min (Karlsen, 2015). This elucidates the potential to meet the minimum level of physical activity required for health through everyday activities, which in turn could save time otherwise needed for engaging in additional physical activity. Also, facilities like sports halls, indoor ice rinks, ski lifts, etc., entail increased emissions through energy demands for construction and operation. Activities requiring less equipment and amenities would be more carbon-friendly (Schmidt, 2006) and thus preferable. Artificial needs constructed by the market forces and personal attitudes may also play a part, as the amount of equipment considered necessary for conducting sports is probably highly relative. Nevertheless, in Norway, and likely in other rich Western countries as well, a strong materialization of leisure activities has taken place, entailing increased demand for specialized equipment and clothing (Aall et al., 2011).

Energy expenditure

An individual's basal metabolic rate, i.e., the threshold for maintaining bodily functions, generally accounts for 60–70% of total energy expenditure with variation by age, body mass, height, and sex, and represents the fundamental basis for estimating energy requirements in humans (Shetty, 2005). Total energy expenditure is often calculated as multiples of basal metabolic rate, commonly referred to as the physical activity level (PAL) index (Shetty, 2005). A PAL of 1.4 indicates a sedentary lifestyle, while the recommended PAL of 1.75 requires an occupation involving regular physical activity, or conducting regular exercise (Saris et al., 2003). From an evolutionary perspective, the latter energy expenditure is still limited, as it has been calculated that the total energy expenditure of a typical current Westerner is about 65% of that of Paleolithic Stone Agers (Cordain et al., 1998).

Physical activity recommendations

The many health benefits from physical activity are well documented (WHO, 2010), and adults are recommended to do at least 150 min of moderate-intensity aerobic physical activity, or at least 75 min of vigorous-intensity aerobic physical activity, or a combination of these, every week. Also, muscle-strengthening activities involving major muscle groups should be conducted on 2 or more days a week (WHO, 2010, Helsedirektoratet, 2014), and sedentary time should be reduced (Helsedirektoratet, 2014). For further health promotion and maintenance of a healthy body composition, weekly amount of physical activity is suggested to be doubled (WHO, 2010, Helsedirektoratet, 2014). Despite methodological limitations and challenges regarding physical activity monitoring, there are substantial disparities in physical activity levels across regions and populations where surveillance has been conducted. Worldwide, one third of adults and four fifths of adolescents do not reach physical activity guidelines (Hallal et al., 2012), something which is further estimated to cause 6–10% of the major non-communicable diseases of coronary heart disease, type II diabetes, breast- and colon cancer, and 9% of

premature deaths (Lee et al., 2012). Concerning daily energy expenditures for physical activity, calculations have suggested that modern sedentary adults reach about 38% of that of a typical hunter-gatherer (Cordain et al., 1998). In order to approximate these differences, about one additional hour of aerobic physical activity daily would be required (Saris et al., 2003).

Energy balance

If physical activity increases to recommended levels for the population as a whole, it will also increase total energy expenditure. Despite variability in biological responsiveness between individuals, long-term increased energy expenditure is related to increased basal hunger (Blundell et al., 2015). Consequently, overall energy intake is likely to increase (Blundell et al., 2015), probably entailing the need for enhanced food production. Therefore, it is reasonable to believe that with increased PA levels, as recommended, more food is needed. Diet and food production represents a major issue regarding global sustainability (FAO, 2012); however, different foods and different food production methods have greatly different impact. For illustration, greenhouse gas (GHG) emissions per gram of protein for ruminant meat are about 250 times those of legumes (Tilman & Clark, 2014). Simultaneously, rising incomes and urbanization drives a dietary transition entailing, among others, increased meat consumption (Tilman & Clark, 2014). Worldwide dietary energy supply for the years 2014–2016 is calculated to be 12 146 kJ per person per day, which should be sufficient for meeting energy requirements for the current world population (FAO, 2013). Still, approximately a billion people live in chronic hunger (FAO, 2012), while about 1.9 billion adults are overweight or obese (WHO, 2011). This clearly expresses the pivotal role of food, yet a comprehensive discussion regarding food issues is beyond the scope of this paper.

Still, overconsumption of energy resulting in accumulation of fat tissue and weight gain may be considered indirect food waste, and the current obesity epidemic illustrates global imbalance in energy distribution. In 2010, high BMI (>25 kg/m^2) represented the sixth leading risk for deaths worldwide, and overweight and obesity were estimated to cause 3.4 million deaths and 3.8% of disability-adjusted life-years (Lim et al., 2013). Between 1980 and 2013, the prevalence of overweight and obesity combined increased by 27.5% for adults and 47.1% for children, yet since 2006, weight gain seem to have attenuated in developed countries (Ng et al., 2014). Obesity is clearly not sustainable, yet to decrease food intake in order to feed more people and prevent excessive weight gain, is not a simple task. The mismatch between biological predispositions and current food environment (Cordain et al., 1998) is illustrated by the fact that no country has achieved a significant decrease in obesity rates during the last 33 years (Ng et al., 2014). More specific, Lobstein calculated that an 8% reduction of current food purchase patterns in the United Kingdom would be required over a period of at least 3 years, in order to reduce population BMI to 1980 levels (Lobstein, 2011). In order to achieve and maintain energy balance, the overall rate of energy movement, referred to as energy flux, has been emphasized by some researchers (Hand & Blair, 2014; Blair et al., 2015). It is proposed that a high energy flux, meaning high levels of both energy intake and expenditure, is likely to reflect the optimal strategy for maintaining a healthy weight, as well as improving metabolic parameters (Hand & Blair, 2014). However, weighting up both resource demands, food production, and human biology, it could be assumed that a level of physical activity meeting the minimum requirements for health would be the most sustainable one, yet may not optimal from an evolutionary point of view (Cordain et al., 1998).

Perspective

Globally, a third of adults and four fifths of adolescents ought to be more physically active in order to promote health and prevent major non-communicable diseases. Nevertheless, in light of upcoming resource challenges and the fact that various types of physical activity could provide equal health benefits yet different environmental impacts, types of physical activity should be taken into account. Therefore, in order to bridge the topical issues of sustainability and physical activity, which is previously undone, the aim of the present paper was to introduce the concept sustainable physical activity, and suggest certain physical activity habits due to their potentially sustainable properties:

- Active transportation represents a carbon-friendly mean of transportation, as well as an opportunity for enhanced physical activity levels.
- Physical activity conducted in the local community is likely to favor sustainability from a broad perspective.
- Going "back to basic" using less equipment and appliances for everyday tasks could contribute toward energy balance through increased physical activity, and could also decrease resource use.
- Balancing food intake and energy expenditure would require less food production with accompanying energy savings.

Key words: Resource challenges, environmental impact, health promotion, active transportation, community-based physical activity, equipment, energy balance.

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Paper IV

The Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score and socio-demographic correlates - a cross-sectional study

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The Healthy and Sustainable Dietary and Physical Activity habits(HSDPA)score and socio-demographic correlates- a cross-sectional study

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Abstract:	Background: Environmental sustainability and public health are connected through diets and physical activity, suggesting a shared route for promotion and protection. Enhanced understanding regarding socio-demographic correlates of dietary and physical activity habits is important to allow for tailoring of interventions to relevant target groups, which in turn could increase adherence to the selected aspects at the population level. Currently, little is known about correlates of a combined approach. Thus, the purpose of the present study was to: (I) Create a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, and (II) assess potential socio-demographic correlates of the HSDPA score. Methods: Cross-sectional data were obtained from 530 parents of toddlers participating in the Healthy and Sustainable Lifestyle (HSL) project (2014-2015). Multilevel linear mixed models explored associations between potential correlates and selected dietary and physical activity habits, both separately and collapsed into the HSDPA score (possible range: 0-40). Results: The HSDPA score incorporated the following aspects: (I) New Nordic Diet, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities. For the fully adjusted models mean scoring on the HSDPA score in total was higher for participants with high education (mean (95% CI): 18.2 (17.4-19.0)), compared to those with low education (16.8 (15.8-17.7), p = 0.002), and for participants living centrally (18.4 (17.6-19.2)), compared to those living less centrally (16.5 (15.6-17.4), p = <0.001)). No differences were observed for sex, ethnicity or age. Conclusion: Higher education and centrality singled out as the most relevant correlates of selected dietary and physical activity habits. Our findings indicate that interventions should be tailored to low educated groups and to those living in non-central areas, in order to facilitate lifestyle habits potentially promoting public health and environmental sustainability. Keywords: Health, environmental sustainability, diet, physical activity, socio-demographic correlates
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Title: The Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score and socio-demographic correlates - a cross-sectional study

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Abstract

Background: Environmental sustainability and public health are connected through diets and physical activity, suggesting a shared route for promotion and protection. Enhanced understanding regarding socio-demographic correlates of dietary and physical activity habits is important to allow for tailoring of interventions to relevant target groups, which in turn could increase adherence to the selected aspects at the population level. Currently, little is known about correlates of a combined approach. Thus, the purpose of the present study was to: (I) Create a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, and (II) assess potential socio-demographic correlates of the HSDPA score.

Methods: Cross-sectional data were obtained from 530 parents of toddlers participating in the Healthy and Sustainable Lifestyle (HSL) project (2014-2015). Multilevel linear mixed models explored associations between potential correlates and selected dietary and physical activity habits, both separately and collapsed into the HSDPA score (possible range: 0-40).

Results: The HSDPA score incorporated the following aspects: (I) New Nordic Diet, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities. For the fully adjusted models mean scoring on the HSDPA score in total was higher for participants with high education (mean (95% CI): 18.2 (17.4-19.0)), compared to those with low education (16.8 (15.8-17.7), $p = 0.002$), and for participants living centrally (18.4 (17.6-19.2)), compared to those living less centrally (16.5 (15.6-17.4), $p = <0.001$)). No differences were observed for sex, ethnicity or age.

Conclusion: Higher education and centrality singled out as the most relevant correlates of selected dietary and physical activity habits. Our findings indicate that interventions should be tailored to low educated groups and to those living in non-central areas, in order to facilitate lifestyle habits potentially promoting public health and environmental sustainability.

Keywords: Health, environmental sustainability, diet, physical activity, socio-demographic correlates

Introduction

Environmental sustainability and human health are connected through diets [1] and physical activity [2], suggesting a shared route for promotion and protection of both human and environmental health.

A major issue for the near future is how to feed the growing world population, expected to increase from today's 7 billion to close to 10 billion people in 2050 [3], without compromising planetary sustainability and the needs of future generations [4]. It has been estimated that food production must double, entailing growing demands for diminishing natural resources [4]. Agriculture is suggested to be responsible for 30-35 % of global greenhouse gas emissions [5], with about 18 % related to the livestock sector alone [6]. Dietary shifts away from traditional diets, to diets rich in processed foods, meats, refined sugars, refined fats, and oils, contributes to the environmental strain [1]. By 2050 these dietary trends, if uncurbed, are likely to account for a major share of the calculated 80 % increase in greenhouse gas emissions from agriculture, as well as land clearing [1]. Also, such diets would result in enhanced incidence of chronic diseases, which are currently causing nearly two thirds of all deaths worldwide [7].

Another major public health challenge is the fact that one third of adults and four-fifths of adolescents do not reach recommended physical activity levels, causing approximately 6-10% of the non-communicable diseases of coronary heart disease, type II diabetes, breast- and colon cancer, and 9 % of premature deaths [8]. Moreover, passive transport activities in total produce about 23% of global climate gas discharges [9]. Probably, an increased share of travels could be conducted as active transportation, i.e. walking or cycling, considering that for instance in Norway, 25 % of daily travels done by car are shorter than 2.5 kilometers [10], and average distance of bicycle trips is 4 kilometers [11]. Therefore, active transportation represents a potential mean to decrease carbon footprint [2, 12] and increase levels of physical activity [9], with accompanying health benefits [9, 13-16].

In order to capture both dietary and physical activity habits that could cause minimal environmental damage and promote healthy eating and healthy levels of physical activity, we have focused on the following nutrition and activity aspects; (I) New Nordic Diet, (II) Local and sustainable foods, (III) Active transportation, and (IV) Non-exercise outdoor activities.

The concept of a New Nordic Diet (NND) has been proposed as an example of a regional diet potentially promoting health, environmental sustainability and food traditions [17], without compromising palatability [18]. The NND consists of healthy foods native to the Nordic climate, or foods that can be produced or cultivated in the Nordic climate, like certain fruits, berries, root

vegetables, cabbages, whole grains, wild fish and game, potatoes, and rapeseed oil [17, 19]. Different trials have shown beneficial effects of constructed Nordic diets in at-risk populations [20-24], while observational studies have found favorable associations between adherence to Nordic diets and various health outcomes [25-32]. The NND seems to cause lower environmental impact mainly due to the reduced meat content and exclusion of most of the long distance imports [33].

The NND score, constructed in order to measure adherence to the concept NND [31], does not capture if incorporated foods really are of Nordic origin or produced in a sustainable manner [34]. For illustration, we do not know whether the apples reported to be eaten are locally grown or airborne from the other side of the world. Thus, we want to emphasize "Local and sustainable foods" as a separate aspect of interest, focusing on local produce and sustainability. By "local foods" we mean foods that have travelled short distances only, or foods that are marketed directly from the producer [35], yet there is no universal definition. When applying the term "sustainable foods", our main focus is foods that are likely to promote health and protect biodiversity and ecosystems [36]. Reduction in meat consumption seem to be the most important dietary factor for climate change [37], advocating a decreased intake of meat and animal foods in general, in favor of more plant foods. Still, choosing local and seasonal foods could potentially reduce food miles and further climate gas discharges related to transportation and cooling underway [38]. Locally produced foods may also be characterized by an increased freshness and higher nutritional quality, due to short time between harvest and consumer access to foods, and less intensive processing [39]. A basic tenet of organic production is consideration for nature and biodiversity, entailing use of organic fertilisers and limited use of pesticides, as well as care for animal welfare [18, 40]. Therefore, organic produce is generally assumed to cause lower environmental impact than conventional agriculture [41], although total footprint is unclear due to traits like lower production per unit of land, variations across different foods (positive and negative organics) [38], and use of external energy e.g. for heating of greenhouses [42]. It is debated whether organic produce result in more nutritious foods, yet a recent meta-analysis reported that several antioxidants were present in 19 % to 69 % higher concentrations in organic crops, compared with conventional crops [43]. Also, occurrence of pesticide residues were four times less frequent in the organic types, and cadmium concentrations were lower [43]. Moreover, the certainty that roughly 30 % of all foods produced on the planet are either discarded, spoiled, lost or consumed by pests [5], expresses the potential for major improvements related to a decrease in food waste. In developed countries the majority of foods are wasted at the consumer level, caused by factors like insufficient planning of meals and food management, low price of foods relative to income, and maybe also increased disconnection between consumers and food production [44]. Purchasing locally grown foods, for instance from

farmers markets, could entail awareness-raising favourable for declining food waste, which may also apply for self-growing of vegetables, fruits and herbs. Besides, since current knowledge indicates that contact with nature can promote health, especially in forms of short-term restorative effects [45], gathering wild plants or picking berries might entail a way to combine recreational physical activity with food procurement.

