Initiating the PREPARED project: a digital dietary intervention for preconception young adults – protocol development, validation of dietary methods, and DOHaD knowledge-diet quality insights

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Foreword

My academic journey began with the opportunity to write my master's thesis in Public Health Science for the Centre for Lifecourse Nutrition (previously the research group FEED), which introduced me to the PREPARED project. Afterwards, I continued as a research assistant at the centre for a year. Eventually, I seized the chance to apply for a PhD position within the PREPARED project, enabling me to carry on the work initiated during my master's.

I extend my gratitude to the University of Agder for granting me this invaluable opportunity to pursue a PhD.

I am grateful to my esteemed colleagues at the Department of Nutrition and Public Health for their support, which has made this journey truly enriching and fulfilling. However, amidst this gratitude, I feel compelled to extend a heartfelt thanks to Sissel Heidi Helland, whose unwavering belief in my potential and persistent encouragement to pursue a PhD have played an important role in shaping my academic path.

Thank you to the members of the PREPARED project for the immense learning experience throughout the development of a research intervention and their unwavering support and input in writing my research papers.

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maintain our sanity during these past years. I eagerly look forward to reciprocating the support when it’s you turn for a PhD.

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–Lorentz Salvesen

Kristiansand, October 2023

Summary

Background

The Developmental Origins of Health and Disease (DOHaD) theory suggests that environmental exposures during critical developmental periods can profoundly affect long-term health and disease risk of both the individual and subsequent generations. Within the theory of DOHaD, maintaining a healthy diet offers a triple dividend in health, encompassing short- and long-term health of the individual and potential benefits for future generations. An individual's diet and nutrition before conceiving a child is commonly referred to as preconception nutrition. Adopting a public health perspective on preconception nutrition is essential for promoting a healthier future, as it sets the foundation for long-term health and lifestyle behaviours that can significantly influence the prospect of future offspring health.

Aims and objectives

The current thesis aimed to plan and establish the basis for the PREPARED project, with a specific emphasis on validating dietary assessment methods to be utilized throughout the entire project, while also conducting a specific analysis of DOHaD knowledge and diet quality on the baseline data.

This was to be accomplished through four specific objectives: (a) develop a study protocol outlining the research process for the PREPARED project, (b) develop digital food item image-series to aid portion size estimation accuracy in a 24-hour dietary recall system to be used in PREPARED project, and validate their accuracy by comparing them with pre-weighed food portions, (c) validate a dietary screener against a semi-quantitative food frequency questionnaire (FFQ) for rapid dietary assessment in the PREPARED project, and (d) assess preconception young adults' DOHaD knowledge and diet quality, and the association between the two, using the baseline data from the PREPARED study.

Methods and findings

Four papers were included in this thesis.

In Paper I, a research protocol was established for the PREPARED project, which aims to evaluate the effectiveness of a digital dietary intervention for

preconception young adults through a randomised controlled trial. The primary outcome of the intervention is postintervention preconception diet. The secondary outcomes are health-related quality of life and maternal pregnancy health and neonatal health. The PREAPRED project aimed to enrol 7000 young adult men and women aged 20 to 35 in Norway, all without biological children, by utilizing social media platforms. The intervention group would receive a 6-month digital dietary intervention. The control group would not receive any intervention. Follow-up assessments are planned until the birth of the participants' first child or up to a maximum of 20 years. Two dietary assessment tools were used to assess the participants' diets, the "myfood24" dietary recall system and a dietary screener. When participants become parents the study data will be linked to the Medical Birth Registry of Norwegian.

In Paper II, twenty-three culturally specific digital food item image-series were developed to assist portion size estimation in the web-based dietary assessment system "myfood24". Absolute validity of the image-series was assessed by employing a perception approach using pre-weighed food portions. The study involved forty-one young adult participants. The results indicated that, on average, 55% of participants portion size estimations using the image-series were a perfect match with the presented food portions, and 93% were either a perfect or partial match. A mean discrepancy of 2.5% was observed between the participants' portion size estimates and the pre-weighed food portions. Females tended to estimate portion sizes more accurately than males. The newly developed portion size image-series for traditional and commonly consumed Norwegian foods performed satisfactorily when compared to pre-weighed food portions, except for the image-series "Bread", "Marzipan cake", and most spreads.

In Paper III, the relative validity of the non-quantitative dietary screener "MyFoodMonth 1.1" was assessed against a semi-quantitative FFQ. The study involved 172 first-year university students. Kendall's tau-b analyses showed moderate-to-strong concordance for most of the raw measures, and all aspects of diet quality and Diet Quality Score (DQS) components. Concordance was generally similar between sexes. Ranking ability was evaluated using cross-tabulation and box-and-whisker plots, corroborating the observed concordance. Overall, the relative validity of the dietary screener "MyFoodMonth 1.1" was satisfactory compared to an FFQ in a young student population comprising both men and women, except for the food items “Cereal and porridge, sweetened”, “Tomato sauce”, and “Coffee/tea/iced coffee/iced tea with sugar/syrup/honey”.

In Paper IV, $DOHaD_{KNOWLEDGE}$ and diet quality in preconception young adults were described and investigated for an association using the PREPARED baseline data, while also exploring potential gender differences. The study involved 1362 participants, of which 88% were women and 77% had higher levels of education. Moderate scores were observed for both $DOHaD_{KNOWLEDGE}$ (mean score of 12/20 points) and diet quality (mean DQS of 60/100 points). Gender differences were observed for $DOHaD_{KNOWLEDGE}$, favouring men, and diet quality, favouring women. A linear regression analysis showed a positive association between $DOHaD_{KNOWLEDGE}$ and diet quality, indicating that a one-unit increase in $DOHaD_{KNOWLEDGE}$ (1/20 points) was associated with a 0.71-point (95% CI: 0.52, 0.91) increase in DQS (0.71/100 points). This was slightly attenuated after adjusting for gender, body mass index, and education (B: 0.60, 95% CI: 0.41, 0.79). Overall, moderate $DOHaD_{KNOWLEDGE}$ and suboptimal diet quality were observed in a sample of preconception young adults in Norway, indicating potential for improvements in both, and a positive association between $DOHAD_{KNOWLEDGE}$ and diet quality.

Conclusion

A study protocol outlining the research process of the PREPARED project was developed and initiated, with a specific emphasis on validating dietary assessment tools informing the project. Twenty-three digital food item image-series were developed and validated to aid portion size estimation accuracy in “myfood24”, demonstrating satisfactory portion size estimation accuracy for most image-series. The rapid non-quantitative dietary screener “MyFoodMonth 1.1” exhibited moderate-to-strong concordance for most raw measures and all aspects of diet quality and DQS components compared to an FFQ. The PREPARED study baseline data indicated that preconception young adults had moderate $DOHaD_{KNOWLEDGE}$ and suboptimal diet quality. Additionally, a positive association was observed between $DOHaD_{KNOWLEDGE}$ and diet quality, regardless of participants gender, body mass index, and education.

List of papers

Paper I

Øverby, N. C., Medin, A. C., Valen, E. L., Salvesen, L., Wills, A. K., Engeset, D., Vik, F. N., & Hillesund, E. R., *Effectiveness of a digital dietary intervention program targeting young adults before parenthood: protocol for the PREPARED randomised controlled trial*. BMJ Open, 2021. **11**(12): p. e055116.

Paper II

Salvesen, L., Engeset, D., Øverby, N. C., & Medin, A. C., *Development and evaluation of image-series for portion size estimation in dietary assessment among adults*. Journal of Nutritional Science, 2021. **10**: p. e3.

Paper III

Salvesen, L., Wills, A. K., Øverby, N. C., Engeset, D., & Medin, A. C., *Relative validity of a non-quantitative 33-item dietary screener with a semi-quantitative food frequency questionnaire among young adults*. Journal of Nutritional Science, 2023. **12**: p. e72.

Paper IV

Salvesen, L., Valen, E. N., Wills, A. K., Hillesund, E. R., Vik, F. N., Engeset, D., Øverby, N. C., & Medin, A. C., *Developmental Origins of Health and Disease knowledge is associated with diet quality in preconception young adult men and women*. (Manuscript submitted to the Journal of Developmental Origins of Health and Disease, awaiting decision on second round of peer-review).