Active transportation may represent a feasible and time efficient way to increase physical activity levels [9], which could favor public health through enhanced physical fitness [9], obesity prevention [46], decreased risk of chronic diseases [9, 13, 47], and reduced mortality risk [14, 15]. The environment would probably benefit from a decline in CO_2 emissions, and thus lower levels of air pollution [2, 9, 10]. Active transportation could entail more than walking or cycling to school or work, such as travelling by foot or bike to the store, to friends, to the city centre, or transporting children to the kindergarten [47]. Like for active transportation, everyday activities conducted outdoors in the local community, e.g. playing, gardening, hiking, or walking in the neighbourhood, could make motorized transportation redundant, potentially reducing vehicle-related emissions. Besides, non-exercise physical activities seem to associate with cardiovascular health and longevity, irrespective level of regular exercise [48]. Exposure to natural or "green" environments has shown relations with more favorable physiological and psychological conditions [49], and increased well-being [50], also when taking level [51] and type [50] of physical activity into account. Therefore, a restorative quality of green space as such seems probable. Additionally, hiking in the nature has been reported to associate with less overweight [52].

Lifestyle behaviors like food consumption [53], dietary patterns [54], and participation in physical activity in general [55-57], are affected by several underlying factors. It is well documented that socioeconomic disadvantaged individuals are less likely to engage in health related behaviors [58], and more likely to suffer from poorer health and higher mortality rates than groups with higher social status [59]. Studies have found active transportation to be influenced by ethnicity [47, 60], gender [47, 60, 61], age [47], educational level [47, 61, 62], and travel distance [61, 63, 64], while engagement in non-exercise physical activity seem to correlate with higher education [48]. Further, NND is reported to obtain greater acceptance among women, and also among consumers who follow a healthy dietary pattern and prefer organic and seasonal foods [65], which often applies those with higher education and those who live in urban areas [66]. Other studies confirm that adherers to predefined healthy Nordic diets tend to be higher educated [25, 31, 67, 68], and older [31, 67, 68]. Enhanced understanding regarding socio-demographic correlates of the selected dietary and physical activity habits is relevant to allow for tailoring of interventions to relevant target groups, or to explore time trends. In turn, tailored initiatives could result in increased

adherence to the selected aspects at the population level, and further promotion of both public health and environmental sustainability. Previous research, however, address specific behaviors individually, and little is known about correlates of the selected aspects as a totality. Therefore, we want to assess potential socio-demographic correlates of the aspects of interest both separately, and as a unity. To enable measuring degree of adherence to selected constructs they need to be operationalized, thus the aim of the present study was twofold: I) to create a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, including the following aspects; New Nordic Diet, Local and sustainable foods, Active transportation, and Non-exercise outdoor activities, and (II) to assess potential socio-demographic correlates of these selected aspects separately, and as a unity.

Methods

Procedure and sample

Cross-sectional data was obtained from the Healthy and Sustainable Lifestyle (HSL) project, which collected data in collaboration with the Child Food Courage project [69] from October 2014 to January 2015. A web-based questionnaire was constructed to explore lifestyle behaviors, self-perceived health and quality of life. Parents of toddlers born in 2012, residing in Southern Norway, were recruited through kindergartens. All kindergartens in the counties of Vest-Agder and Aust-Agder fulfilling the inclusion criteria, i.e. having children born in 2012 whose parents were able to speak and read Norwegian, were invited to participate (*n*=351). Out of these, 309 kindergartens signed up, entailing distribution of information to eligible parents. Parents were provided additional information regarding purpose and implications of the study through a web-page, and via e-mail distribution. For each child, either the mother or the father could take part. A total of about 3100 parents were invited to participate, of whom 605 parents from 207 kindergartens signed up. Participants provided consent electronically, followed by administration of the questionnaire survey by e-mail. In total 530 participants (17%) filled in the electronic questionnaire, from which all variables were assessed. The study was conducted according to the guidelines laid down in the Declaration of Helsinki, and research clearance was obtained from the Norwegian Social Science Data Services.

The Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score

The cross-sectional survey incorporated a food frequency questionnaire (FFQ) assessing participants' habitual frequency intake of selected foods, among them foods included in the NND [17, 19]. There was no specification of amounts consumed. The NND score was previously developed in order to capture adherence to the concept NND [17, 18], it has been thoroughly

described [31], and was found to be reliable in a test-retest study [70]. Moreover, the questionnaire comprised indicator questions targeting "Local and sustainable foods", "Active transportation", and "Non-exercise outdoor activities", to enable an operationalization of these aspects. The items concerning each aspect (see table appendix 1 and table appendix 2) were merged into separate subscales, to measure degree of adherence. Number of indicator questions for the subscales ranged from 8 (Non-exercise outdoor activities) to 24 (NND), in total 53 questions. Each of the subscales was assigned equal weighting, meaning that possible range for all four scales was adjusted to 0-10. Further, the subscales were collapsed into a summary index, the Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, potentially ranging from 0-40. Higher HSDPA score indicated increased compliance with the selected aspects as a totality. Table appendix 1 describes the items, response options and calculations underlying the construction of the subscales Local and sustainable foods, Active transportation, Non-exercise outdoor activities, and the HSDPA score in total, while table appendix 2 gives details on the construction of the NND score.

Test-retest reliability of the NND score has recently been tested and found acceptable in a convenience sample (n = 67, 85 % females, mean age 34 years (SD = 5.3 years)) of parents of toddlers [70], with a test-retest correlation (Pearson's correlation coefficient) of $r = 0.80$ ($p = <0.001$). For the additional subscales, i.e. Local and sustainable foods, Active transportation and Non-exercise outdoor activities, test-retest correlations (Spearman's rank correlation coefficient) were $r = 0.84$, 0.92 and 0.74, respectively (all $p = <0.001$), and for the HSDPA score in total, test-retest correlation was $r = 0.85$ ($p = <0.001$).

Other study variables

The questionnaire also included basic demographic and socioeconomic variables (e.g. sex, age, height, weight, ethnicity, and educational level), in addition to questions mapping distance to workplace/study site, the kindergarten, the nearest grocery shop and the nearest city center. Participants were asked to identify their sex, while age was determined from date of birth and date of filling in the questionnaire, and further dichotomized by the sample specific median; <32 years vs. ≥32 years. Participants' body mass index (BMI (kg/m^2)) was computed from self-reported height and weight and further collapsed into a binary variable; not overweight/obese (BMI <25 kg/m^2) and overweight/obese (BMI ≥25 kg/m^2) [71]. Ethnicity was assessed by two questions; if their mother/ father were born in Norway. Ethnicity was dichotomized into non-native or native, with participants considered native Norwegians if both parents were born in Norway. Educational attainment was assessed by asking participants to mark their highest level of completed education, and the following options: less than 10 years of primary education; primary education; 3 years of secondary education; <4 years of college/university education; ≥4 years of college/university education.

Education was further merged into a binary variable; low education (not having attended college or university) and high education (having attended college or university). In order to obtain information on distance to workplace/study site, the kindergarten, the nearest grocery shop and the nearest city center, participants reported distance in kilometers (km) from their residence to each destination. The four variables were trichotomized with the following cut-offs: ≤1.0 km and ≤3.0 km for the kindergarten and the nearest grocery shop, respectively, and ≤3.0 km and ≤10 km for workplace/study cite and the nearest city center, respectively. Distances over 50 km were considered outliers for the kindergarten, nearest grocery shop and nearest city center, entailing that participants reporting distances greater than 50 km for these destinations, were not included in the analyses (n = 1). For workplace/study site none were excluded, as commuting could cause greater distances than 50 km. Further, variables were summed up in order to create a proxy for "centrality" potentially ranging from 0-8, with increasing values indicating longer distances from the home to selected destinations, and thus lower centrality. Further, the variable "centrality" was dichotomized by the median, i.e ≤3 (coded 1) vs. >3 (coded 0), in order to compare "high" centrality (1) vs. "low" centrality (0).

Statistical methods

Statistical analyses were performed using the statistical software package IBM SPSS Statistics version 22.0 (IBM Corp., Somers, NY, USA). Descriptive analyses were conducted to assess distribution of the socio-demographic correlates in the study sample (table 1). Further, crude associations between the HSDPA score in total and the subscales separately, with the dichotomous correlates, were assessed using One-Way ANOVA. Results are presented as mean values with 95 % confidence intervals (CIs) for the total HSDPA score and the continuous subscales (NND, Local and sustainable foods and Non-exercise outdoor activities), and as proportions with 95 % CIs for Active transportation (table appendix 3), as this subscale was dichotomized due to highly skewed data. Multilevel linear mixed models, taking the clustering of participants within kindergartens into account [72], were conducted with the total HSDPA score and the four subscales as dependent variables [73], i.e. five separate models. Sex, age, ethnicity, educational level and centrality were included as binary correlates in all models, and mean values with 95 % CIs are presented for the HSDPA score in total and the continuous subscales, and as proportions with 95 % CIs for the dichotomized Active transportation scale (table 1). A two-sided p-value of <0.05 was considered statistically significant.

Results

In total 530 participants filled in the questionnaire, with a mean age of 32.2 years (SD ± 4.7 years). Moreover, n=453 (90 %) were females, n= 267 (53 %) > 32 years, n= 419 (83 %) native Norwegians, and n= 349 (69 %) reported higher education. In addition, n= 285 (56 %) were categorized as living centrally, and n= 202 (40 %) were classified as overweight or obese.

Crude analyses on how the potential correlates were bivariately related to the HSDPA score in total, and the subscales separately, are presented in table appendix 3. All models were tested without taking the clustering of participants within kindergartens into account, yet they were significantly improved when kindergartens were included as random effects. Hence results are reported for the fully adjusted models, taking the hierarchical structure into account (table 1). Mean rating on the total HSDPA score was significantly higher for participants with high education (mean (95%CI): 18.2 (17.4-19.0)), compared to those with low education (16.8 (15.8-17.7), $p = 0.002$), and for participants living centrally (18.4 (17.6-19.2)), compared to those living less centrally (16.5 (15.6-17.4), $p = <0.001$). No differences were observed for the variables sex, ethnicity or age.

The highly educated group achieved significantly greater scoring on the NND subscale separately (4.5 (4.1-4.9)), than participants with low education (4.0 (3.5-4.4), $p = 0.01$). No differences were detected for sex, ethnicity, age, or centrality. Concerning "Local and sustainable foods", we found higher ratings for those with high education (4.7 (4.4-5.0)), compared to those with low education (4.2 (3.8-4.5), $p = 0.001$), and for participants >32 years (4.6 (4.3-4.9)), in comparison with those <32 years (4.3 (3.9-4.6), $p = 0.02$). Scoring did not differ according to sex, ethnicity or centrality. For the dichotomized "Active transportation" scale, a higher proportion among non-natives (% (95%CI): 56 (45-67)) than natives (44 (37-52), $p = 0.03$) obtained scoring, and a larger proportion of participants living centrally (71 (62-79)), compared to those living less centrally (30 (21-39), $p = <0.001$), were categorized into "Active transportation". Proportions did not differ relative to the variables sex, education or age. Regarding the subscale "Non-exercise outdoor activities", females (mean (95%CI): 7.3 (7.0-7.6)) scored higher than males (6.8 (6.3-7.2), $p = 0.04$), natives (7.3 (7.1-7.6)) were scoring higher than non-natives (6.7 (6.3-7.1), $p = 0.001$), and participants living centrally (7.2 (6.9-7.4)) obtained greater scoring than those living less centrally (6.9 (6.6-7.2), $p = 0.05$). For education and age, categories did not differ significantly from another.

Discussion

In the present study we assessed potential socio-demographic correlates of specific healthy and sustainable dietary and physical activity habits both individually and as a unity, expressed through the HSDPA score. We found that higher educated participants and those living more centrally seemed to comply with such an integrative approach to a larger degree than participants with lower

education and those living less centrally. Concerning education, our finding agrees with current knowledge regarding associations between socioeconomic status and overall dietary quality [53], adherence to healthier dietary patterns [54], as well as participation in physical activity in general [55-57]. Previous studies have reported adherence to healthy dietary patterns to correlate with age and gender as well [54], yet we could not reveal these associations. However, when addressing the subscales separately, we observed that participants older than 32 years reported greater compliance with "Local and sustainable foods" than those younger than 32 years, in addition to those with higher education. Likewise, well-educated and middle-aged consumers have formerly shown a greater tendency to purchase sustainable foods [74]. A possible explanation could be increased awareness for sustainable foods with age [74], as well as better economy, making products with higher prices, like organic foods, accessible.

Educational attainment, and also younger age and male sex, have repeatedly been identified as correlates for participation in physical activity in general [55, 56]. Nevertheless, in the present study engagement in neither "Non-exercise outdoor activities" nor "Active transportation" did differ significantly between those with high or low education, or between age categories. These divergent results may partly be explained by the operationalization of the constructs, and the assessment of specific aspects within physical activity. Unlike previous studies, however, we found that females tended to conduct more of "Non-exercise outdoor activities" than males. Since the aetiology of physical activity differs across domains [55], our results likely reflect that we included various outdoor recreational physical activities, in addition to trips in different settings, when we operationalized "Non-exercise outdoor activities". Correspondingly, walking patterns, representing a key indicator of total physical activity levels, have been reported to differ only slightly in men and women [57]. Moreover, it was observed in a Swedish sample of parents-to-be that 76 % of the women vs. 65 % of the men participated in outdoor recreational physical activity [75].