Associated papers:

- Valen, E. N., Grasaas, E., Engeset, D., Salvesen, L., Skeie, G., Øverby, N. C., & Medin, A. C., *Myfood24 på norsk: et selvadministrert digitalt 24-timers kostintervju*. Norsk tidsskrift for ernæring, 2023. **21**(2): p. 13-22. [1].
- Valen, E. N., Øverby, N. C., Hardy-Johnson, P., Vik, F. N., Salvesen, L., Omholt, M. L., Barker, M. E., & Hillesund, E. R., *Lessons learned from talking with adults about nutrition: A qualitative study in the PREPARED project*. Maternal & Child Nutrition, 2023: p. e13540. [2].

Contents

List of tables and figures

List of abbreviations

24HR	24-hour dietary recall
BMI	Body mass index
CIs	Confidence intervals
DOHaD	Developmental Origins of Health and Disease
DQS	Diet Quality Score
FFQ	Food frequency questionnaire
FOAD	Council for the Fetal Origins of Adult Disease
GBD	Global Burden of Disease
IQR	Interquartile range
MBRN	Medical Birth Registry of Norway
NCD	Non-communicable diseases
NNR 2023	Nordic Nutrition Recommendations 2023
QoL	Quality of Life
RCT	Randomised controlled trial
SD	Standard deviation
SSB	Sugar-sweetened beverages
WHO	World Health Organization

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1 Introduction

1.1 Insight into the history of the Developmental Origins of Health and Disease

The Developmental Origins of Health and Disease (DOHaD) suggests that environmental exposures acting during the ‘critical windows’ of development can profoundly impact long-term health and disease risk in adulthood [3]. These ‘critical windows’ represent periods of heightened plasticity when the developing organism is particularly sensitive to its surrounding environment. Environmental exposures encompass various factors throughout life, including the physical environment (pollution, accessibility to green spaces, and food availability), stress (life situation, work-related stress, etc.), physical activity, and nutrition [4-6].

A key historical event in the investigation of developmental origins of health and disease was the Second World War. During wartimes, famines exposed women to severe undernutrition, inadvertently creating “natural experiments” that otherwise would have been impossible to conduct. Among these, the Dutch Winter Famine, which occurred in Rotterdam and The Hague from September 1944 to May 1945, provided the clearest epidemiological data on the effects of famine exposure. The data revealed that exposure to starvation during the last trimester of pregnancy led to a reduction in birth weight in the offspring, while exposure to famine around the time of conception or soon after increased chances of miscarriages and malformations [7]. In post-war Germany, the effects of reduced food availability supported the findings on reduced birth weight and highlighted a significant reduction in women’s ability to breastfeed [8]. Moreover, undernutrition during gestation after the Dutch Winter Famine was associated with the manifestation of metabolic diseases later in life.

Further studies in 1976 by Ravelli, Stein [9] indicated that the rates of obesity were significantly higher in young men exposed to famine during the first two trimesters of their mother’s pregnancy compared to those exposed to famine for one to three months in the last trimester of pregnancy. Additionally, they found that offspring of women exposed to famine during the first trimester had lower birth weights compared to those not exposed to famine in utero, while no reduction in birth weight was observed in women exposed to famine during the second or third trimester [10]. In 1977, the Norwegian scientist Anders Forsdahl observed a correlation by county between mortality from arteriosclerotic heart disease in middle-aged men (aged 40 to 69) and poor standard of living derived from infant mortality rates in childhood and adolescence in the same cohort [11]. This suggested that poor standards of living in childhood and adolescence followed by prosperity as a potential risk factor for arteriosclerotic heart disease in middle age. A correlation was also observed between disease-caused mortality (any type) and county infant mortality during childhood and youth. Similar associations were observed in women, although the correlations were weaker, for arteriosclerotic heart disease and mortality caused by disease (any type).

The work of David Barker in the 1980s coalesced the observations between exposure in early life and later disease into a field. A geographical mapping of mortality from selected diseases [12] revealed a robust relationship between areas with high infant mortality and areas with high ischaemic heart disease mortality rates [13]. Barker and colleagues suggested that this geographical distribution reflected variations in nutrition, indicating that fetal conditions *in utero* might be the origins of metabolic disease risk in later life [14, 15].

In 1994, a workshop on “fetal origins of adult disease” took place [16], leading to the formation of the “Council for the Fetal Origins of Adult Disease” (FOAD). Later, in 2003, FOAD was reformed into an academic society, broadening its scope to include childhood vulnerability windows and developmental processes related to health determinants and the risk of chronic disease in later life. This evolution resulted in the establishment of the Developmental Origins of Health and Disease framework. The DOHaD research now encompasses exposures during various stages of life for both mothers and fathers, introducing the Paternal Origins of Health and Disease (POHaD) [17, 18], covering weeks, months, and years leading up to conception [19].

The DOHaD approach includes the importance of a healthy and balanced diet throughout the life course, which offers the potential for a triple dividend in health encompassing short- and long-term individual health, and improved health for future generations (Fig. 1) [20, 21]. In the short term, a healthy diet will support the diverse physiological needs for growth and development at every stage in life. It ensures an adequate supply of energy and essential nutrients to support bodily functions. Over the long term, benefits include maintaining a healthy weight, improved quality of life, and reduces the risk of developing chronic diseases (noncommunicable diseases). Importantly, the impact of a healthy diet extends beyond the individual, influencing both parent-child (intergenerational) and subsequent generations (transgenerational) through environmental exposures [22]. This influence can affect various aspects, including birth outcomes and the risk of disease later in the offspring's life (Fig. 1). The effects of diet and nutrition on an individual before conception, whether intergenerational or transgenerational, are collectively referred to as preconception nutrition [23].

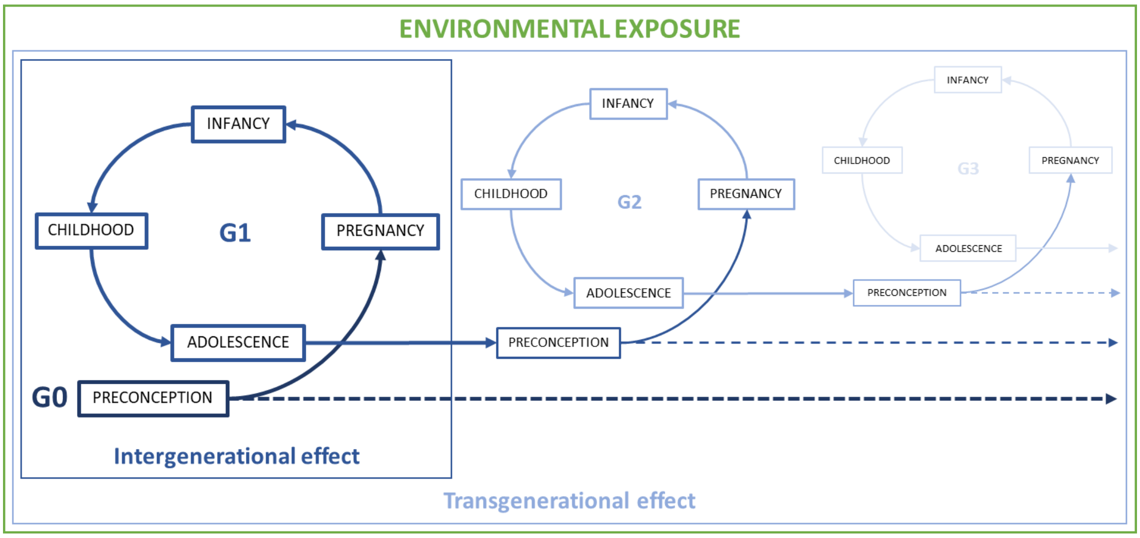


Figure 1. The Developmental Origins of Health and Disease generational (G0, G1, G2 and G3) transmission of effects. Generation (G0, G1, G2, and G3) indicated by colour. Dotted lines indicating the continuation of the life course.

1.2 Nutritional epidemiology

Nutritional epidemiology as a field examines food intake and relates it to diet nutrient content and disease incidence. The interpretation of dietary intake studies and surveys is heavily reliant food composition data, whether the objective is diet-related chronic disease or intakes of specific nutrients [24].

The World Health Organization (WHO) characterises a healthy diet for adults as one including fruit, vegetables, legumes, nuts, and whole grain, and limiting the intake of free sugars, fat, and salt [25]. Similarly, Norway's general dietary recommendation emphasizes a balanced and varied diet. The Norwegian Department of Public Health [26] has established ten dietary guidelines for a healthy diet, summarised by:

i) Eat more vegetables, fruits, berries, fish, and fish products.
ii) Eat less red meat, meat products, salt, high-salt foods, sugar, sugar-sweetened beverages (SSB), and candy.
iii) Opt for whole grains over refined grains, use oil and soft margarine instead of butter, low-fat dairy products rather than high-fat alternatives, and water instead of SSB.

The Nordic Council of Ministers released the latest edition of the Nordic Nutrition Recommendations in June 2023 (NNR2023) for Nordic and Baltic countries [27, 28]. The NNR2023 has updated the background papers for all the nutrients included in the 2012 recommendations and introduces new background papers for 15 food groups. New to the NNR2023 is providing scientific evidence for the following dietary aspects:

- Dietary patterns
- Meal patterns (insufficient evidence to set dietary guidelines)
- Ultra-processed foods (specific recommendations not formulated)
- Integrating environmental sustainability by considering environmental aspects of food consumption.
- Addressing overweight and obesity, considering evidence of the association with food intake, nutrients, and consumption patterns.

Dietary data from 185 countries, covering 99% of the global population in 2018, indicate a modest overall diet quality [29]. The Global Burden of Disease study (GBD) in 2017 [30] found suboptimal consumption of almost all healthy foods and nutrients in adults aged 25 years or older, with nuts and seeds, milk, and whole grains being the most deficient food groups. Conversely, unhealthy foods and nutrients, such as SSB, processed meat, and sodium, exceeded optimal levels.

In Norway, the general adult population shows relatively healthy diets and sufficient nutritional status, although there is room for improvement. The Norwegian National Public Health Survey of 2020 [31] revealed that adherence to dietary guidelines for fruits and vegetables, fish, and whole grain products was relatively low (2.3%, 42%, and 45%, respectively). Men had slightly lower diet quality than women, and young adults showed higher intake of unhealthy foods like SSB and confectionaries. Enhancing the intake of fruits, vegetables, whole grains, and fish, while reducing candy/snacks/pastries and SSB consumption, can positively impact health.

Unhealthy diets contribute significantly to noncommunicable diseases (NCDs) [30]. In 2017, dietary risk factors were attributable to 11 million deaths and 255 million disability-adjusted life years [30], with high sodium intake and low whole grain and fruit intake being major contributors. NCDs develop over time due to various factors and exposures. The WHO Global Health Observatory identified four preventable risk factors underlying most NCDs: tobacco use, physical inactivity, unhealthy diet, and harmful alcohol consumption [32]. A systematic overview of reviews indicates that a healthy diet and physical activity provide the strongest protection against selected risk factors for five NCDs (cancers, coronary heart disease, stroke, diabetes mellitus, and dementia) [33].

1.3 Preconception nutrition

In broad terms, preconception nutrition refers to the nutrition status of reproductive men and women before conceiving their first child, encompassing the period from sexual maturation in puberty to conception. Table 1, based on Stephenson, Heslehurst [34], provides definitions of the preconception period from three perspectives: biological, individual and public health.

Table 1. Defining the preconception period.

The preconception period	Definition
The biological perspective	"From a biological perspective, a critical period spans the weeks around conception when gametes mature, fertilisation occurs, and the developing embryo forms" [34].
The individual perspective	"In relation to an individual, the preconception period starts whenever a woman or couple decides they want to have a baby because the time to conception is unknown" [34].
The public health perspective	"From a public health perspective, the preconception period can relate to a sensitive phase in the lifecourse, such as adolescence, when health behaviours affecting diet, exercise, and obesity, along with smoking and drinking, become established before the first pregnancy" [34].

The significance of preconception health and nutrition was emphasized and summarized in The Lancet series on preconception health [34-36], which called attention to the need for intervention strategies to enhance nutrition and health behaviours before conception. The series also advocated for a social movement aimed at supporting and enhancing preconception health.

This thesis particularly focuses on the public health perspective of preconception health. It recognizes this phase as formative and sensitive in the lifecourse, as it sets the foundation for long-term health and lifestyle behaviours that can significantly influence the prospect of future health.

1.3.1 Brief description of biological mechanics in preconception nutrition

The body of evidence explaining the biological processes underlying the inter- and transgenerational effects of preconception nutrition through the DOHaD framework is comprehensive and beyond the scope of this thesis. While studies exploring human DNA/genome and gene-diseases associations do exist [37], animal models serve as primary tools to investigate the connections between environmental exposures and the transmission of effects to future generations. The use of animal models is advantageous due to their fast generational turnover and the feasibility of conducting controlled experimental studies [35, 38, 39].

Some of the proposed biological processes elucidating the impact of preconception nutrition on offspring health include epigenetic mechanisms (alterations in gene expressions), cellular mechanisms (factors influencing the cellular environment), metabolic mechanisms (metabolic regulators affecting the oocyte), and physiological mechanisms (affecting embryo potential) [35].

1.3.2 The public health preconception perspective

The duration of the preconception period, from a public health perspective, is characterised by large individual variation, given that the age at which people reproduce may occur as early as adolescence for some, whereas others have their first child in midlife or even as older adults. Data from various sources sheds light on this variation. For instance, in 2019, the mean age of women at the birth of their first child was 28.2 years across the 50 member countries of the United Nations Economic Commission for Europe, with Kyrgyzstan reporting the youngest age of 22.6 years and Andorra the oldest at 32.8 years [40]. Within the EU, the mean age of women at first birth in 2021 ranged from 26.5 years in Bulgaria to 31.6 years in Italy and Spain, with an overall age of 29.7 years [41]. In Norway, mothers' mean age at first birth was 30 years, while fathers were around 32 years old in 2021 [42]. Based on the timing of puberty [43, 44] and mean age at first birth in the Norwegian population, this implies a preconception period that typically extend from 17 to 20 years.

Notably, women with unintended pregnancies miss the opportunity to prepare for pregnancy during different preconception periods (as depicted in table 1), preventing them from harnessing potential health benefits for both maternal and offspring health. Globally, unintended pregnancies have been estimated to account for as much as 48% (46-51) among all pregnancies in 2015-19 [45]. In Norway, a prospective cross-sectional study from 2008-10 reported that more than one in five pregnancies (21%) were unintended [46]. The high prevalence of unintended pregnancies underscores the importance of focusing on the public health preconception perspective, as nearly half of all pregnancies worldwide miss the opportunity for potential health benefits that interventions during the individual and biological preconception periods could bring. This reinforces the need for long-term preventive measures in the public health preconception perspective to mitigate adverse diet and lifestyle behaviours and the development of NCDs.

Two key preconception behaviours relevant to the public health perspective are: weight management to prevent overweight and obesity, and the consumption of 5-a-day servings of fruits and vegetables, both linked to the prevention of NCDs [30, 32]. Emphasizing these lifestyle behaviours is crucial, as preventing NCDs proves to be significantly more effective than treating them [47], especially in the short term before conception, as it can impact both maternal and offspring outcomes and overall health trajectory.

Current state of preconception nutrition

The public health preconception nutrition perspective covers diet and nutrition from puberty to the first conception, encompassing adolescence (10-24 years of age) as a part of the preconception period. Given the lack of comprehensive data on preconception diet and diet quality, research on adolescents and young adults provide insight into the current state of preconception diet. Studies have highlighted a lack of objective, comparable and high-quality data on adolescent nutrition [48], indicating an underinvestment in nutrition during adolescence compared to other age groups, keeping nutritional problems invisible [49, 50].

As mentioned above, the GBD study in 2017 found suboptimal consumption of healthy foods and nutrients among adults aged 25 years or older, while unhealthy foods and nutrients exceeded optimal levels [30]. Another study, by Miller, Webb [29], revealed a global J- or U-shaped relationship between the diet quality score and age, with the highest scores observed in the young (≤5 years) and/or old (≥75 years) age groups for most regions. This was also evident in high-income countries, reaching a 30-point decline in diet quality score from birth to approximately age 17, before gradually improving from age 20 and onwards.