Current evidence for ethnic origin as a correlate of physical activity in general is inconclusive [55], yet we observed differences between natives and non-natives for both aspects of physical activity, although in opposite directions. We found that natives seemed to conduct "Non-exercise outdoor activities" to a larger degree than non-natives, while a larger proportion of non-natives were categorized into "Active transportation" than natives. As we included trips in various surroundings when operationalizing "Non-exercise outdoor activities", our finding agrees with the tradition for hiking and outdoor life in the Nordic countries, and the fact that values, preferences and content related to outdoor life could be culturally dependant [76]. Consequently, the type of activities that we included may apply less to non-natives. Consistent with our results, immigrants commuted more actively than natives in a recent Swedish study [60], and in a UK sample, non-white ethnic groups

tended to be more likely to walk to work than whites [47]. One potential reason may be a social gradient in car-ownership [77], as not having car-access has shown to associate strongly with both walking and biking to work [61]. Nonetheless, it should be taken into account that we assessed walking and biking combined, which could have influenced the lack of observed differences between males and females regarding transportation habits. Besides, the inclusion and equal weighting of transportation for additional purposes than work or studies should be noted, since the correlates of active transportation may not be equal to those of active commuting [78], i.e. walking or biking to work specifically [79].

Previous studies have revealed that urban location is positively associated with leisure-time physical activity [56], supporting our finding that participants living centrally, compared to those living less centrally, tended to engage significantly more in "Non-exercise outdoor activities". When targeting active transportation specifically, current evidence shows that travel distance [61, 63], and residing in an urban opposed to a rural area [60], affect mode of commuting. This seemed to apply to our sample as well, as we found that residing more centrally correlated with active transportation. An explanation is likely to be that living closer to the relevant destination makes walking or bicycling more realistic and feasible transportation options.

A number of limitations need to be taken into account when study results are evaluated. The questionnaire has not been tested for validity, and the study sample was somewhat biased towards mothers (90 %), native Norwegians (83 %), and higher educated (69 %), which limits generalization of study results. The different sizes of sub-groups, especially females (90 %) vs. males (10 %), also decrease statistical power and might hinder significant outcomes. Another limitation is the reliance on self-reported data, since misreporting is a well-known problem in both physical activity and dietary assessments [80, 81], and foods considered "unhealthy" tend to be under-reported more often than foods perceived "healthy" [81]. However, if randomly distributed, misreporting should still allow ranking of participants according to intake. Like for intake of healthy foods, physical activity is also likely to be over-reported due to social desirability of reporting certain behaviors [82]. Nonetheless, parents who signed up could have been more health-conscious and thus more likely to adhere to a healthy lifestyle, than the average parent of toddlers.

The use of summary indexes has emerged, mainly as a complementary and crude approach for summing up and quantifying dietary patterns, and further assessing relations between diet and health [83]. Yet, other relevant aspects like a physically active and non-smoking life, and low stress have been targeted recently, in addition to a healthy diet, in order to assess potential associations between adherence to such a broader lifestyle index with health parameters [84]. Still, subjectivity

is introduced related to selection and scoring of included components and cut off points [83, 85]. Since no validation data exist for the summary scores, nor for the questionnaire items from which the scores are constructed, we cannot be certain if we actually capture the dietary and physical activity behaviors of interest. If not, reported associations between the potential correlates and the selected aspects could be biased. Besides, as we determined cut-offs for the NND score and the variable "centrality" by the median scoring is sample specific, which hampers generalization of the results. Nevertheless, determining cut-off by the median is a procedure applied in previous studies exploring relations between predefined dietary patterns and various health parameters [25, 31, 68, 86]. The dichotomization of the subscale targeting active transportation, because of highly skewed data, could have affected associations between the scale and the assessed correlates due to reduced precision compared with continuous scales. Nonetheless, in line with former findings [47, 60], the skewed data distribution expressed that motor vehicles represented the main form of transportation in the present study, especially during the winter season.

To our knowledge, a summary index incorporating diet, physical activity, health and the environment, is previously unaddressed. It is also likely that data collected electronically are more valid than data collected by paper questionnaire or interview [87], and there were few missing data in the present study, since the participants needed to answer most of the questions in order to progress and complete the questionnaire. Another potential study strength was the inclusion of additional types of active travel than simply to and from work, since walking or bicycling to shops, to the kindergarten etc. also would qualify as active transportation [47]. Moreover, seasonal variations in type and level of activity [88] were accounted for through distinguishing summer and winter when operationalizing "Non-exercise outdoor activities", and "Active transportation".

Based on the relatively low HSDPA scoring in all subgroups, a relevant question may be if the score represents an elitist approach. Our results suggest that such an integrative approach applies to a larger degree to higher educated groups and to those living in more central areas. In view of the existing inequalities in health behaviors and further health across socioeconomic position, it is not desirable to promote an approach potentially increasing socioeconomic inequalities. On the other hand, our findings may be considered to support current knowledge, and underpin the importance of tailoring interventions to those who are in the greatest needs of more favorable lifestyle behaviors. Noteworthy, we aimed to develop a summary index measuring degree of adherence to specific dietary and physical activity habits, selected on grounds of health and sustainability properties, and to assess potential socio-demographic correlates of such a broader approach. At this stage, we did not aim to test potential associations with health outcomes. Recently a relatively simple unitary index, constructed from self-reports assessing diet, exercise and psychological stress, was reported

to associate with elements of metabolic syndrome and cardiovascular health profile across adherence groups [84]. This reflects that such a crude summary score, applying a single value as a proxy for a healthy lifestyle, could distinguish subjects according to degree of compliance with the aspects of interest, and further capture relations between adherence and health outcomes. Thus, the HSDPA score might entail a potential to serve as a measurement tool for use in future observational or intervention studies. Still, due to the novelty of such a summary index, we cannot at this point draw any inferences regarding health and environmental benefits related to different HSDPA scoring.

Conclusion

In the present study we created a combined Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score, including the following aspects; New Nordic Diet, Local and sustainable foods, Active transportation, and Non-exercise outdoor activities. We found that higher education and centrality distinguished as the most relevant socio-demographic correlates of selected dietary and physical activity habits, when assessed in a sample of parents of toddlers. These findings indicate that interventions should be tailored to low educated groups and to those living in non-central areas, in order to facilitate increased adherence to dietary and physical activity habits potentially promoting public health and environmental sustainability.

List of abbreviations

HSDPA: Healthy and Sustainable Dietary and Physical Activity habits

HSL: Healthy and Sustainable Lifestyle

NND: New Nordic Diet

CO_2: Carbon dioxide

BMI: Body Mass Index

Declarations

Ethics approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and research clearance was obtained from The Norwegian Social Science Data Services. Written informed consent was obtained from all subjects.

Consent for publication

Not applicable.

Availability of data and material

We do not wish to share our data prior project completion.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

EB, MKT, NCØ and THS conceived the Healthy and Sustainable Lifestyle-project. HBTB, SHH, NCØ and EB developed the study and created the questionnaire. HBTB and SHH conducted the data collection, HBB and EB prepared the dataset, HBB analyzed the data and wrote the paper, HBB and EB had primary responsibility for final content. All authors read and approved the final manuscript.

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Table 1: Associations between socio-demographic correlates and the Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score

Socio-demographic correlates†	HSDPA score (0-40) (n = 506)	New Nordic diet (0-10) (n = 506)	Local and sustainable foods (0-10) (n = 512)	Non-exercise outdoor activities (0-10) (n = 510)	Active transportation (0-1) (n = 511)
	Mean (95 % CI)‡	Mean (95 % CI)	Mean (95 % CI)	Mean (95 % CI)	% (95 % CI)‡
Sex					
Male	17.2 (16.0-18.5)	4.0 (3.4-4.6)	4.5 (4.1-5.0)	6.8 (6.3-7.2)	47 (35-61)
Female	17.7 (17.1-18.3)	4.4 (4.2-4.7)	4.3 (4.1-4.5)	7.3 (7.0-7.6)	53 (47-59)
p-value	0.46	0.19	0.82	**0.04**	0.42
Education					
Low	16.8 (15.9-17.7)	4.0 (3.5-4.4)	4.2 (3.9-4.5)	6.9 (6.6-7.2)	50 (40-60)
High‖	18.2 (17.4-18.9)	4.5 (4.1-4.9)	4.7 (4.4-4.9)	7.1 (6.9-7.4)	51 (42-59)
p-value	**0.002**	**0.01**	**<0.001**	0.19	0.89
Ethnicity					
Non-native	17.2 (16.1-18.2)	4.1 (3.6-4.6)	4.6 (4.2-4.9)	6.7 (6.3-7.1)	56 (45-67)
Native¶	17.8 (17.1-18.5)	4.4 (4.1-4.8)	4.3 (4.1-4.5)	7.3 (7.1-7.6)	44 (37-52)
p-value	0.24	0.15	0.13	**0.001**	**0.03**
Age					
<32 years	17.3 (16.4-18.2)	4.3 (3.9-4.8)	4.2 (3.9-4.5)	7.0 (6.6-7.3)	49 (40-58)
≥32 years	17.6 (16.8-18.4)	4.1 (3.8-4.5)	4.6 (4.4-4.9)	7.1 (6.8-7.4)	51 (43-60)
p-value	0.41	0.26	**0.004**	0.38	0.48
Centrality					
Low	16.5 (15.6-17.4)	4.2 (3.8-4.6)	4.5 (4.2-4.8)	6.9 (6.6-7.2)	30 (21-39)
High[1]	18.5 (17.7-19.3)	4.3 (3.9-4.7)	4.4 (4.1-4.6)	7.2 (6.9-7.4)	70 (62-79)
p-value	**<0.001**	0.47	0.53	**0.05**	**<0.001**

†Socio-demographic variables are fixed effects.
‡Multilevel linear mixed models adjusted for all variables presented in the table and kindergartens as random effect.
‖Having attended college or university.
¶Both parents born in Norway.
[1]≤3 (median) on the variable "centrality" (range 0-8)

Table appendix 1: The components underlying the construction of the 10 subscales within the NND score

Subscale	Related question(s)	Response alternatives and coding	Calculations (min-max)	Median = cut-off	Dietary behavior associated with scoring
Meal pattern	How often do you eat -breakfast -lunch -dinner -evening meal/supper	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7	Sum of answers to the four questions (0-28)	Women: 25.0 Men: 26.0	Women: ≤25.0 = 0 >25.0 = 1 Men: ≤26.0 = 0 >26.0 = 1
Nordic fruits	How often do you eat typical Nordic fruits (apple, pear, plum)	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7 Several times a day = 10	No calculation (0-10)	Women: 3.0 Men: 3.0	Women: ≤3.0 = 0 >3.0 = 1 Men: ≤3.0 = 0 >3.0 = 1
Root vegetables	How often do you eat root vegetables (e.g. carrot, rutabaga, onion)?	Never = 0 up to Several times a day= 10	No calculation (0-10)	Women: 4.0 Men: 3.0	Women: ≤4.0 = 0 >4.0 = 1 Men: ≤3.0 = 0 >3.0 = 1
Cabbages	How often do you eat cabbages (e.g. cauliflower, broccoli, brussel sprouts, kale)?	Never = 0 up to Several times a day= 10	No calculation (0-10)	Women: 3.0 Men: 3.0	Women: ≤3.0 = 0 >3.0 = 1 Men: <3.0 = 0 ≥3.0 = 1
Potatoes vs. rice/pasta	How often do you eat -potatoes -rice -pasta	Never = 0 up to Several times a day= 10	Frequency of eating potatoes relative to eating rice and pasta combined: potatoes/ (0.1+rice+pasta) (0-100)	Women: 0.65 Men: 0.49	Women: ≤0.65 = 0 >0.65 = 1 Men: ≤0.49 = 0 >0.49 = 1
Whole grain breads vs. white breads	How often do you eat -refined breads/bread rolls -whole grain breads -whole grain hard breads	Never = 0 up to Several times a day= 10	Frequency of eating whole grain breads and whole grain hard breads combined relative to eating refined breads: (whole grain breads+whole grain hard breads)/(0.1+refined breads) (0-200)	Women: 12.33 Men: 10.83	Women: ≤12.33 = 0 >12.33 = 1 Men: ≤10.83 = 0 >10.83 = 1

Table appendix 1 (continued): The components underlying the construction of the 10 subscales within the NND score (*n* = 75)

Subscale	Related question(s)	Response alternatives and coding	Calculations (min-max)	Median = cut-off	Dietary behavior associated with scoring
Oatmeal porridge	How often do you eat oatmeal porridge?	Never = 0 up to Several times a day= 10	No calculation (0-10)	Women: 0.5 Men: 0.5	Women: ≤0.5 = 0 >0.5 = 1 Men: ≤0.5 = 0 >0.5 = 1
Foods from the wild countryside	How often do you eat -game (e.g. moose, reindeer, deer) -lean fish (e.g. cod, caley, haddock) -fatty fish (e.g. mackerel, herring, halibut) -other seafood (e.g. shrimps, crabs, mussels -berries	Never = 0 up to Several times a day= 10	Sum of answers to the five questions (0-50)	Women: 2.2 Men: 2.6	Women: ≤2.2 = 0 >2.2 = 1 Men: ≤2.6 = 0 >2.6 = 1
Milk vs. juice	How often do you drink -milk -fruit juice without added sugar	Never = 0 up to Several times a day= 10	Frequency of drinking milk relative to drinking fruit juice: milk/(0.1+juice) (0-100)	Women: 1.29 Men: 2.5	Women: ≤1.29 = 0 >1.29 = 1 Men: ≤1.22 = 0 >1.22 = 1
Water vs. sugar/artificially sweetened beverages	How often do you drink -water -sugar sweetened beverages -artificially sweetened beverages	Never = 0 up to Several times a day= 10	Frequency of drinking water relative to drinking sugar sweetened beverages and artificially sweetened beverages combined: water/(0.1+sugar sweetened beverages+artificially sweetened beverages) (0-100)	Women: 6.25 Men: 2.8	Women: ≤3.23 = 0 >3.23 = 1 Men: ≤3.23 = 0 >3.23 = 1