A study covering nutrition and dietary patterns from 1990-2015 found that most adolescents globally consumed insufficient amounts of fruits and vegetables, while consuming alarmingly high levels of sodium, sugar, solid fat, and added sugar [48]. Similarly, a systematic review in 2020 on dietary guideline adherence during preconception showed that women did not achieve the daily recommended intake for vegetables and cereals [51]. The most frequently achieved recommendation was observed for dairy intake.

Western Europe reflected the global dietary trends observed in the GBD study. However, intakes of healthy foods were higher for milk and calcium consumption, but legume and whole grain consumptions were lower. The consumption of red meat, processed meat, and SSB were close to double that of global intakes [30]. Suboptimal diet quality scores in adolescents and young adults have been reported in the UK (age: 13-30, mean DASH-score: 35/80) [52], US (age: 16.5 with 4-year follow-up, mean HEI-score at 4th follow-up: 45/100, 2010-2014) [53], US (age: 18-39, HEI-score: 56/100, 2011-2014) [54], and Belgium (age groups: 19-25 and 26-39 years, FSAm-NPS-DI-score: 58.1/100 and 58.5/100, 2014) [55]. In the UK, 91% of women aged 18-25 years old and 70% aged 26-30 years reported eating fewer than five portions of fruits and vegetables per day [34].

Norwegian dietary surveys have reported similar trends, with young adults exhibiting suboptimal diets. The Norkost 3 nationwide dietary survey in 2010-11 among adults aged 18-70 years [56] revealed that while nutrient intakes generally aligned with the Norwegian dietary recommendations, there were lower-than-recommended intakes of fruits and berries, whole grain, and fish. Negative trends were apparent for young adults, showing increased intake with age for potatoes, fruits/berries, and fish, and a decrease by age for SSB and snacks. This trend extended to a study reflecting the public health preconception perspective, with younger age groups (18-24 and 25-35) scoring the lowest for fruits, vegetables, and fish intake. Young adults reported higher consumption of red meat (during dinner), salty snacks, and SSB than older adults, with men reporting more frequent consumption of red meat and SSB than women [31]. In a 2020 cross-sectional dietary survey of university students (mean age of 23.5 years), diets were found to be suboptimal compared to Norwegian guidelines, with lower-than-recommended intakes of fruit, vegetables, oily fish, whole grains, folate, iodine, and iron [57]. A 2018 study analysing dietary trajectories in adolescents and young adults (14 to 30 years) from the Norwegian Longitudinal Health Behaviour Study indicated a J- or U-shaped relationship with age, consistent with findings by Miller et al. [58]. Fruit and vegetable intake declined from age 14 through the early 20s before gradually increasing toward age 30. Conversely, there was an opposite trend for SSB consumption and, to a lesser extent, confectionary.

1.3.3 Recommendations during preconception

Table 2 presents selected preconception nutritional behaviours contextualized within preconception perspectives for young women, comparing current and optimal behaviours for high-income countries. Stephenson, Heslehurst [34] suggests intervening from a public health perspective to achieve optimal levels of weight loss and consuming 5-a-day, whereas optimal levels of folic acid supplementation and alcohol consumption can be attained through intervening from an individual and biological perspective (Table 1).

A study by Shawe, Delbaere [59], investigating preconception care policies, guidelines, recommendations and services in six European countries, revealed that all countries had recommendations for women with chronic diseases, but guidance for healthy women was fragmented and inconsistent, and limited attention was given to men. Advice on preconception nutritional largely align with healthy eating guidelines. To the best of my knowledge, there are no specific national recommendations relating exclusively to the public health preconception perspective. Generally, preconception health recommendations target those planning a pregnancy, advising them to adhere to 5-a-day fruit and vegetable consumption, abstain from alcohol, quit smoking, take iodine and folate supplements, and manage weight.

The Norwegian Directorate of Health advises women to avoid alcohol, start taking folate and iodine, refrain from using tobacco products, and review their medication before getting pregnant, aiming to establish good habits and provide the baby with the best start in life [60].

Table 2. Recommended time to intervene by months and preconception period to achieve optimal preconception nutrition behaviours in young adult women, based on typical levels from Norwegian women.

Preconception nutritional behaviours	Time to intervene before conception, months	Preconception period	Typical levels of young adult women (optimal behaviour), %
Weight management	24-36	Public health perspective	45-47* (0) [31, 61]
Eating 5-a-day	12-24	Public health perspective	3.5† (100) [31]
Taking folic supplement	3 (or decision for pregnancy)	Individual and biological perspective	20 (100) [31]
Drinking alcohol	2.5	Individual and biological perspective	70-84 (0) [62-64]

Description of the typical levels of preconception behaviours in Norwegian women, and the optimal behaviours before conception, inspired by Stephenson, Heslehurst [34]. Eating 5-a-day relating to the dietary recommendation of consuming five portions of fruits and vegetables per day. *proportion of overweight and obesity. †females ages 18-92 years.

1.4 DOHaD knowledge

Translating the academic knowledge of DOHaD to the public, with a focus on emphasising the importance of health and nutrition during the preconception period, has the potential to impact the health and disease development of both the current and future generations [65, 66]. Efforts to communicate the concept of DOHaD and the role of nutrition to the public have yielded positive results.

For instance, a LifeLab intervention study in Southampton found that school-aged teenagers exposed to an intervention focusing on the long-term implications of their current diet and lifestyle and an introduction to DOHaD concepts retained a greater understanding of the DOHaD concept 12 months after the intervention [67]. However, the change in understanding and knowledge of DOHaD concepts did not necessarily translate into sustained behaviour changes in diet or exercise levels. Similarly, an educational intervention among New Zealand adolescents successfully increased their understanding of the link between maternal diet during pregnancy and the long-term health of the fetus in adulthood [68].

A study conducted in 2018 assessed DOHaD awareness in undergraduate students enrolled in health professional training programs in New Zealand and Japan. The study revealed that students typically had little awareness of "DOHaD" upon entering the programs, but that DOHaD-specific training in their first year positively correlated with increased awareness over time [69]. However, the study also highlighted that awareness of the paternal impacts before conception and nutritional exposures during pregnancy, related to later-life health, remained less than optimal.

In Australia, an exploration of public knowledge found that while the concept of DOHaD was relatively better understood than the first 1000 days or epigenetics, overall understanding of DOHaD remained low [70]. A 2020 survey of pregnant Canadian women revealed that DOHaD knowledge was positively associated with diet quality, even after accounting for sociodemographic factors [71]. These findings suggest that translating the theory and evidence of DOHaD could not only enhance the knowledge of DOHaD, but potentially also lead to improved diet quality.

1.5 Dietary assessment

Dietary assessment is an essential component of nutritional epidemiology, with human diet as the exposure of interest [72]. Interactions and synergies across different dietary components make dietary intake a complex behavioural exposure. Techniques to assess dietary intake have been developed, targeting different dietary aspects (habitual diet, dietary patterns, foods or nutrients), each dietary assessment method with its own sets of limitations and unique strengths [73].

1.5.1 Dietary assessment methods

One way to classify dietary assessment methods is to divide them into objective and subjective methods.

Objective dietary assessment methods

Objective methods are employed to measure specific dietary aspects accurately. These methods can be classified into three categories: (i) direct observation, where researchers observe what and how much individuals consume; (ii) duplicate diets, where participants prepare and consume identical portions of food for chemical composition analysis; and (iii) biomarkers, which involve analysing biological specimens to reflect dietary exposure [74].

The primary strength of objective methods lies in their independence of participants' cognition or memory. However, they do have some limitations. They can be intrusive, demanding more effort from participants, resulting in increased burden. Moreover, they are usually expensive and may not be practical for large-scale studies [75]. Objective dietary assessment methods were not utilized in this thesis and, therefore, will not receive further focus in this section.

Subjective dietary assessment methods

Subjective dietary assessment methods rely on individuals' self-reporting their past or present food intake. This is one of the key limitations of subjective methods, that the dietary assessment relies on the individual's memory, conceptualisation, or perception of food intake, potentially introducing human error.

Subjective dietary assessment can be divided into retrospective and prospective methods (Table 3), both with different strengths and limitations.

Retrospective dietary assessment methods

Retrospective methods assess diet backwards in time, varying from the last 24 hours to a lifetime. Commonly used retrospective methods are the 24-hour dietary recall (24HR) and food frequency questionnaires (FFQ) [76]. Other methods, such as a diet screener and diet history, are less common. Methodological strengths and the degree of respondent burden depend on the method used [77]. Retrospective methods can be used to assess detailed short-term dietary intake (24HR) and habitual long-term intake (FFQ). However, retrospective methods are generally susceptible to recall bias due to participants' memory [76].

Table 3. Description of subjective dietary assessment methods.

		24HR	Food record	FFQ	Dietary screener
		Subjective dietary assessment methods			
Study design applicable	Cross-sectional	✓	✓	✓	✓
	Retrospective			✓	✓
	Prospective	✓	✓	✓	✓
	Intervention	✓		✓	✓
Direction of assessment	Prospective		✓		
	Retrospective	✓		✓	✓
Dietary assessment	Total diet	✓	✓	✓	
	Specific components			✓	✓
Time period of assessment	Short	✓	✓		
	Long			✓	✓
Inherent type of measurement error	Random	✓	✓		
	Systematic			✓	✓
Time requirement	>15 min	✓	✓	✓	
	<15 min				✓
Memory requirement	Generic			✓	✓
	Specific	✓			
	Does not require		✓		

Abbreviations: 24HR, 24-hour dietary recall; FFQ, food frequency questionnaire. Dietary assessment methods not used in the papers comprising the thesis are shaded. Inspired by National Institutes of Health [77].

Dietary screener

A dietary screener is a short questionnaire aiming to measure a limited number of foods or nutrients, typically for the last month or year [78-80]. Dietary screeners are similar to short FFQs, often employing a non-quantitative design, that is, without querying about portion sizes. They can be self-administered or interviewer-administered, and typically takes less than 15 minutes to complete [78, 80].

Methodological strengths of the dietary screener are the low respondent burden and investigator cost. Moreover, dietary screeners do not lead to reactivity bias by participants changing their eating behaviour as a result of monitoring their diet [79]. Disadvantages of the dietary screener include its inherent systematic error, relying on generic memory to remember dietary intake, and that it can be cognitively difficult to complete (particularly if portion size are included) [78-80]. Furthermore, dietary screeners only measure a limited number of dietary components, and the pre-specified food list may not reflect eating patterns across populations.

FFQ

The food frequency questionnaire, like the dietary screener, consists of a closed food list and a frequency response section. It queries about frequency of consumption for food items (e.g., tomato) or food groups (e.g., vegetables), typically per day, week, month, or year [79]. The range of food items and frequency categories may vary according to its objective, whether it aims to assess usual/habitual diet or specific nutrients. However, generally, an FFQ includes between 50 and 150 food items [79], requiring more time to complete than a dietary screener (Table 3). The semi-quantitative FFQ design uses a combination of individual or standard/typical portion sizes to estimate food quantities [79].

The methodological strengths of an FFQ are similar to those of the dietary screener, having low investigator and respondent burden, low costs, and does not lead to reactivity bias [72, 79]. Limitations include inherent systematic error, relying on generic memory to remember dietary intake, the cognitive difficult task for participants to complete an FFQ, and difficulties in precisely reporting usual portion sizes which may lead to misreported intake estimates [79, 81].

24HR

The 24-hour dietary recall is an open-ended dietary assessment method. In this approach, respondents are asked to recall and report all the foods and beverages they consumed in the preceding 24 hours or the previous day [79]. The 24HR is often structures into meal occasions and employs specific prompts to aid participants in remembering their diet, such as inquiring about the use of sugar, sweetener, or creamer in coffee. Traditionally, the 24HR was administered through in-person or telephone interviews, but more recently, self-administered digital solutions have become available [79, 82, 83].

The 24HR offers several methodological advantages, including relatively low respondent burden, absence of reactivity, suitability for diverse population groups, facilitating cross-population comparisons, and the ability to estimate individual intake by assessing portion sizes through different quantification means [79]. However, disadvantages include the need for repeated measurements to capture individuals' usual intake, inherent random error, relying on short-term memory, and potential recall bias due to social desirability in reporting food intake (Table 3) [79].

Prospective dietary assessment methods

Prospective methods can enable real-time assessment of diet, often involving different types of food records. For instance, a weighed food record requires the participants to continuously weigh and record all their food intake over one or more days. These methods offer strengths such as independence from participants' memory and flexible data registration without limiting food items [79].

However, prospective method also come with limitations, which vary depending on the specific approach used. Food records, for example, can lead to relatively high respondent and researcher burden, potentially causing reactivity or participant drop out. Additionally, they tend to be time-consuming and expensive [79].

Web-based dietary assessment

With the growing accessibility of the Internet, dietary assessment has witnessed a shift from traditional instruments like paper-based questionnaires and interviewer-based recalls to web-based digital solutions [84, 85]. Traditional methods impose a higher demand on both the participants and the researchers [83], relying on postal services or scheduled phone calls/interviews for data collection and manual data processing, resulting in time-consuming and costly procedures.

In contrast, digital solutions offer several advantages. Participants can access the dietary assessment methods conveniently, and data can be automatically processed, streamlining the overall process and reducing costs [85, 86]. Digitalization of dietary assessment has brought about increased efficiency and accessibility while alleviating the burdens associated with traditional methods.

1.5.2 Portion size estimation

Quantifying portion sizes is a challenge when relying on subjective methods. Estimating portion size depends on participants’ memory and recollection, leading to considerable variation in misestimation. Consequently, this variability becomes a major contributor to errors in measuring dietary intake [81, 87].

To address this issue, various portion size estimation tools have been developed. Semi-quantitative FFQs commonly utilize standard portion sizes or offer a range of options (e.g., small, medium, or large) to quantify food intake. In the 24HR method, different tools are employed to quantify intake, such as standard portion sizes, household measures (e.g., utensils, cups, decilitres, etc.), portion size image-series or food atlases, and allowing participants to enter portion size weight in grams.

A review of different portion size estimation tools revealed that digital images were more accurate compared to food models and household utensils [87]. This suggests that utilizing digital images can potentially improve the accuracy of portion size quantification.

1.5.3 Indices or scores of diet quality

Diet quality indices or scores are valuable tools for dietary pattern analysis, as they condense multiple dietary variables into smaller sets of independent components, reducing redundancy while retaining information. By simplifying the dietary data and moving away from individual food items or nutrients, it facilitates a more straightforward analysis and allows for inferences to be drawn about the total diet [79].

A diet quality index or score can be established based on a priori criteria for a healthy diet, such as existing dietary recommendations or well-known healthy dietary habits [88]. They rely on underlying dietary variables, which may be derived from quantitative intake, frequency of intake, or reported counts of food groups obtained from short- or long-term dietary assessment instruments [79].

Diet quality indices or scores have been developed to reflect different aspects of diet. Some examples include:

- Healthy Eating Index (HEI), designed to infer the overall diet quality [89].
- Mediterranean Diet Score (MDS), reflecting a specific dietary pattern [90].
- Dietary Approaches to Stop Hypertension (DASH), aimed at preventing chronic diseases [91].
- The WELL diet score, measuring diet quality based on frequency of intake [92].

1.5.4 Validation of dietary assessment methods

Validation studies are essential for assessing the accuracy of dietary assessment method and their ability to measures what they claim to measure [75]. The validation process involves evaluating the degree of variation between the estimated value and the true value, which can be expressed as “estimated value = true value + total error” [93].

There are two main approaches to validation: absolute validation and relative validation.

The absolute validation approach validates a subjective dietary assessment method using an unbiased objective reference method [75]. In this case, the emphasis is on the agreement between methods based on the specific phenomenon they measure, such as nutrients or the total energy expenditure. For example, protein intake measured by 24HRs can be compared with a recovery biomarker measuring the excretion of urinary nitrogen in 24-hour urine samples to evaluate absolute validity. Another example would be to assess portion size estimation accuracy by comparing a portion size estimation tool with the actual portion size weights.

The other approach, relative validation, involves comparing a subjective test method with another biased or error-prone subjective reference method that is considered more accurate [75]. In this thesis, the focus is on the association between the methods and their ability to rank individuals in the same order. For instance, assessing the relative validity of a dietary screener (test method) by comparing it with a more comprehensive tool like an FFQ, multiple 24HRs, or a weighed food record (reference method).