NND, New Nordic Diet

Table appendix 2: The components underlying the construction of the HSDPA score

Subscale	Related question(s)	Response alternatives and coding	Calculations (min-max)
New Nordic Diet (see details "Table appendix 1")			Adding the 10 subscales yielded a total score ranging from 0-10
Local and sustainable foods	To what extent do you agree in the following statements: -I often buy foods produced locally -I often buy foods when they are in season -I often buy organic foods -I try to eat less animal foods (meat, fish, dairy products, eggs etc.) for environmental reasons -I am good at recycling the food waste -I barely ever throw foods -I grow edible plants (vegetables, fruits, berries, herbs etc.) at home for personal use -I gather edible wild plants (e.g.wild berries) and/or mushrooms	Fully disagree = 0 Partly disagree = 1 Neither agree nor disagree = 2 Partly agree = 3 Fully agree = 4	Sum of answers to the 8 questions (0-32), further weighted (divided by 3.2) in order to range from 0-10
Active transportation	How do you usually travel to/from in the *summer* season when you are: -going to work/studies? -shopping groceries? -shopping other items? -transporting yourself in your leisure time? -transporting children to/from the kindergarten How do you usually travel to/from in the *winter* season when you are: -going to work/studies? -shopping groceries? -shopping other items? -transporting yourself in your leisure time? -transporting children to/from the kindergarten	By car/motorcycle/moped/scooter = 0 By public transportation = 0 By foot = 1 By bike/el-bike = 1	Sum of answers to the 10 questions (0-10)
Non-exercise outdoor activities	How often do you engage in outdoor activities in the *summer* season (e.g. gardening, bathing/swimming, playing, working with firewoods etc.)? How often do you engage in outdoor activities in the *winter* season (e.g. shoveling, sledding, skating etc.)?	Never = 0 Less than monthly = 1 Monthly, but less than weekly = 2 Once a week = 3 More than once a week = 4	Sum of answers to the 8 questions (0-32), further weighted (divided by 3.2) in order to range from 0-10

Non-exercise outdoor activities (continued)	How often do you and your family go on trips in the *summer* season -in the neighborhood (other than green spaces)? -in the nature (e.g. in the forest, in the mountains, by the sea etc.)? -in other green spaces (e.g. parks)? How often do you and your family go on trips in the *winter* season -in the neighborhood (other than green spaces)? -in the nature (e.g. in the forest, in the mountains, by the sea etc.)? -in other green spaces (e.g. parks)?	Never = 0 Less than monthly = 1 Monthly, but less than weekly = 2 Once a week = 3 More than once a week = 4	Sum of answers to the 8 questions (0-32), further weighted (divided by 3.2) in order to range from 0-10
The HSDPA score in total			Adding the four subscales yielded a total score ranging from 0-40

HSDPA, Healthy and Sustainable Dietary and Physical Activity habits

Table appendix 3: Associations between socio-demographic correlates and the Healthy and Sustainable Dietary and Physical Activity habits (HSDPA) score

Socio-demographic correlates		HSDPA score (0-40) (n = 506)	New Nordic diet (0-10) (n = 506)	Local and sustainable foods (0-10) (n = 512)	Non-exercise outdoor activities (0-10) (n = 510)	Active transportation (0-1) (n = 511)
	N (%)	Mean (95% CI)†	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	% (95% CI)‡
All	530	18.2 (17.8-18.6)	4.6 (4.4-4.8)	4.4 (4.3-4.5)	7.5 (7.3-7.6)	51 (46-55)
Sex						
Female	453 (90)	18.2 (17.7-18.6)	4.7 (4.5-4.9)	4.4 (4.2-4.5)	7.5 (7.4-7.7)	50 (46-55)
Male	53 (10)	18.2 (16.9-19.5)	4.2 (3.6-4.8)	4.6 (4.1-5.0)	7.0 (6.5-7.5)	53 (39-67)
p-value		0.98	0.17	0.40	**0.02**	0.73
Education						
Low	157 (31)	17.3 (16.6-18.0)	4.3 (4.0-4.7)	4.0 (3.7-4.2)	7.4 (7.3-7.6)	50 (42-58)
High‖	349 (69)	18.6 (18.1-19.1)	4.7 (4.5-5.0)	4.5 (4.4-4.7)	7.3 (7.1-7.6)	51 (45-56)
p-value		**0.003**	**0.04**	**<0.001**	0.15	0.93
Ethnicity						
Non-native	85 (17)	18.0 (16.9-19.0)	4.4 (3.9-4.8)	4.6 (4.3-4.9)	6.9 (6.5-7.3)	64 (53-74)
Native¶	419 (83)	18.3 (17.8-18.7)	4.7 (4.5-4.9)	4.3 (4.2-4.5)	7.6 (7.4-7.7)	48 (43-53)
p-value		0.58	0.20	0.11	**0.001**	**0.01**
Age						
<32	239 (47)	17.8 (17.2-18.4)	4.7 (4.4-5.0)	4.1 (3.9-4.3)	7.4 (7.2-7.6)	49 (42-55)
≥32	267 (53)	18.5 (18.0-19.0)	4.5 (4.3-4.8)	4.6 (4.4-4.8)	7.5 (7.3-7.7)	52 (46-58)
p-value		0.09	0.47	**0.001**	0.36	0.38
Centrality						
Low	222 (44)	17.1 (16.5-17.6)	4.6 (4.3-4.8)	4.5 (4.3-4.7)	7.3 (7.1-7.5)	27 (21-32)
High[1]	285 (56)	19.0 (18.5-19.6)	4.6 (4.4-4.9)	4.3 (4.1-4.5)	7.5 (7.4-7.7)	68 (63-74)
p-value		**<0.001**	0.63	0.18	0.13	**<0.001**

†Mean scoring with 95% CI for the socio-demographic correlates were calculated using One-Way ANOVA.
‡Proportions with 95 % CI for the socio-demographic correlates were calculated using One-Way ANOVA.
‖Having attended college or university.
¶Both parents born in Norway.
[1]≤3(median) on the variable "centrality" (range 0-8).

Strobe Checklist- cross-sectional studies

Appendix 1
The HSL questionnaire

Takk for at du tar deg tid til å delta i forskningsstudien Barns matmot, som pågår blant småbarnsforeldre i Aust- og Vest-Agder.
Studien inngår som en del av to doktorgradsprosjekt ved UiA og ledes av professorene Elling Bere og Nina Øverby.

Familien bestemmer selv hvem av foreldrene/de foresatte som besvarer spørreskjemaet. Den som fyller ut skjemaet bes gjøre det ut fra det som stemmer for seg selv og barnet født i 2012. Spørreskjemaet består av to deler og vil ta ca 50 min å besvare. Første del dreier seg i hovedsak om dine kost- og aktivitetsvaner, samt helse og livskvalitet, mens du i andre del får spørsmål om barnets mat- og spisevaner.

Sett deg gjerne et sted hvor du kan sitte uforstyrret, les spørsmålene nøye og svar så godt du kan. Lykke til!
Trykk på neste for å komme i gang.

TUSEN TAKK FOR AT DU DELTAR!
Vennlig hilsen
Doktorgradsstipendiat Helga Birgit Bjørnarå
Doktorgradsstipendiat Sissel H. Helland

Først vil vi stille deg noen spørsmål om mat, drikke og spisevaner:

Hvor ofte spiser du:

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Frokost	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Lunsj	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Kveldsmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Mellommåltider	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑

Hvor ofte drikker du?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Melk	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Fruktjuice uten tilsatt sukker	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Vann	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Drikker med tilsatt sukker (eks. brus, saft, iste, iskaffe)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Drikker med kunstig søtning (eks. lettbrus, lettsaft, lett iste)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Kaffe	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Te	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Alkohol til måltider	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Alkohol utenom måltider	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Typisk nordiske frukter (eple, pære, plomme)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre frukter (eks. banan, appelsin, kiwi, ananas)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Jordbær og andre dyrkede bær	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ville bær (eks. blåbær, tyttebær, multer)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Rotgrønnsaker (eks. gulrot, kålrot, løk)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Kål (eks. blomkål, brokkoli, rosenkål, grønnkål)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre grønnsaker (eks.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
tomat, agurk, paprika, salat)										
Belgfrukter (eks. erter, bønner, kikerter)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Usaltede nøtter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Poteter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ris	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pasta	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du følgende varmrett?

	Aldri	Mindre enn 1 g/mnd	1-3 g/mnd	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Viltkjøtt (elg, reinsdyr, rådyr)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Rent kjøtt av eks. okse,svin,lam,kalkun,kylling (ikke viltkjøtt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Mager fisk (torsk, sei, hyse)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

	Aldri	Mindre enn 1 g/mnd	1-3 g/mnd	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Fet fisk (makrell, sild, kveite)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Laks og/eller ørret	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Annen sjømat (eks. reker, krabber, blåskjell)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du?

	Aldri	Mindre enn 1 g/mnd	1-3 g/mnd	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Suppe	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Gryterett (eks. lapskaus, frikassè, fiskegryte, vegetargryte, Toro-gryte)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Nudler	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pizza	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ferdigretter fra eks. Findus, Fjordland	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pølser	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pommes frites	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Hamburger/karbonade/kjøttkake/kjøttpudding	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Kjøttdeigbaserte	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

	Aldri	Mindre enn 1 g/mnd	1-3 g/mnd	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
middagsretter (eks. taco, pasta)										
Fiskepinner/fiskekake/fiskepudding	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Fint brød/rundstykker/loff	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Grovt brød/rundstykker (minst 50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Grove knekkebrød	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Havregrøt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Musli/havregryn uten tilsatt sukker	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre frokostblandinger	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Salte kjeks	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Søte kjeks/cookies	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Søtt bakverk (eks. kaker, boller)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Salt snacks (eks. chips, ostepop, salte nøtter)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Søtsaker (eks. smågodt, sjokolade)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte salter du maten du spiser?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 gang/uke

(3) ❑ 1 gang/uke

(4) ❑ 2 ganger/uke

(5) ❑ 3 ganger/uke

(6) ❑ 4 ganger/uke

(7) ❑ 5 ganger/uke

(8) ❑ 6 ganger/uke

(9) ❑ Hver dag

(10) ❑ Flere ganger daglig

I hvilken grad er du enig i følgende påstander?

	Helt uenig	.....	.....	Verken enig eller uenig	.....	.....	Helt enig
Jeg prøver stadig ny og ulik type mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg stoler ikke på ukjent mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Hvis jeg ikke kjenner til hva som er i maten, vil jeg ikke smake	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg er redd for å spise ting jeg ikke har spist før	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg er veldig kresen på hva slags mat jeg vil spise	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg spiser nesten all slags mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Hvor ofte?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Spiser du på restaurant/kafè	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Spiser du mat fra fast-food restaurant (eks. McDonalds, gatekjøkken)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Spiser du mat kjøpt på bensinstasjon/stor-kiosk (eks. 7-eleven, Narvesen)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑

Har du hovedansvar for matlagingen hjemme?

(1) ❑ Ja

(2) ❑ Nei

(3) ❑ Ansvaret er delt

Hvor ofte?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Kutter du opp grønnsaker	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Kutter du opp frukt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑
Lager du middag fra bunnen	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑

Hvor mye salt tilsetter du i de hjemmelagede middagsrettene?

(1) ❑ Mindre enn det som står i oppskriften

(2) ❑ Mengden som står i oppskriften

(3) ❑ Mer enn det som står i oppskriften

(4) ❑ Bruker aldri oppskrift

Hvor ofte lager du?

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn 1 g/uke	1 g/uke	Mer enn 1 g/uke
Amerikansk pizza (tykk bunn og mye fyll)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Italiensk pizza (tynn bunn og begrenset med fyll)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Når du lager pizza, hvor ofte er?

	Alltid	Ofte	Av og til	Sjelden	Aldri
Sausen hjemmelaget (ikke fra glass/pose)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Bunnen hjemmelaget (ikke fra pose/rull)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvor ofte baker du?

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn i g/uke	1 g/uke	Mer enn 1 g/uke
Fint brød/rundstykker (0-25% sammalt mel/hele korn og	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn i g/uke	1 g/uke	Mer enn 1 g/uke
kjerner)					
Halvgrovt brød/rundstykker (25-50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Grovt brød/rundstykker (50-75% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Ekstra grovt brød/rundstykker (75-100% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Når du baker brød, hvor ofte bruker du?

	Alltid	Ofte	Av og til	Sjelden	Aldri
Brød-mix	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Gjær eller andre hevemidler	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hjemmelaget surdeig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvor ofte lager du?

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn 1 g/uke	1 g/uke	Mer enn 1 g/uke
Suppe	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Gryterett som eks. frikassè, lapskaus, fiskegryte, vegetargryte, Toro-gryte	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Når du lager suppe eller andre "gryteretter", hvor ofte bruker du?

	Alltid	Ofte	Av og til	Sjelden	Aldri
Pose	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Buljong (industrifremstilt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hjemmelaget kraft	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

I hvilken grad er du enig i følgende påstander?

	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg kjøper ofte lokalprodusert mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg kjøper ofte sesongens råvarer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg kjøper ofte økologisk mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg prøver å spise mindre animalske matvarer (kjøtt, fisk, meieriprodukter og egg) for å spare miljøet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg velger bevisst matvarer som er miljømerket	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg er flink til å kildesortere husholdningsavfallet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg kaster nesten aldri mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg dyrker spiselige planter hjemme til eget forbruk	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg sanker spiselige ville planter/bær/sopp	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg jakter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg fisker fisk/skalldyr	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

I hvilken grad stemmer følgende påstander for deg?

	Stemmer ikke i det hele tatt	-	-	Stemmer til dels	-	-	Stemmer helt
Å nyte mat er en av de viktigste gledene i livet mitt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

	Stemmer ikke i det hele tatt	-	-	Stemmer til dels	-	-	Stemmer helt
Jeg vil heller spise mitt favorittmåltid enn å se mitt favoritt TV-program	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg tenker på mat på en positiv og forventningsfull måte	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Penger brukt på mat er vel anvendte penger	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Dersom jeg kunne tilfredsstille mine ernæringsmessige behov trygt, billig og uten sult ved å ta en daglig pille, ville jeg gjøre dette	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Så noen spørsmål om transportvaner:

Hvor langt er det fra hjemmet ditt til?

Fyll inn antall km. For eksempel 3,4

Arbeidsplassen/studiestedet? ____

Barnehagen ____

Nærmeste matvarebutikk ____

Nærmeste sentrum ____

Har du egen sykkel?

(1) ❑ Ja

(2) ❑ Nei

Har du el-sykkel?

(1) ❑ Ja

(2) ❑ Nei

Hvor mange dager i uka er du på jobb/skole (ikke hjemmekontor)?

__

Hvordan kommer du deg som oftest til og fra i sommerhalvåret når du?

	Til fots	Sykkel/el-sykkel	Bil/motorsykkel/ moped/skuter	Offentlig transport	Ikke aktuelt

	Til fots	Sykkel/el-sykkel	Bil/motorsykkel/ moped/skuter	Offentlig transport	Ikke aktuelt
Skal på jobb/studere	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Handler matvarer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Handler andre varer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Transporterer deg selv på fritiden	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Transporterer barn til/fra barnehagen	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvordan kommer du deg som oftest til og fra i vinterhalvåret når du?