1.6 Research gaps and challenges

Research on preconception nutrition has previously predominantly focused on females and individuals planning pregnancy. A systematic review assessing adherence to dietary guidelines during preconception (and pregnancy) found that only five studies reported diet and nutrient intake during preconception, and none of them included male participants [51]. However, emerging evidence indicates that not only maternal but also paternal preconception nutrition can influence offspring outcomes [35, 38, 94]. As a result, there is a growing call for the inclusion of men in preconception nutrition studies [17, 18]. Moreover, studies should broaden their focus beyond those planning pregnancy and explore the potential health benefits of preconception nutrition from a public health perspective, encompassing all people of reproductive age, regardless of pregnancy planning.

There is a pressing need to incorporate nutrition within the three preconception perspectives in public health policies. Targeting modifiable behaviours such as nutrition is a crucial strategy to effectively alleviate the development and burden of NCDs. Furthermore, this will benefit future generations, considering the evidence of intergenerational transmission of NCD risk factors. The observation of J- or U-shaped trends in suboptimal diet quality prevalent among adolescents and young adults underscores the need for preventative measures. Furthermore, longitudinal and frequent collection of dietary data from adolescence continuing into early adulthood should be prioritised to track dietary behaviour trajectories

[95]. These data will help to identify targeted interventions to improve preconception nutrition from a public health perspective.

The concept of DOHaD is increasingly recognized as an approach to reduce the burden of NCDs. However, there is currently a lack of a clear strategy to use and implement the DOHaD concept into action. Furthermore, there is a scarcity of public understanding and knowledge of the DOHaD approach. Exploring public perceptions of this concept could enhance the understanding of how nutritional behaviour impacts both individual and next-generation health. Emphasising the importance of health and nutrition in the preconception period, not only during pregnancy and early childhood, as highlighted by DOHaD, presents unexploited opportunities for public health actions in policy and government initiatives at the population level.

2 Aims and objectives

This thesis is part of the PREPARED project (Fig. 2), a digital dietary intervention study targeting preconception young adult men and women in Norway. The project aims to intervene during the preconception period of young adults to promote healthy dietary habits and achieve adequate nutritional status, ultimately achieving a triple dividend: short-term health, long-term health, and the health of the next generation.

The overall aim of this thesis was to plan and establish the basis for the PREPARED project, with a specific emphasis on validating dietary assessment methods to be utilized throughout the entire project, while also conducting a specific analysis of DOHaD knowledge and diet quality on the baseline data.

To achieve the aim, four specific objectives had to be achieved:

1. Develop a study protocol outlining the research process for the PREPARED project (Paper I).
2. Develop digital food item image-series to aid portion size estimation accuracy in a 24-hour dietary recall system to be used in PREPARED project, and validate their accuracy by comparing them with pre-weighed food portions (Paper II).
3. Validate a dietary screener against a semi-quantitative FFQ for rapid dietary assessment in the PREPARED project (Paper III).
4. Assess preconception young adults' DOHaD knowledge and diet quality, and the association between the two, using the baseline data from the PREPARED study (Paper IV).

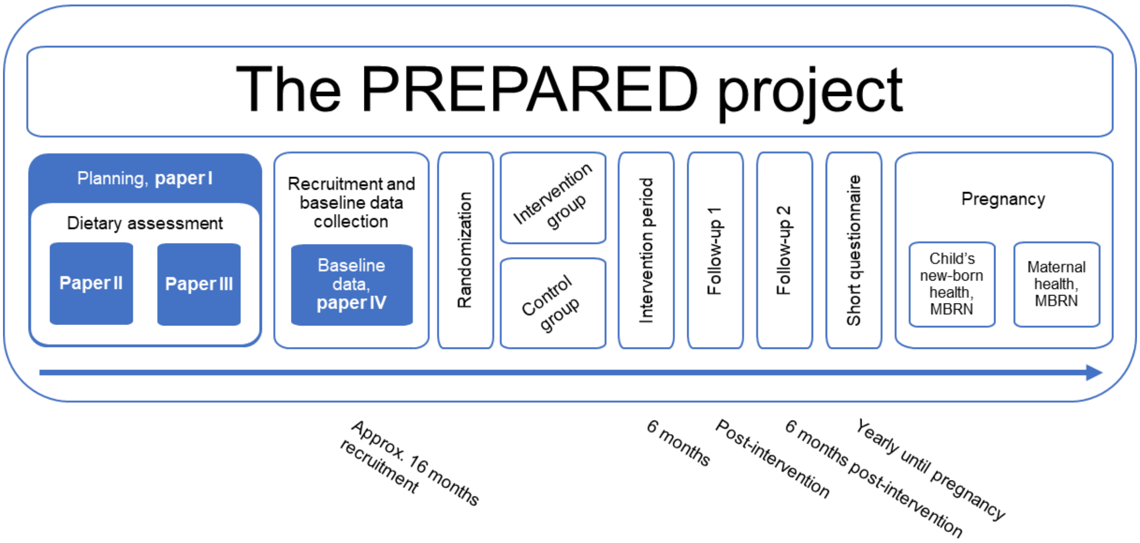


Figure 2. Schematic of the PREPARED project with thesis Papers I-IV indicated. MBRN, Medical Birth Registry of Norway.

3 Methods

The methods chapter is structured into four sections. First, section 3.1 provides a brief description of the PREPARED digital dietary intervention. Second, section 3.2 outlines the study designs featured in the included papers. Third, section 3.3 details the methodological approaches that respond to the overall aim and objectives of the thesis, with a specific focus on the DOHaD-knowledge questionnaire and the dietary assessment methods ("myfood24" and the dietary screener). Finally, section 3.4 includes ethical statements pertaining to the included papers. Components of the PREPARED project beyond baseline data collection are not included in this section of the thesis (details in Paper I).

3.1 The PREPARED digital dietary intervention (Paper I)

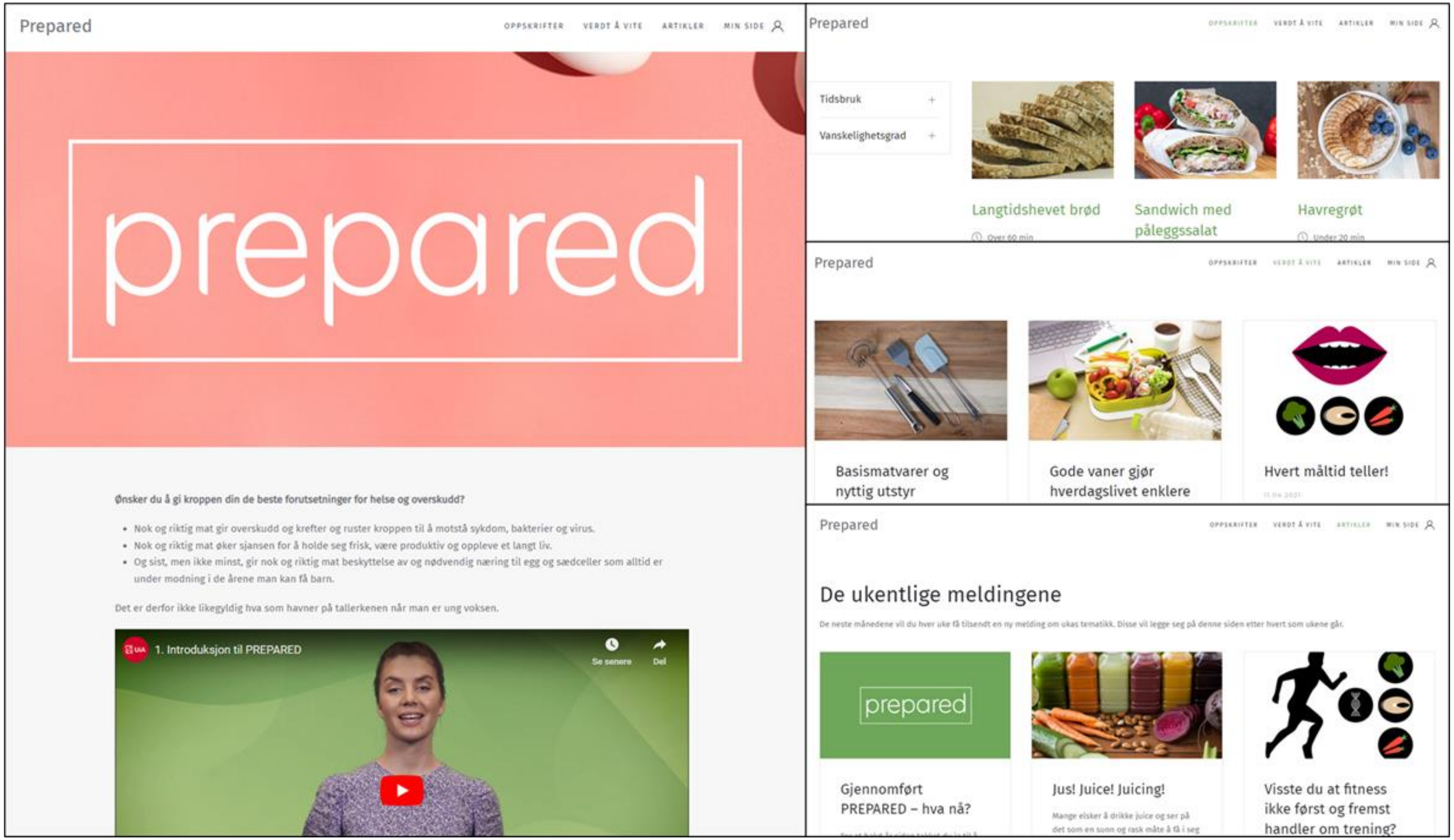
Before initiating the development of the dietary intervention, 34 short interviews were conducted with young adult men and women [2]. These interviews informed the approach to behaviour change, content, and delivery of the intervention.