	Til fots	Sykkel/el-sykkel	Bil/motorsykkel/ moped/skuter	Offentlig transport	Ikke aktuelt
Skal på jobb/studere	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Handler matvarer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Handler andre varer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Transporterer deg selv på fritiden	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Transporterer barn til/fra barnehagen	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Noen spørsmål om fysisk aktivitet

Hvor ofte er du fysisk aktiv i minst 30 minutter totalt i løpet av dagen (i minst 10 minutter om gangen)? Med fysisk aktivitet menes all aktivtet hvor hjertet ditt slår fortere enn vanlig og hvor du blir andpusten innimellom, for eksempel rask gange.

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/uke

(3) ❑ 1 g/uke

(4) ❑ 2 g/uke

(5) ❑ 3 g/uke

(6) ❑ 4 g/uke

(7) ❑ 5 g/uke

(8) ❑ 6 g/uke

(9) ❑ Hver dag

Hvor ofte trener du eller driver med idrett?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Utendørs (alle typer idrett)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Innendørs (alle typer idrett, i gymsal, i treningsstudio, i basseng etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte driver du med utendørs aktiviteter i sommerhalvåret (eks. hagearbeid, bading/svømming, lek, vedstabling)?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/måned

(3) ❑ Månedlig, men mindre enn 1 g/uke

(4) ❑ 1 g/uke

(5) ❑ Mer enn 1 g/uke

Hvor ofte driver du med utendørs aktiviteter i vinterhalvåret (eks. snømåking, aking, gå på skøyter)?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/måned

(3) ❑ Månedlig, men mindre enn 1 g/uke

(4) ❑ 1 g/uke

(5) ❑ Mer enn 1 g/uke

De to neste spørsmålene omhandler deg OG din familie- hvor ofte dere er på tur sammen:

Hvor ofte er du og din familie på tur i sommerhalvåret?

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn 1 g/uke	1 g/uke	Mer enn 1 g/uke
I nærmiljøet (ikke i	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn 1 g/uke	1 g/uke	Mer enn 1 g/uke
grøntområder)					
I naturen (eks. i skogen, på fjellet, ved sjøen)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
I andre grøntområder (eks. parker)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvor ofte er du og din familie på tur i vinterhalvåret?

	Aldri	Mindre enn 1 g/måned	Månedlig, men mindre enn 1 g/uke	1 g/uke	Mer enn 1 g/uke
I nærmiljøet (ikke i grøntområder)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
I naturen (eks. i skogen, på fjellet, ved sjøen)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
I andre grøntområder (eks. parker)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

I hvilken grad stemmer følgende påstander om fysisk aktivitet (generelt) for deg?

	Stemmer ikke i det hele tatt	-	-	Stemmer til dels	-	-	Stemmer helt
Jeg liker fysisk aktivitet svært	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

	Stemmer ikke i det hele tatt	-	-	Stemmer til dels	-	-	Stemmer helt
godt							
Det er moro å drive med fysisk aktivitet	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg synes fysisk aktivitet er kjedelig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg er ikke opptatt av fysisk aktivitet i det hele tatt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg vil beskrive fysisk aktivitet som svært motiverende	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Jeg synes fysisk aktivitet er ganske fornøyelig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Mens jeg er fysisk aktiv, tenker jeg på hvor mye jeg liker det	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

I hvilken grad er du enig i følgende påstander?

	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg tar trappene i stedet for heisen	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg tar trappene i stedet for rulletrappa	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Spørsmål om dine skjermvaner:

På fritiden, omtrent hvor mange timer om dagen ser du vanligvis på TV/film?

	Ingen	Mindre enn 30 min	30 min	1 t	1 t og 30 min	2 t	2 t og 30 min	3 t	3 t og 30 min	4 t eller mer
På hverdagene	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
I helgene	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du mens du ser på TV/film (både jobb og fritid)?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/uke

(3) ❑ 1 g/uke

(4) ❑ 2 g/uke

(5) ❑ 3 g/uke

(6) ❑ 4 g/uke

(7) ❑ 5 g/uke

(8) ❑ 6 g/uke

(9) ❑ Hver dag

(10) ❑ Flere ganger daglig

På fritiden, omtrent hvor mange timer om dagen bruker du vanligvis PC/nettbrett/smarttelefon/spillkonsoll?

	Ingen	Mindre enn 30 min	30 min	1 t	1 t og 30 min	2 t	2 t og 30 min	3 t	3 t og 30 min	4 t eller mer
På hverdagene	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
I helgene	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser du mens du bruker PC/nettbrett/ smarttelefon/spillkonsoll (både jobb og fritid)?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/uke

(3) ❑ 1 g/uke

(4) ❑ 2 g/uke

(5) ❑ 3 g/uke

(6) ❑ 4 g/uke

(7) ❑ 5 g/uke

(8) ❑ 6 g/uke

(9) ❑ Hver dag

(10) ❑ Flere ganger daglig

Noen spørsmål om tid og tidsbruk:

En vanlig hverdag, omtrent hvor mye tid bruker du på å?

	Mindre enn 15 min	15 min	30 min	1 t	1 t og 30 min	2 t	2 t og 30 min	3 timer eller mer
Lage middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Lage alle dagens måltider (totalt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Spise middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Spise alle dagens måltider (totalt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

En vanlig lørdag eller søndag, omtrent hvor mye tid bruker du på å?

	Mindre enn 15 min	15 min	30 min	1 t	1 t og 30 min	2 t	2 t og 30 min	3 timer eller mer
Lage middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Lage alle dagens måltider (totalt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Spise middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Spise alle dagens måltider (totalt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Hvor ofte stemmer følgende påstander for deg?

	Aldri	Sjelden	Av og til	Ofte	Alltid
Jeg kjøper hurtigmat til middag fordi jeg verken har tid eller ork til å lage middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg har ikke tid til å tilberede de sunne måltidene som jeg ønsker å lage	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Vi har ikke tid til å sette oss ned sammen og spise middag som et familiemåltid	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg spiser lunsjen min på kontoret, siden jeg ikke har tid til lunsjpause	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg har ikke tid til å trene så mye som jeg ønsker	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvor ofte stemmer følgende påstander for deg?

	Aldri	Sjelden	Av og til	Ofte	Alltid
Jeg er under tidspress	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg ønsker at jeg hadde mer tid til meg selv	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjelden	Av og til	Ofte	Alltid
Jeg føler jeg er under tidspress fra andre	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg får ikke håndtere viktige ting riktig grunnet mangel på tid	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg får ikke ordentlig søvn	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg får ikke restituert meg ordentlig etter sykdom grunnet mangel på tid	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg er under så mye tidspress at det går ut over helsa	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Så noen spørsmål om andre levevaner:

Hvor mange timer sover du vanligvis om natten på hverdagene?

Fyll inn antall timer. For eksempel 7,5

____

Hvor mange timer sover du vanligvis om natten i helgene?

Fyll inn antall timer. For eksempel 7,5

___

Prøver du å slanke deg?

(1) ❑ Nei, vekten min er passe

(4) ❑ Nei, jeg trenger å gå opp i vekt

(2) ❑ Nei, men jeg trenger å gå ned i vekt

(3) ❑ Ja

Røyker du?

(1) ❑ Nei, jeg har aldri røykt regelmessig

(2) ❑ Nei, jeg har sluttet

(3) ❑ Ja, men ikke daglig

(4) ❑ Ja, daglig

Snuser du?

(1) ❑ Nei, jeg har aldri snust regelmessig

(2) ❑ Nei, jeg har sluttet

(3) ❑ Ja, men ikke daglig

(4) ❑ Ja, daglig

De neste spørsmålene dreier seg om opplevelse av egen helse

Hvordan vil du beskrive din egen helse?

(1) ❑ Meget god

(2) ❑ God

(3) ❑ Verken god eller dårlig

(4) ❑ Dårlig

(5) ❑ Meget dårlig

I hvilken grad begrenser din helse dine hverdagslige gjøremål?

(1) ❑ I stor grad

(2) ❑ I noen grad

(3) ❑ I liten grad

(4) ❑ Ikke i det hele tatt

Har du, eller har du hatt følgende?

	Ja	Nei	Vet ikke
Spiseforstyrrelser	(1) ❑	(2) ❑	(3) ❑
Angst	(1) ❑	(2) ❑	(3) ❑
Depresjon	(1) ❑	(2) ❑	(3) ❑

I løpet av de siste 7 dagene, hvor ofte har du?

	Hele tiden	Mye av tiden	Deler av tiden	Noe av tiden	Ikke i det hele tatt
Følt deg rolig og harmonisk	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Hele tiden	Mye av tiden	Deler av tiden	Noe av tiden	Ikke i det hele tatt
Hatt overskudd av energi	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Følt deg nedfor og deprimert	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Og så noen bakgrunnsspørsmål om deg og barnet som deltar i undersøkelsen:

Hvilket kjønn er du?

(1) ❑ mann

(2) ❑ kvinne

Er du gravid?

(1) ❑ Ja

(2) ❑ Nei

Hvilken relasjon har du til barnet som deltar i undersøkelsen?

(1) ❑ Barnets mor

(2) ❑ Barnets far

(3) ❑ Annen person

Hva er din fødselsdato?

Fyll inn dato. XX.XX.XX (for eksempel 24.10.76)

_____

Hvor høy er du (cm)?

cm

___

Hvor mye veier du (kg)?

kg

___

Etnisk bakgrunn

	Ja	Nei	Vet ikke
Ble du født i Norge?	(1) ❑	(2) ❑	(3) ❑
Ble din mor født i Norge?	(1) ❑	(2) ❑	(3) ❑
Ble din far født i Norge?	(1) ❑	(2) ❑	(3) ❑
Ble barnet som deltar i undersøkelsen født i Norge?	(1) ❑	(2) ❑	(3) ❑

	Ja	Nei	Vet ikke
Ble barnets andre forelder født i Norge?	(1) ❑	(2) ❑	(3) ❑

Hva er din sivile status?

(1) ❑ Enslig

(2) ❑ Gift

(3) ❑ Samboer

(4) ❑ Separert

(5) ❑ Skilt

(6) ❑ Annet

Bor barnets mor og far/barnets foresatte sammen?

(1) ❑ Ja

(2) ❑ Nei

Hvor mange personer bor det i husholdningen din?

Fyll inn antall

—

Hvor mange av personene som bor i husholdningen er barn?

Fyll inn antall

—

Hvilken utdannelse har du? Marker høyeste fullførte utdannelse

(1) ❑ Mindre enn 10 års grunnskole

(2) ❑ Grunnskole

(3) ❑ Videregående skole (inkl. gymnas/yrkesskole)

(4) ❑ Universitet eller høyskole (inntil 4 år)

(5) ❑ Universitet eller høyskole (mer enn 4 år)

(6) ❑ Annet

Utdannelse til barnets andre forelder/foresatt? Marker høyeste fullførte utdannelse.

(1) ❑ Mindre enn 10 års grunnskole

(2) ❑ Grunnskole

(3) ❑ Videregående skole (inkl. gymnas/yrkesskole)

(4) ❑ Universitet eller høyskole (inntil 4 år)

(5) ❑ Universitet eller høyskole (mer enn 4 år)

(6) ❑ Annet

(7) ❑ Vet ikke

Hva er din hovedaktivitet?

(1) ❑ Arbeid, heltid

(2) ❑ Arbeid, deltid

(3) ❑ Hjemmeværende

(4) ❑ Sykemeldt

(5) ❑ Permisjon

(6) ❑ Uføretrygdet

(7) ❑ Under attføring/rehabilitering

(8) ❑ Student/skoleelev

(9) ❑ Arbeidsledig

(10) ❑ Annet

Den neste delen dreier seg om

barnet som deltar i undersøkelsen

- Du vil få spørsmål om barnets mat, drikke og spisevaner

Tenk tilbake på barnets overgang fra melk til fast føde

Hvor lenge ble barnet fullammet (det vil si at barnet ikke fikk annet enn morsmelk)?

(1) ❑ Barnet ble aldri ammet fullt

(2) ❑ Ammet fullt mindre enn to uker

(3) ❑ 2 uker

(4) ❑ 4 uker

(5) ❑ 6 uker

(6) ❑ 8 uker

(7) ❑ 10 uker

(8) ❑ 12 uker

(9) ❑ 4 måneder

(10) ❑ 5 måneder

(11) ❑ 6 måneder

(12) ❑ 7 måneder

(13) ❑ 8 måneder

(14) ❑ 9 måneder

(15) ❑ 10 måneder

(16) ❑ 11 måneder

(17) ❑ 12 måneder

(18) ❑ Mer enn 12 måneder

(19) ❑ Vet ikke

Hvor gammelt var barnet da det fikk følgende matvarer for første gang?

	Barnets alder (måneder)											
	Ikke fått	**0-3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12 eller mer**	**Vet ikke**
Industrifremstilt grøt/velling f.eks fra: Nestlé, Småfolk eller	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑

Barnets alder (måneder)

	Ikke fått	0-3	4	5	6	7	8	9	10	11	12 eller mer	Vet ikke
Hipp												
Industrifremstilt frukt-/bærmos fra glass eller beger	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Industrifremstilt middag på glass	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Hjemmelaget grøt av mel/havregryn/hirse/kavring/semule/ris	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Hjemmelaget frukt-/bærmos	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Hjemmelaget middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Youghurt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Brød	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Kumelk som drikke	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Morsmelkerstatning som drikke	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑
Vann	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑	(11) ❑	(12) ❑

Over til dagens måltidsmønster

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

	Aldri/sjeldnere enn hver uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Frokost	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Formiddagsmat/lunsj	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Ettermiddagsmat (måltid etter lunsj og før middag)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Kveldsmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑
Andre måltider/mellommåltider	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑

Pleier barnet å bli matet (dvs. en voksen holder skjeen eller deler opp maten og gir den bit for bit) eller spiser det selv? (dvs. barnet selv har tallerken med mat og ev. bestikk)

	Spiser selv	Blir matet
Frokost	(1) ❑	(2) ❑
Lunsj	(1) ❑	(2) ❑
Ettermiddagsmat (måltid etter	(1) ❑	(2) ❑

	Spiser selv	Blir matet
lunsj og før middag)		
Middag	(1) ❑	(2) ❑
Kveldsmat	(1) ❑	(2) ❑
Andre måltider/mellommåltider	(1) ❑	(2) ❑

Hvor ofte spiser barnet følgende måltider sammen med familien? (dvs. samtidig som en voksen spiser samme måltid)

	Aldri/sjeldnere enn hver uke	1-3 ganger/uke	4-6 ganger/uke	Hver dag
Frokost	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Lunsj	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Ettermiddagsmat (måltid etter lunsj og før middag)	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Middag	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Kveldsmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑
Andre måltider/mellommåltider	(1) ❑	(2) ❑	(3) ❑	(4) ❑

Hvor ofte spiser barnet mens han/hun ser på TV/film?

(1) ❑ Aldri

(2) ❑ Mindre enn 1 g/uke

(3) ❑ 1 g/uke

(4) ❑ 2 g/uke

(5) ❑ 3 g/uke

(6) ❑ 4 g/uke

(7) ❑ 5 g/uke

(8) ❑ 6 g/uke

(9) ❑ Hver dag

(10) ❑ Flere ganger daglig

Nå kommer spørsmål om hva barnet drikker og spiser

Hvor ofte drikker barnet?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Melk	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Fruktjuice (uten tilsatt sukker)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Vann	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Drikker med tilsatt sukker (eks. brus, saft, nektar, leskedrikk, iste)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Drikker med kunstig søtning (eks. lettbrus, lettsaft, lett-iste)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Typisk nordiske frukter (eks. eple, pære, plomme)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre frukter (eks. banan, appelsin, kiwi, ananas)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Jordbær og andre dyrkede bær	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ville bær (eks. blåbær, tyttebær, multer)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Rotgrønnsaker (eks.gulrot, kålrot, løk)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Kål (eks. blomkål, brokkoli, rosenkål,grønnkål)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre grønnsaker (eks. tomat, agurk, paprika, salat)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Belgfrukter (eks. erter, bønner, kikerter)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Usaltede nøtter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Poteter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ris	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pasta	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet følgende varmrett?

	Aldri	Mindre enn 1 g/måned	1-3 g/mnd	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Viltkjøtt (eks. elg, reinsdyr, rådyr)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Rent kjøtt av okse/svin/lam/kalkun/kylling etc. (ikke viltkjøtt)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Mager fisk (eks. torsk, sei, hyse)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Feit fisk (eks. makrell, sild, kveite)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Laks og/eller ørret	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Annen sjømat (eks. reker, blåskjell, krabbe)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet?

	Aldri	Mindre enn 1 g/måned	1-3 g/måned	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag
Suppe	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Gryterett (lapskaus, frikassè, fiskegryte, Toro-gryte etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Nudler	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pizza	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Ferdigretter (fra Findus, Fjordland etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pølser	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Pommes frites	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Hamburger/karbonade/kjøttkake/kjøttpudding	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Kjøttdeigbaserte middagretter (eks. taco, pasta)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Fiskepinner/fiskekake/fiskepudding	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Industrifremstilt middag på glass for eksempel fra Nestlé, Småfolk, Hipp	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Fint brød/rundstykker/loff	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Grovt brød/rundstykker (minst 50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Grove knekkebrød	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Havregrøt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Musli/havregryn uten tilsatt sukker	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Andre frokostblandinger	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Industrifremstilt barnegrøt fra for eksempel Nestlé, Småfolk, Hipp	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Hvor ofte spiser barnet?

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Salte kjeks	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Søte kjeks/cookies	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

	Aldri	Mindre enn 1 g/uke	1 g/uke	2 g/uke	3 g/uke	4 g/uke	5 g/uke	6 g/uke	Hver dag	Flere ganger daglig
Søtt bakverk (kaker, boller etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Salt snacks (chips, ostepop, salte nøtter etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑
Søtsaker (godteri, sjokolade etc.)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑	(8) ❑	(9) ❑	(10) ❑

Allergi og intoleranse mot matvarer

	Ja	Nei
Er det noen matvarer det kunne vært aktuelt å gi barnet, men som du unngår å gi fordi du er redd for at barnet kan reagere med allergi eller intoleranse?	(1) ❑	(2) ❑
Har barnet fått påvist allergi eller intoleranse mot enkelte matvarer?	(1) ❑	(2) ❑

De neste spørsmålene dreier seg om barnets forhold til ny og ukjent mat

I hvilken grad er du enig i følgende påstander?

	Helt uenig	.....	....	Verken enig eller uenig	.....	.....	Helt enig
Barnet mitt prøver stadig ny og ulik type mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Barnet mitt stoler ikke på ukjent mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Hvis barnet mitt ikke vet hva som er i maten vil han/hun ikke smake	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Barnet mitt er redd for å spise ting han/hun ikke har spist før	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Barnet mitt er veldig kresen på hva slags mat han/hun vil spise	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑
Barnet mitt spiser nesten all slags mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑	(7) ❑

Har barnet smakt følgende matvarer? (Selv om maten ble spyttet ut igjen regnes det som smakt)

	Ja	Nei
Blomkål	(1) ❑	(2) ❑
Gresskar	(1) ❑	(2) ❑

	Ja	Nei
Løk	(1) ❑	(2) ❑
Rosenkål	(1) ❑	(2) ❑
Bringebær	(1) ❑	(2) ❑
Solbær	(1) ❑	(2) ❑
Pære	(1) ❑	(2) ❑
Moreller	(1) ❑	(2) ❑

Ville barnet smakt om han/hun fikk muligheten? Sett ett kryss på det alternativet du antar er mest sannsynlig

	Ja	Nei
Blomkål	(1) ❑	(2) ❑
Gresskar	(1) ❑	(2) ❑
Løk	(1) ❑	(2) ❑
Rosenkål	(1) ❑	(2) ❑
Bringebær	(1) ❑	(2) ❑
Solbær	(1) ❑	(2) ❑
Pære	(1) ❑	(2) ❑
Moreller	(1) ❑	(2) ❑

Hvor mange ganger antar du at barnet har smakt følgende matvarer og godtar barnet å spise dem? Her skal du sette to kryss. Ett for hvor mange ganger barnet har smakt på matvaren og ett for om barnet godtar å spise en eller flere biter.

	Hvor mange ganger har barnet smakt?					Godtar barnet å spise følgende matvarer?	
	1 gang	2 ganger	3-5 ganger	6-10 ganger	11 ganger eller flere	Ja	Nei
Blomkål	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Gresskar	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Løk	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Rosenkål	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Bringebær	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Solbær	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Pære	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Moreller	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑

Har barnet ditt smakt følgende matvarer? (Selv om maten ble spyttet ut igjen regnes det som smakt)

	Ja	Nei
Jarlsberg ost	(1) ❑	(2) ❑
Hvit geitost	(1) ❑	(2) ❑
Syrnet melk, smakstilsatt	(1) ❑	(2) ❑

	Ja	Nei
(eksempel Biola/Q BioQ med smak)		
Kulturmelk (alle typer uten smaks tilsetning)	(1) ❑	(2) ❑
Eggehvite i et kokt egg	(1) ❑	(2) ❑
Eggeplomme i et kokt egg	(1) ❑	(2) ❑
Grovbrød (minst 50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑
Rugbrød	(1) ❑	(2) ❑
Havregrøt	(1) ❑	(2) ❑
Bokhvetegrøt	(1) ❑	(2) ❑
Erter	(1) ❑	(2) ❑
Bønner	(1) ❑	(2) ❑
Kylling	(1) ❑	(2) ❑
Lammekjøtt	(1) ❑	(2) ❑
Laks	(1) ❑	(2) ❑
Sild	(1) ❑	(2) ❑

Ville barnet smakt om han/hun fikk muligheten? Sett ett kryss på det alternativet du antar er mest sannsynlig

	Ja	Nei

	Ja	Nei
Jarlsberg ost	(1) ❑	(2) ❑
Hvit geitost	(1) ❑	(2) ❑
Syrnet melk, smakstilsatt (eksempel Biola/Q BioQ med smak)	(1) ❑	(2) ❑
Kulturmelk (alle typer uten smakstilsetning)	(1) ❑	(2) ❑
Eggehvite i kokt egg	(1) ❑	(2) ❑
Eggeplomme i kokt egg	(1) ❑	(2) ❑
Grovbrød (minst 50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑
Rugbrød	(1) ❑	(2) ❑
Havregrøt	(1) ❑	(2) ❑
Bokhvetegrøt	(1) ❑	(2) ❑
Erter	(1) ❑	(2) ❑
Bønner	(1) ❑	(2) ❑
Kylling	(1) ❑	(2) ❑
Lammekjøtt	(1) ❑	(2) ❑
Laks	(1) ❑	(2) ❑
Sild	(1) ❑	(2) ❑

Hvor mange ganger antar du at barnet har smakt følgende matvarer og godtar barnet å spise dem? Her skal du sette to kryss. Ett for hvor mange ganger barnet har smakt matvaren og ett for om barnet også godtar å spise en eller flere biter.

	Hvor mange ganger har barnet smakt?					Godtar barnet å spise matvaren?	
	1 gang	2 ganger	3-5 ganger	6-10 ganger	11 ganger eller mer	Ja	Nei
Jarlsberg ost	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Hvit geitost	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Syrnet melk, smakstilsatt (eksempel Biola/Q BioQ med smak)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Kulturmelk (alle typer uten smakstilsetning)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Eggehviten i kokt egg	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Eggeplommen i kokt egg	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Grovbrød (minst 50% sammalt mel/hele korn og kjerner)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Rugbrød	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Havregrøt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Bokhvetegrøt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Erter	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑

	Hvor mange ganger har barnet smakt?					Godtar barnet å spise matvaren?	
	1 gang	2 ganger	3-5 ganger	6-10 ganger	11 ganger eller mer	Ja	Nei
Bønner	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Kylling	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Lammekjøtt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Laks	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑
Sild	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(1) ❑	(2) ❑

I de neste fire bildene blir du bedt om å ta stilling til en rekke påstander knyttet til barnets matvaner. Kryss av på det alternativet som passer best for deg og barnet ditt.

Hvor ofte stemmer følgende påstand for deg?

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
I hvilken grad følger du med på hva barnet ditt spiser av søtsaker (eks. godterier, is, kaker, kjeks, boller)?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
I hvilken grad følger du med	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
på hva barnet ditt spiser av snacks (eks. potetchips, nachos chips, ostepop)?					
I hvilken grad følger du med på hvor mye mat med høy glykemisk indeks barnet spiser?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
I hvilken grad følger du med på ditt barns inntak av sukkerholdig drikke (eks. brus, saft, iste)?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Lar du barnet ditt spise det han/hun vil?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Tenk deg et middagsmåltid: Lar du barnet ditt velge den maten han/hun vil ha blant matvarene som serveres?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Når barnet ditt blir masete, er det første du gjør å gi han/henne noe å spise eller drikke?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Gir du barnet ditt noe å spise eller drikke når det kjeder seg, selv om du ikke tror han/hun er sulten?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
Når barnet ditt er sint eller lei seg, gir du ham/henne noe å spise eller drikke selv om du ikke tror han/hun er sulten?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis barnet ditt ikke liker det som serveres (for eksempel til middag), lager du da noe annet til ham/henne?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Lar du barnet ditt spise snacks når han/hun selv vil?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Får barnet ditt lov til å gå fra bordet når han/hun er mett, selv om resten av familien ikke er ferdig med å spise?	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Hvor ofte stemmer følgende påstander for deg?

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
Jeg oppmuntrer barnet mitt til å spise sunn mat i stedet for usunn mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Mestparten av maten jeg har i huset er sunn	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg involverer barnet mitt i	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
planlegging av familiemåltider					
Jeg har mye snacks (eks. potetchips, nachos chips, ostepop) i huset	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Barnet mitt må alltid spise opp all maten på tallerkenen sin	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg må forsikre meg om at barnet mitt ikke spiser for mye mat med høy glykemisk indeks	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg tilbyr barnet mitt hans/hennes favorittmat dersom han/hun lover å oppføre seg fint	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg lar barnet mitt "hjelpe" til med matlaging	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis jeg ikke passet på eller satte noen begrensninger for mitt barns matinntak, ville han/hun spise for mye av sin favorittmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Flere ulike sunne matvarer er tilgjengelig for barnet mitt til hvert av måltidene som	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
serveres hjemme					
Jeg tilbyr barnet mitt søtsaker (eks. godterier, is, kjeks, boller) som belønning for god oppførsel	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg oppmuntrer barnet mitt til å prøve ny mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Noen flere påstander, hvor ofte stemmer disse for deg?

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
Jeg snakker med barnet mitt om hvorfor det er viktig å spise sunn mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg forteller barnet mitt at sunn mat smaker godt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg oppmuntrer barnet mitt til å spise mindre for at han/hun ikke skal bli overvektig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis jeg ikke veiledet eller regulerte spisingen til mitt barn, ville han/hun spise for mye junkfood (energitett mat som inneholder mye fett,salt	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
eller sukker)					
Jeg gir barnet mitt små porsjoner til måltidene for at han/hun ikke skal bli overvektig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis barnet mitt sier at han/hun ikke er sulten prøver jeg å overtale ham/henne til å spise likevel	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg snakker med barnet mitt om næringsstoffer i maten	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg oppmuntrer barnet mitt til å delta ved innkjøp av matvarer (for eksempel ved å snakke med barnet om maten jeg kjøper)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis barnet mitt spiser mer enn vanlig til et måltid, prøver jeg å begrense hans/hennes matinntak ved neste måltid	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg begrenser mitt barns inntak av mat som kan medføre at han/hun blir overvektig	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Det er visse typer matvarer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
barnet mitt spiser som kan føre til at han/hun blir overvektig eller fet					
Jeg holder tilbake søtsaker/dessert som en reaksjon på dårlig oppførsel	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Her kommer undersøkelsens siste påstander, hvor ofte stemmer disse for deg?

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
Jeg har mye søtsaker (eks. godterier, is, kaker, kjeks, boller) i huset	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg oppfordrer barnet mitt til å spise variert (dvs. mange ulike matvarer og retter)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Hvis barnet mitt kun spiser en liten porsjon prøver jeg å overtale ham/henne til å spise mer	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg må forsikre meg om at barnet mitt ikke spiser for mye av sin favorittmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg vil ikke at barnet mitt skal	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
bli overvektig eller fet, derfor tillater jeg ikke at han/hun spiser mellom måltidene					
Jeg sier hva barnet mitt skal spise og hva han/hun ikke skal spise uten å gi noen forklaring på hvorfor	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg må forsikre meg om at barnet mitt ikke spiser for mye søtsaker (eks. godterier, is, kaker, kjeks, boller)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg er et forbilde for barnet mitt ved selv å spise sunn mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg setter ofte barnet mitt på spesiell kost for å kontrollere vekten hans/hennes	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg prøver å spise sunn mat når jeg er sammen med barnet mitt, selv om denne maten ikke er min favorittmat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg prøver å vise entusiasme når jeg spiser sunn mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑
Jeg viser barnet mitt at jeg virkelig liker å spise sunn mat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

	Aldri	Sjeldent	Noen ganger	Som oftest	Alltid
Når barnet mitt sier hun/han er ferdig med å spise prøver jeg å få det til å spise en bit til (to-tre matbiter til)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑

Og, helt til slutt noen få bakgrunnspørsmål om barnet:

Hvilket kjønn er barnet som er med i undersøkelsen?