The 6-month digital dietary intervention was designed as a webpage that emphasised the potential triple dividend of healthy eating through engaging informational videos and texts (Fig. 3). The practical information covered food groups, nutrients, meal habits, preconception nutrition, illustrated recipes, and weekly features encompassing various dietary aspects. This comprehensive approach aimed to inform and empower participants to successfully implement the intervention content.

Throughout the development process, the intervention content was closely aligned with the official Norwegian dietary recommendations and was rooted in the principles of the Self-Determination Theory [96]. By focusing on the participants' autonomy, competence, and relatedness, the intervention aimed to foster lasting behaviour change.

To maintain participant engagement and progression, they received new content on a weekly basis through email notifications during the 26-week intervention period.

Figure 3. Visual depiction of the PREPARED intervention webpage, featuring the front page on the left and information divisions titled "Recipes," "Worth knowing," and "Weekly features" on the right (descending order).



3.2 Study designs of the included papers

The thesis includes four papers, all based in the PREPARED project, consisting of a study protocol for the PREPARED study "Effectiveness of a digital dietary intervention program targeting young adults before parenthood: protocol for the PREPARED randomized controlled trial" (Paper I), two dietary assessment validation studies informing the PREPARED study (Papers II and III), and a cross-sectional study based on the baseline dataset of the PREPARED study (Paper IV). A methodological overview of the included papers is summarised in table 4 and shortly commented below.

Study design

Paper I is a protocol paper describing the theoretical background, rationale, development of the digital intervention, recruitment strategy, and sample size calculations for the PREPARED project. The target population of the PREPARED project was young adult men and women.

Paper II is a validation study describing the development and absolute validation of food item image-series compared to pre-weighed food portions to aid portion size estimation in the digital dietary assessment system "myfood24". The study targeted a young adult population.

Paper III is a validation study describing the relative validation of the rapid dietary assessment screener "MyFoodMonth 1.1" compared to a semi-quantitative FFQ. The target population of the study was new first-year university students.

Paper IV is a cross-sectional study describing preconception young adults' knowledge of DOHaD, diet quality, and the potential association between these factors. The study utilizes baseline data from the PREPARED study.

Sampling and recruitment strategies

Convenience sampling was employed as recruitment method for all three study samples in this thesis (Paper I, II, and III). For participants in the PREPARED study (Papers I and IV), recruitment was exclusively conducted through social media channels. In contrast, the two dietary assessment validation studies (Papers

II and III) adopted a multifaceted approach that included social media, posters and flyer distribution, and recruitment among colleagues and university students.

Inclusion and exclusion criteria

For enrolment in the PREPARED study (Paper I), participants had to meet the following criteria: be aged between 20-35 years, have no biological children, possess an 11-digit Norwegian social security number, be literate in Norwegian or a Scandinavian language, and have access to a smartphone or another digital device. Individuals with biological children were not eligible for participation.

To take part in the study outlined in Paper II, individuals needed to fall within the age range of 18-45 years, be literate in Norwegian, and be able to attend a session at the university campus. Those who had recorded their dietary intake during the past year were excluded, as it was assumed they possessed experience in estimating portion sizes.

In Paper III, eligible participants had to be 18 years or older, literate in a Scandinavian language, and enrolled as a first-year university student. Individuals who were not new first-year university students were excluded from this specific study.

Table 4. Methodological overview of the papers included in the thesis.

	The PREPARED study		**Dietary assessment** (methodological studies informing the PREPARED study)	
	Paper I	**Paper IV**	**Paper II**	**Paper III**
Study design	Protocol for a randomised controlled trial	Cross-sectional	Validation study	Validation study
Target population	Young adult men and women		Young adults	New first-year university students
Inclusion criteria	Individuals born in the years 1986-2001; no biological children; have an 11-digit Norwegian social security number; literate in Norwegian or Scandinavian; access to a smartphone or another digital device		Individuals between 18-45 years; literate in Norwegian; campus based, Kristiansand	Individuals 18 years or older; literate in Scandinavian language; UiA student
Exclusion criteria	Individuals with biological children		Individuals who recorded their diet during the last year	Non new first-year students
Recruitment strategy; duration	Convenience sampling; October 2021-January 2023		Convenience sampling; October-November 2019	Convenience sampling; August -October 2020
Instrumentation	Background questionnaire, health-related behaviour questionnaire, QoL	Background questionnaire, DOHaD knowledge questionnaire,	A questionnaire including background questions and	Background questionnaire (sex, age, height, weight,

	questionnaire, DOHaD knowledge questionnaire, "myfood24", dietary screener	dietary screener	image-series to estimate portion sizes	and parental education), dietary screener, FFQ
Setting (country; location)	Norway; web-based		Norway; university kitchen facilities	Norway; web-based
Data collection; duration		All data collected digitally; October 2021-January 2023	Portion size estimation in real time; November 2019	All data collected digitally; September-December 2020
Outcome	*Planned PREPARED outcomes:* preconception diet, health-related QoL, maternal pregnancy health, and neonatal health	*Study outcomes:* $DOHaD_{KNOWLEDGE}$, diet quality, and association between the two	Portion size estimation accuracy	Concordance and ranking ability of the dietary screener

Abbreviations: UiA, University of Agder; FFQ, Food Frequency Questionnaire; 24HR, 24-hour dietary recall; QoL, Quality of Life; $DOHaD_{KNOWLEDGE}$, Developmental Origins of Health and Disease-knowledge.

3.3 Data collection methods

The following section describes the data collection methods used in this thesis, focusing on the development of the DOHaD knowledge questionnaire and the dietary assessment validation studies.

3.3.1 Questionnaires (Papers I and IV)

In the PREPARED study, a series of questionnaires were developed to capture background information and outcome factors. These questionnaires assessed the following aspects:

- Background questionnaire (gender, ethnicity, socioeconomic status, education, area of residence, family structure, having been breastfed as a child, birth weight of the participant, height, current weight, and whether they are currently trying to conceive)
- Health-related behaviour questionnaire (sleep, physical activity / sedentary behaviour / screen time, and use of tobacco products)
- Quality of life questionnaire
- DOHaD knowledge questionnaire

DOHaD knowledge questionnaire (Papers I and IV)

The DOHaD knowledge questionnaire was designed to assess participants' understanding of the evidence and theory related to DOHaD. It includes five statements measuring the participants' agreement with ideas about the long-term impact of parental and/or grandparental health and behaviour during periconception, prenatal, and perinatal periods on their children's health [71].

To quantify the level of agreement, the response categories were ordinally ranked and assigned corresponding values, with "strongly disagree" being assigned 0 points and "strongly agree" assigned 4 points. The data was then recoded into a 5-point $\text{DOHaD}_{\text{KNOWLEDGE}}$ Likert scale rating system. The scale ranged from 0 points, indicating limited knowledge about the evidence or theory of DOHaD, to 20 points, representing a high level of understanding and knowledge of DOHaD.