(1) ❑ Jente

(2) ❑ Gutt

Hva er fødselsdatoen til barnet som er med i undersøkelsen?

Fyll inn dato. XX.XX.XX(Eksempel12.12.12)

_____

Barnets fødselsvekt (gram)

gram

____

Barnets lengde ved fødsel (cm)

cm

__

Barnets vekt og lengde ved 15 måneders alder, oppgi mål fra helsestasjonen (hopp over om du ikke har tilgjengelig helsekortet eller husker målene):

Barnets vekt ved måling på helsestasjonen 15 mnd (gram)

Om du ikke har helsekortet tilgjengelig oppgi ca vekt

____

Barnets lengde ved måling på helsestasjon 15 mnd (cm)

Om du ikke har helsekortet tilgjengelig oppgi ca lengde

__

Dato for 15 måneders kontroll på helsestasjonen.

Fyll inn dato. XX.XX.XX (Eksempel slik 12.01.14)

_____

Tusen takk for dine svar!

De er nå lagret.

Med vennlig hilsen

Doktorgradsstipendiat Helga Birgit

Bjørnarå og

Doktorgradsstipendiat Sissel H. Helland

Universitetet i Agder

Institutt for folkehelse, idrett og ernæring

Appendix 2
Confirmation of research clearance from NSD

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Elling Bere
Institutt for folkehelse, idrett og ernæring Universitetet i Agder
Serviceboks 422
4604 KRISTIANSAND S

Vår dato: 26.03.2014 Vår ref: 37459 / 3 / LT Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 04.02.2014. Meldingen gjelder prosjektet:

37459	*Sunn og bærekraftig livsstil (SBL) og barns matmot*
Behandlingsansvarlig	*Universitetet i Agder, ved institusjonens øverste leder*
Daglig ansvarlig	*Elling Bere*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 30.06.2018, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Lis Tenold

Kontaktperson: Lis Tenold tlf: 55 58 33 77
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 37459

Viktige risikofaktorer for den globale sykdomsbyrden er relatert til kosthold, fysisk inaktivitet og miljøutfordringer. Det helhetlige konsept SBL vil kunne fremme både helse og miljø. Barnehager er valgt som inklusjonsenheter. Studien består av to phd-prosjekter (med henholdsvis Sissel H. Helland og Helga Bjørnaråsom stipendiater) og av følgende delstudier: en metodestudie, en tverrsnittsundersøkelse (inngår i begge studiene) og en intervensjonsstudie. Hensikten med studien er å: (I) Utvikle og kvalitetsteste et nytt spørreskjema, (II) Kartlegge tilslutning til konseptet HSL blant småbarnsforeldre i Agder, samt mat- og spiseatferd blant deres barn født i 2012 og (III) Gjennomføre en intervensjon for å fremme et sunt og variert kosthold blant småbarn for å forebygge overvekt og matneofobi..

Det gis skriftlig informasjon om alle deler av prosjektet og innhentes skriftlig samtykke. Personvernombudet finner skrivene mottatt henholdsvis 17.02. (studie 1) og 28.02. (studie 2 og 3) tilfredsstillende.

Det behandles sensitive personopplysninger om etnisk bakgrunn eller politisk/filosofisk/religiøs oppfatning, helseforhold, .

Personvernombudet legger til grunn at forsker etterfølger Universitetet i Agder sine interne rutiner for datasikkerhet. Dersom personopplysninger skal sendes elektronisk eller lagres på mobile enheter, bør opplysningene krypteres tilstrekkelig.

Forventet prosjektslutt er 30.06.2018. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å slette direkte personopplysninger (som navn/koblingsnøkkel) og slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn).

Appendix 3

Participant information (methodological study)

Forespørsel om deltakelse i forskningsprosjektet

Sunn og bærekraftig livsstil

Bakgrunn og hensikt
Dette er en forespørsel til deg om å delta i en forskningsstudie som gjennomføres i Agder, blant småbarnsforeldre med barn som går i barnehage. Studien kartlegger foreldre/foresattes spise- og aktivitetsatferder, samt mat- og spiseatferd blant deres barn. Forskningsresultatene skal brukes til senere kartlegginger og helsefremmende tiltak, som kan bidra til en sunnere befolkning og en sunnere klode. Forskning viser at livsstilsvaner etableres tidlig, og foreldrene spiller en svært viktig rolle for barnas spise- og aktivitetsvaner. Ut fra et familieperspektiv har vi derfor valgt å rette oss mot småbarnsforeldre. Det er en forskergruppe ved Universitetet i Agder, Institutt for folkehelse, idrett og ernæring, som gjennomfører studien. Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste, og er finansiert av Universitet i Agder.

Hva innebærer studien?
For å delta i studien må barnet ditt være født før 2012. Studien består av to faser som begge skal gjennomføres våren 2014. I den første fasen blir du spurt om å fylle ut et elektronisk spørreskjema som vil ta omtrent 50 minutter å besvare. Etter to uker blir du bedt om å fylle ut det samme skjemaet på nytt. Her er det viktig at du *begge gangene fyller ut spørreskjemaet samme dagen som du får tilsendt e-posten med link til skjemaet*, slik at det går nøyaktig to uker mellom de to besvarelsene dine. Hensikten er å teste kvaliteten på spørreskjemaet, siden det er et nytt skjema som ikke har blitt brukt tidligere. Spørreskjemaet er todelt hvor første del omhandler deg, mens andre del retter seg mot barnet ditt. I den første delen spørres det hovedsakelig om dine kost-, aktivitets- og transportvaner. Spørreskjemaet inneholder også spørsmål om helse og livskvalitet, samt andre helseatferder som søvnvaner og røykevaner. I tillegg spørres det om kjønn, yrke, utdannelse, etnisk bakgrunn, sivilstatus, graviditet, høyde og vekt. I den andre delen som omhandler barnet, spørres det i hovedsak om mat- og spiseatferd. Spørreskjemaet kartlegger også foreldres/foresattes matingspraksis. I tillegg spørres det om barnets kjønn, høyde og vekt ved fødsel, og ved 15-18 måneders alder.

I den andre fasen, kort tid etter at du har besvart spørreskjemaet for andre gang, ønsker vi å kartlegge kostholdet ditt noe mer grundig, samt å måle det fysiske aktivitetsnivået ditt og kroppssammensetningen din. Dette er en del av arbeidet med å kvalitetsteste spørreskjemaet. For å kartlegge kostholdet ditt vil du bli bedt om å svare på to kostholdsintervju per telefon, med ca 4 ukers mellomrom. Hvert intervju tar 25-40 minutter å gjennomføre. For å måle aktivitetsnivået ditt vil du bli bedt om å gå med aktivitetsmåler i syv sammenhengende dager. I tillegg ønsker vi å måle kroppssammensetningen din, høyde og vekt. Disse målingene tar ca 20 minutter å gjennomføre. Dersom du er gravid, måler vi ikke kroppssammensetningen din, og dersom du har nikkelallergi fraråder vi deg å gjennomføre målingen av ditt fysiske aktivitetsnivå.

Mulige fordeler og ulemper
Studien vil ikke medføre ulemper for deg eller ditt barn, utover tiden det tar å fylle ut spørreskjemaet og å gjennomføre målingene. Når det gjelder måling av kroppssammensetning, vil dette gjøres på Spicheren treningssenter (rett ved Universitetet i Agder), noe som vil ta litt ekstra tid. Her vil du også få utdelt aktivitetsmåleren og få en instruksjon i bruken av den.

Fordelen med studien er at du, dersom du gjennomfører alle delene, vil få tilbud om en kortfattet «helserapport» i etterkant basert på dine resultater. Rapporten gir deg en tilbakemelding på kroppssammensetningen din, samt på kostholdet og aktivitetsnivået ditt. De to siste sees i sammenheng med nasjonale anbefalinger og resultater fra tidligere nasjonale befolkningsstudier. Du kan selv velge om du ønsker en slik rapport, og i så fall hvilke av disse tre områdene du ønsker en tilbakemelding på. Det behøver ikke å være alle. I tillegg får du en gratis prøvetime på Spicheren treningssenter som du kan benytte når du selv måtte ønske.

Studien vil også gi oss i forskergruppen viktig kunnskap om kvaliteten av det nye spørreskjemaet. Dersom skjemaet holder ønskelig kvalitet vil det brukes i fremtidige forskningsstudier, og dermed bidra til økt kunnskap som grunnlag for utvikling av nye tiltak som kan fremme både helse og miljø.

Hva skjer med informasjonen om deg?
Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene, i alle deler av studien, vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg og ditt barn til deres opplysninger gjennom en navneliste. Det er kun forskningsteamet knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg eller barnet ditt. Det vil ikke være mulig å identifisere hverken deg eller barnet i resultatene av studien, når disse publiseres. Ved prosjektslutt, juni 2018, vil datamaterialet anonymiseres. Det innebærer at all kontaktinformasjon og koden som knytter denne informasjonen til dataene vil bli slettet. Dermed vil det ikke lenger være mulig å knytte datafilen til deltakerne, heller ikke for prosjektgruppen.

Frivillig deltakelse
Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien, uten konsekvenser for deg eller ditt barn. Dersom du ønsker å delta, klikk på lenken i bunnen av siden.

Med vennlig hilsen

Stipendiat Helga Birgit Bjørnarå
Tlf: 38141124
E-post: helga.birgit.bjornara@uia.no

Appendix 4
Participant consent form (methodological study)

Velkommen til samtykkeskjema for forskningsprosjektet Sunn og bærekraftig livsstil!

Jeg bekrefter å ha mottatt informasjon om studien, og jeg er villig til å delta. Hvis jeg ønsker tilleggsinformasjon vet jeg hvem jeg skal kontakte. Jeg er informert om at studien er frivillig og at jeg kan trekke meg når som helst uten konsekvenser.

☐ Ja, jeg samtykker til deltakelse i studien

Siden vi fraråder gravide og de med pacemaker å gjennomføre kroppsanalysen med analyseverktøyet InBody, og de med nikkelallergi å gjennomføre aktivitetsmålingen med SenseWear Armband, etterspør vi informasjon om dette her.

Er du kvinne eller mann?

☐ Kvinne
☐ Mann

Er du gravid?

☐ Ja
☐ Nei
☐ Vet ikke

Har du pacemaker?

☐ Ja
☐ Nei

Har du nikkelallergi?

☐ Ja
☐ Nei

Kontaktinformasjon

Mitt fornavn:

_____

Mitt etternavn:

_____

E-postadresse:

_____

Vennligst gjenta e-postadresse:

Mobilnummer:

Gatenavn og nummer:

Postnummer og sted:

Navnet på barnehagen hvor mitt barn går:

Ønsker du en kortfattet helserapport i etterkant, basert på resultatene dine?

- ☐ Ja
- ☐ Nei

På hvilke resultater ønsker du tilbakemelding? Her kan du krysse av for alle eller noen:

- ☐ Fysisk aktivitetsnivå
- ☐ Kosthold
- ☐ Kroppssammensetning

Tusen takk for at du ønsker å delta i studien!

Du vil innen kort tid få tilsendt en e-post med link til selve spørreskjemaet for første gangs besvarelse. I tillegg tar vi kontakt med deg for å avtale tid for oppmøte på Spicheren treningssenter og gjennomføring av de aktuelle målingene.

Vennlig hilsen

Stipendiat Helga Birgit Bjørnarå

Appendix 5

The “health report” (methodological study)

Deltakernavn

Tusen takk for at du deltok i første del av forskningsstudien Sunn og bærekraftig livsstil! Takket være deg og ditt bidrag har vi fått ny og viktig kunnskap som skal brukes til videre forskning og konkrete tiltak for å fremme folkehelse og miljø.

Med dette skrivet får du en kortfattet rapport basert på dine resultater fra målingene av aktivitetsnivå (SenseWear Armband), kosthold (to telefonintervjuer) og kroppssammensetning (InBody 720). For å vurdere dine resultater er aktivitetsnivå og kosthold sett i forhold til gjennomsnittsverdier i befolkningen, basert på landsrepresentative befolkningsundersøkelser, samt Helsedirektoratets anbefalinger.

Det er viktig å være klar over at målingene av kroppssammensetning og aktivitetsnivå er estimater. Det betyr at selv om det i dette prosjektet er brukt feltmetoder som er grundig kvalitetstestet og anses som pålitelige, vil det kunne forekomme feilkilder/forstyrrelser som gjør at resultatene ikke nødvendigvis er helt nøyaktige.

Når det gjelder kostintervjuene er det viktig å være bevisst på at to tilfeldige dager ikke nødvendigvis er representativt for ditt vanlige kosthold. Det vil ofte være dag-til-dag variasjoner, og tilfeldigheter og unntak på nettopp de to dagene du ble intervjuet vil påvirke resultatet. Eventuell bruk av kosttilskudd er ikke regnet med i de oppgitte verdiene dine, da dette heller ikke gjøres i referansestudien.

For å estimere aktivitetsnivået ditt, har vi brukt et nyere måleapparat enn i referansestudien, noe som gjør at sammenligninger med gjennomsnittsverdiene må gjøres med forsiktighet. Likevel har studier vist at disse to målerne estimerer aktivitetsnivå og energiforbruk relativt likt. I tillegg må du huske på at bevegelsesmålere ikke klarer å fange opp all aktivitet i like stor grad, særlig «horisontale» aktiviteter som sykling, eller vannaktiviteter som svømming.

Parameterne som du får tilbakemelding på er valgt ut fra det helhetlige livsstilsperspektivet i studien, og fokuset på helse. Vi håper du finner rapporten interessant og nyttig!

Mvh. prosjektledelsen

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Fysisk aktivitetsnivå

	Din verdi (gjennomsnitt)	*Gjennomsnittet i befolkningen (kvinner)	*Gjennomsnittet i befolkningen (menn)	Helsedirektoratet sine anbefalinger
[1]Moderat/hard fysisk aktivitet (minutter/døgn)	**179**	32	35	150 min/uke (bolker på minst 10 min)
[2]Skritt (antall/døgn)	**7210**			10 000 per dag
[3]Inaktivitet (minutter/døgn)	**589**	534	559	Redusert tid
[4]Søvn (t:min/døgn)	**6:28**	6-9	6-9	

*Gjennomsnittstallene for fysisk aktivitetsnivå er basert på resultatene fra studien KAN (Kartlegging Aktivitet Norge) gjennomført i 2008-2009 blant et landsrepresentativt utvalg av 3322 kvinner og menn i alderen 20-85 år.

[1]Med *moderat fysisk aktivitet* menes all aktivitet som medfører høyere puls enn vanlig (f.eks hurtig gange), og et energiforbruk som er 3-6 ganger høyere enn hvilestoffskiftet. Med *høy fysisk aktivitet* menes aktivitet som medfører mye høyere puls enn vanlig (f.eks løping), og et energiforbruk som er mer enn 6 ganger høyere enn hvilestoffskiftet (Helsedirektoratet).

Din gjennomsnittlige, daglige tid med moderat/høy fysisk aktivitet er summen av all aktivitet, ikke bare den som har foregått i bolker på 10 minutter eller mer. Referanseverdiene fra KAN er derimot aktivitet som har foregått i minst 10 minutter sammenhengende, og vil derfor være mye lavere. Vi har likevel valgt å rapportere all aktivitet, siden nyere studier viser helsegevinst også av aktivitet som foregår over en kortere periode enn 10 minutter. Bare det å bryte opp sittetiden viser seg å være fordelaktig for flere helseparameter.

[2]Når det gjelder antall skritt er ikke dette en offisiell anbefaling, men likevel en anbefaling som blir mye brukt. Anbefalingen baseres på at studier gjort på friske voksne finner samsvar mellom 10 000 skritt totalt og oppnåelse av anbefalt nivå av daglig fysisk aktivitet, dersom primær aktivitetsform er gange. Av de 10 000 skrittene estimeres det at hverdagsaktivitet utgjør mellom 6000-7000 skritt, mens ytterligere 30 minutter fysisk aktivitet med moderat intensitet utgjør 3000-4000 skritt (Tudor-Locke og medarbeidere 2008).

[3]*Inaktivitet* defineres som våken tid i sittende, liggende, eller annen fysisk hvilende stilling, og innebærer et energiforbruk som er under 1.5 ganger høyere enn hvilestoffskiftet. Eksempler er bruk av nettbrett og PC, TV- titting og annen skjermaktivitet, bilkjøring osv. (Helsedirektoratet). Det nasjonale målet for inaktivitet er at vi reduserer og bryter opp tiden vi er inaktive.

[4]Tallene for søvn i befolkningen er hentet fra Nasjonal kompetansetjeneste for søvnsykdommer ved Haukeland universitetssjukehus (SOVno). Det finnes ikke forskningsbaserte anbefalinger for antall

timer søvn per natt, da dette er svært individuelt. I tillegg regnes søvnkvaliteten å være vel så viktig som det totale antallet timer søvn. På individnivå er det å kjenne seg uthvilt på dagtid det mest brukte målet på nok søvn. Basert på norske befolkningsundersøkelser sover de aller fleste mellom 6 og 9 timer per natt (SOVno). Ifølge Amerikansk søvnpasientforening (National Sleep Foundation) er de fleste eksperter enige om en **tommelfingerrege**l på 7-9 timer per natt for voksne over 18 år, med **forbehold** om individuelle variasjoner (sleepfoundation.org). Gjennomsnittstallet ditt for antall timer og minutter med søvn per døgn (fra kl.00 til kl.00) skiller ikke når på døgnet du sov- om det var på natta eller på dagen.

Kosthold

	Din verdi	*Gjennomsnittet i befolkningen (kvinner)	*Gjennomsnittet i befolkningen (menn)	Helsedirektoratet sine anbefalinger
[1]Energi (MJ/dag)	7.5	8	10.9	
Protein [2](E%)	24.1	18	18	10-20
Fett (E%)	25.4	34	34	25-40
-mettede fettsyrer (E%)	9.5	13	13	<10
-enumettede fettsyrer (E%)	9.1	12	11	10-20
-flerumettede fettsyrer (E%)	3.7	6.2	6.2	5-10
Karbohydrater (E%)	47.3	44	44	45-60
-tilsatt sukker (E%)	0	7.4	7.4	<10
-kostfiber (g/MJ)	3.1	2.9	2.5	3
[3]Vitamin D (µg)	4.63	4.9	6.7	10
[4]Vitamin C (mg)	69	111	105	75
[5]Jern (mg)	14.2	10	13	9 (menn) 15 (kvinner)
[6]Kalsium (mg)	1030	811	1038	800

*Gjennomsnittstallene er basert på resultatene fra studien NorKost 3, gjennomført i 2010-2011 blant et landsrepresentativt utvalg av 1787 kvinner og menn i alderen 18- 70 år (inkluderer ikke bruk av kosttilskudd).

[1] 1 MJ = 239 kcal (kalorier). Det finnes naturlig nok ikke noen generell anbefaling for totalt daglig energiinntak, da dette er svært individuelt og avhengig av mange faktorer.

[2] E % vil si hvor stor andel av totalt energiinntak det aktuelle næringsstoffet utgjør/bør utgjøre.

[3] Vitamin D er nødvendig for at kroppen skal kunne ta opp og utnytte kalsium, og er dermed viktig for et sterkt skjelett. I tillegg har studier rapportert mulig sammenheng med diabetes, hjerte-karsykdommer, ulike kreftformer og sykdommer knyttet til nervesystemet, men her vet vi enda for

lite. Vitamin D finnes i matvarer som fisk, tran og egg, samt berikede produkter som ekstra lettmelk, margarin og smør. I tillegg danner kroppen D-vitamin selv når huden eksponeres for sollys. De fleste bør være påpasselige for å få i seg nok D-vitamin, siden det finnes i relativt få matvarer, og mange oppholder seg mye innendørs.

[4] Vitamin C er nødvendig for kroppens immunforsvar, for celler og vev, samt for opptak av jern. I tillegg finnes det holdepunkter for at vitamin C kan beskytte mot visse kreftformer og infeksjoner. De viktigste kildene er frukt, bær og grønnsaker, samt poteter. Vitamin C utnyttes best dersom matvarene spises i rå tilstand, siden vitaminet er følsomt for både varme, luft, lys og lagring.

[5] Jern er nødvendig i energiomsetningen, for dannelsen av røde blodceller, og dermed transport av oksygen. Viktige kilder er brød av sammalt mel og grove kornprodukter, kjøtt, innmat og egg. I tillegg finnes det noe jern i poteter, grønnsaker, frukt og bær.

[6] Kalsium er viktig for oppbygning og vedlikehold av skjelett og tenner, for regulering av muskel- og nerveaktivitet, for ulike enzymreaksjoner og blodkoagulering. Melkeprodukter inneholder mye kalsium. I tillegg finnes også kalsium i grønne grønnsaker, frukt, bær, kornvarer, poteter, nøtter, og fisk som spises hele - som sardiner og brisling.

Kroppssammensetning

	Din verdi	Referanseområde (kvinner)	Referanseområde (menn)
*Kroppsmasseindeks (KMI; kg/m^2)	**21.1**	18.5-25.0	18.5-25.0
[1]Kroppsfett (%)	**22.3**	12-33	5-20
[2]Visceralfett (cm^2)	**54.9**	<100	<100

*Kroppsmasseindeks (KMI) er et av de mest brukte målene på vektstatus. KMI beregnes ved formelen kg/(høyde i m)^2. KMI er velegnet på gruppenivå, men må tolkes med forsiktighet på individnivå, da det ikke tar høyde for kroppssammensetning (som muskelmasse versus fettmasse), kun forholdet mellom høyde og vekt. WHO sine referanseverdier er satt ut fra et helseperspektiv, ved at verdier over og under «normalvekt» (KMI 18.5-25.0 kg/m^2) medfører økt helserisiko.

[1]Per i dag finnes ingen nasjonal eller internasjonal konsensus på anbefalinger knyttet til prosentandel kroppsfett for optimal helse. Likevel er vanlige referanseverdier mellom 12 og 33 % for kvinner og mellom 5 og 20 % for menn (Heymsfield og medarbeidere 2005, McArdle og medarbeidere 2006, Gallagher og medarbeidere 2000, Ode og medarbeidere 2007).

[2]Visceralfett er fettvevet som omgir de indre organene i bukhulen. Studier rapporterer en sterk sammenheng mellom visceralfett og en rekke livsstilssykdommer, og måling av visceralfett er derfor sentralt ut fra et helseperspektiv. Det er kun moderat sammenheng mellom visceralfett og vektstatus, noe som betyr at en slank, utrent person kan ha mer visceralfett enn en overvektig, trent person. Mengden visceralfett estimeres som areal (cm^2), basert på analyse av lengden på kroppsstammen og motstanden i vevet (impedans). Bakgrunnen for referanseverdien på 100 cm^2 er at forskningsstudier har funnet økt risiko for hjerte-karsykdom dersom visceralfett utgjør et større areal enn dette (Ryo og medarbeidere 2005, Nagai og medarbeidere 2008). Det finnes ingen forskningsbasert anbefaling for nedre grense på mengde visceralfett.

Når det gjelder muskelmasse finnes det per i dag ikke vitenskapelig grunnlag for et anbefalt referanseområde sett ut fra et helseperspektiv. Derfor har vi valgt ikke å ta dette med i rapporten.

Appendix 6

Participant information (cross-sectional study)

UNIVERSITETET I AGDER

Forespørsel om deltakelse i forskningsprosjektet

Sunn og bærekraftig livsstil og Barns matmot

Bakgrunn og hensikt
Dette er et spørsmål til deg om å delta i en forskningsstudie som gjennomføres blant småbarnsforeldre med barn i barnehage, i Aust- og Vest Agder. Alle barnehager i begge Agder-fylkene med flere enn 8 barn i 2012-kull inviteres til å delta. Studien kartlegger foreldre/foresattes spise- og aktivitetsatferder, samt mat- og spiseatferd blant deres barn født i 2012. Forskningsresultatene skal brukes til senere helsefremmende tiltak som kan bidra til en sunnere befolkning og en sunnere klode. Forskning viser at livsstilsvaner etableres tidlig, og foreldrene spiller en svært viktig rolle for barnas spise- og aktivitetsvaner. Derfor er det valgt et familieperspektiv for prosjektet. Det er en forskergruppe ved Universitetet i Agder, Institutt for folkehelse, idrett og ernæring, som gjennomfører studien. Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste, og er finansiert av Universitet i Agder og Norske Kvinners Sanitetsforening.

Hva innebærer studien?
Du blir spurt om å fylle ut et elektronisk spørreskjema som vil ta omtrent 50 minutter å besvare. Etter ca. seks måneder vil vi spørre deg om du kan fylle ut samme skjema på nytt. Spørreskjemaet er todelt hvor første del omhandler deg, mens andre del retter seg mot barnet. I den første delen spørres det hovedsakelig om dine kost-, aktivitets- og transportvaner. Spørreskjemaet inneholder også spørsmål om helse og livskvalitet, samt andre helseatferder som søvnvaner og røykevaner. I tillegg spørres det om kjønn, yrke, utdannelse, etnisk bakgrunn, sivilstatus, graviditet, høyde og vekt. I den andre delen som omhandler barnet født i 2012, spørres det i hovedsak om mat- og spiseatferd. Spørreskjemaet kartlegger også foreldres/foresattes matingspraksis. I tillegg spørres det om barnets kjønn, høyde og vekt ved fødsel, og ved 15-18 måneders alder. Det kan komme fremtidige forespørsler om å delta i oppfølgingsundersøkelser.

Mulige fordeler og ulemper
Studien vil ikke medføre ulemper for deg eller ditt barn, utover tiden det tar å fylle ut spørreskjemaet. Fordelen med studien er at den vil gi økt kunnskap som kan bidra til utvikling av nye tiltak, som kan fremme både helse og miljø. I tillegg blir du med i trekningen av 10 gavekort á 1000 kroner. Enkelte barnehager vil i tillegg bli tilfeldig trukket ut til å delta i en oppfølgingsstudie. Personalet i de forespurte barnehagene vil bli kurset i ulike tema knyttet til måltidspedagogikk slik at de kan stimulere barna til matglede og til variasjon i kostholdet i barnehagen.

Hva skjer med informasjonen om deg?
Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg og ditt barn til deres opplysninger gjennom en navneliste. Det er kun forskningsteamet knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg eller barnet ditt. Det vil ikke være mulig å identifisere hverken deg eller barnet i resultatene av studien, når disse publiseres. Ved prosjektslutt, juni 2018, vil datamaterialet anonymiseres. Det innebærer at all kontaktinformasjon og koden som knytter denne informasjonen til dataene vil bli slettet. Dermed vil det ikke lenger være mulig å knytte datafilen til deltakerne, heller ikke for prosjektgruppen.

UNIVERSITETET I AGDER

Frivillig deltakelse
Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien, uten konsekvenser for deg eller ditt barn. Dersom du ønsker å delta, klikk her.

Med vennlig hilsen

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Appendix 7

Participant consent form (cross-sectional study)

Velkommen til samtykkeskjema for forskningsprosjektet Sunn og bærekraftig livsstil og Barns matmot!

Jeg og mitt barn født i 2012 er villige til å delta i studien, og jeg bekrefter å ha mottatt informasjon om studien. Hvis jeg ønsker tilleggsinformasjon vet jeg hvem jeg skal kontakte. Jeg er informert om at studien er frivillig og at jeg kan trekke meg når som helst uten konsekvenser.

☐ Ja, jeg samtykker til deltakelse i studien

Kontaktinformasjon

Mitt fornavn:

_____

Mitt etternavn:

_____

E-postadresse:

_____

Vennligst gjenta e-postadresse:

_____

Mobilnummer:

_____

Gatenavn og nummer:

_____

Postnummer og sted:

_____

Navnet på barnehagen hvor mitt barn går:

_____

Tusen takk for at du ønsker å delta i studien!

Du vil innen kort tid få tilsendt en e-post med link til selve spørreskjemaet.

Vennlig hilsen

Stipendiat Sissel H. Helland og stipendiat Helga Birgit Bjørnarå