3.3.2 24-hour dietary recall "myfood24" (Paper I)

To assess the participants' intake of foods and nutrients in the PREPARED study, the dietary assessment system "myfood24" was employed, enabling the collection of detailed nutritional data linked to the Norwegian food composition table. Developed in Leeds, UK, in 2015, “myfood24” is a web-based dietary assessment system [82]. Its name, short for “measure your food on one day”, reflects its application as both a 24HR and a food diary, following three basic steps: (1) the participant searches for a specific food or beverage item in the built-in database, (2) the portion size consumed is quantified, and (3) the researcher downloads a data file containing the participants’ food and nutrient intake [97].

Currently, the “myfood24” system is available in England, USA, Germany, Denmark, France, Middle East, Australia, Caribbean, Peru, West Africa, and Norway [1, 98]. The “myfood24” 24HR has been validated against interview-administered 24HR, weighed food records, and biomarkers, showing moderate to strong correlations for energy intake and nutrients in relative validations, and moderate to good agreement with potassium and protein from 24-hour urine samples, respectively [99, 100].

In 2019, the research group Lifecourse Nutrition at UiA developed a Norwegian version of “myfood24” [1]. This version includes a built-in database comprising of 1727 food and beverage items [101-105].

Development and validation of food item image-series to aid portion size estimation (Paper II)

In an effort to enhance the accuracy of the dietary assessment system “myfood24”, digital food item image-series were developed for traditionally and frequently eaten Norwegian foods. These image-series were designed to help participants accurately estimate portion sizes.

The selection of food items for the image-series was based on our knowledge of Norwegian food culture and previously used image-series [56, 106]. The chosen food items had to meet two essential criteria: (a) be available in the Norwegian food composition table and (b) be applicable as a proxy for similar foods (e.g., using the image-series for “müesli” as a proxy for other breakfast cereals). Each image-series comprised seven images displaying increasing portion sizes. To ensure accuracy, several factors were considered, including:

(1) One of the middle portion size images (image 3-5) representing an approximate of the Norwegian or Swedish standard serving size [105, 107].
(2) The smallest and largest portion size images depicting portion sizes within a plausible range.
(3) The quantity of food packaging or container was considered, when appropriate.
(4) A fixed percentage weight increment was used, except when criterion (3) applied (e.g., using the content of a stew can as the largest portion size image). In the case of bread, a fixed weight increment in grams was applied to include the Norwegian standard servings for thin, medium, and thick slices (image 3, 4, and 5).

Figure 4. Examples of the image-series (a) “Stew”, (b) “Strawberry jam” and (c) “Candy with chocolate” developed to aid portion size estimation accuracy. The letters a-g indicate portion size from smallest to largest.

To ensure precision, two identical kitchen weights were utilized to measure the correct portion sizes. Foods items were presented on plates or bowls “naturally”, without arranging them for aesthetic purposes. Cutlery served as a reference measure in most image-series, except for six (bread, kidney beans, peanuts, potato chips, candy, and candy without chocolate). In total, twenty-three digital food item image-series were developed to aid portion size estimation (examples shown in fig. 4).

To assess the portion size estimation accuracy of the image-series, pre-weighed food portions were presented to study participants in real-time. Each food item from the image-series was presented twice: once with an identical weight relative to a portion size image and once with a weight altered by 25% of the differential to one of the adjacent portion size images. This simulated real-world scenarios where actual portion sizes might not perfectly match the depicted sizes (detailed in Paper II). Overall, 46 pre-weighed food portions were presented, with some having altered weights relative to a portion size image and others presented with different plates or bowls than depicted.

The perception approach was used to evaluate the validity of the newly developed image-series. This approach required participants to observe the pre-weighed food portions in real-time and utilize the corresponding image-series to estimates the portion sizes. The classification system of a participant's portion size estimation using an image-series relative to the actual portion size can be seen in fig. 5.

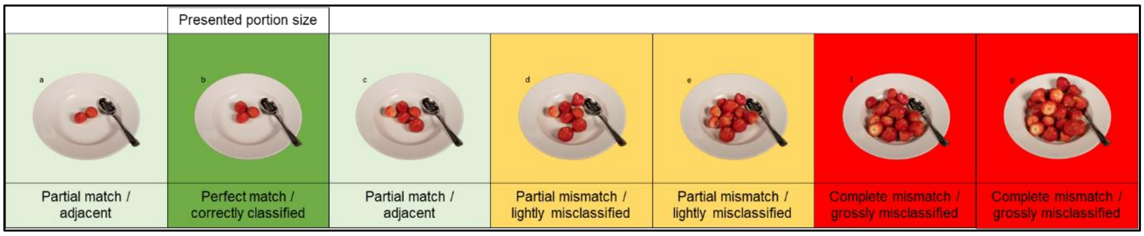


Figure 5. Colour-coded classification system of portion size estimates using the newly developed food item image-series.

3.3.3 Food frequency questionnaires (Papers I, III and IV)

To facilitate a rapid dietary assessment in the PREPARED project, the dietary screener "MyFoodMonth 1.1" was validated relative to a semi-quantitative FFQ.

The dietary screener "MyFoodMonth 1.1" (Papers I, III and IV)

In the PREPARED study, the dietary screener tool "MinMatMåned 1.1" (in English: "MyFoodMonth 1.1") was used to capture the intake frequencies of selected dietary aspects.

Developed by the UiA Lifecourse Nutrition research group in 2020, "MyFoodMonth 1.1" was based on a previous dietary screener's food list [108], but tailored to reflect a Norwegian food culture. The Norkost3 national dietary survey in Norway [56] was consulted to evaluate the included food items.

Unlike many other dietary assessment methods, “MyFoodMonth 1.1” employs a non-quantitative design. It does not involve portion sizes but instead assesses intake frequency per day, week, or month for the previous 30 days. The dietary screener was specifically designed to cover selected Norwegian dietary guidelines, dietary markers of interest, and to provide a rough estimate of iodine and calcium intake by assessing the main food groups: fruits and vegetables, whole grain, dairy, red meat, processed meat, fish, and sugary foods/beverages, as shown in Table 5.

Table 5. Dietary aspects the 33-item non-quantitative dietary screener "MyFoodMonth 1.1" was designed to cover.

Norwegian dietary guidelines	Eat at least five portions of vegetables, fruit and berries every day.
	Eat whole grain foods every day.
	Eat fish two to three times a week. You can also use fish as a spread on bread.
	Choose lean meat and lean meat products. Limit the amount of processed meat and red meat.
	Avoid foods and drinks that are high in sugar.
	Choose water as a thirst-quencher.
Nutrients	A rough estimate of calcium intake.
	A rough estimate of iodine intake.
Dietary markers of interest	Plant-based meat substitutes.
	Salty snacks.
	Fried potatoes / sweet potatoes.
	Alcoholic beverages.
	Sugary foods and drinks.

The "MyFoodMonth 1.1" dietary screener was divided into five sections (Paper III, Supplementary material 1). Section 1 consists of 33 food and beverages items, with participants indicating their intake frequencies using ten categories divided into *never, times per month, times per week,* and *times per day.* Section 2 inquires about the use of dietary supplements, while section 3 asks about weekly meal patterns. Section 4 checks if participant avoids certain foods, and section 5 allows participants to leave a comment.

The design of "MyFoodMonth 1.1" allows for dietary assessment using intake frequencies, enabling ranking of intake, and distinguishing between high and low intake. As it does not consider portion sizes, it was not intended to evaluate overall habitual diet, estimate total energy intake, or provide absolute values for macronutrients or micronutrients. Instead, the focus lies on capturing specific dietary aspects and their frequency of consumption in the PREPARED study.

Data processing of the dietary screener

The data processing of the dietary screener involved assessing three types of information for their ranking ability (detailed in Paper III):

(i) raw measures, in the format in which they were collected,

(ii) ordinal variables reflecting aspects of diet quality, and

(iii) a diet quality score (DQS).

<u>Aspects of diet quality</u>

Ordinal variables were created for selected health-related aspects of diet quality, facilitating a clear and straightforward presentation of the data (details in Paper III, Table 2). This approach aimed to reflect typical intake frequencies observed in a population and evaluate adherence to selected Norwegian dietary guidelines, and to account for low cell counts in food item intake frequencies. The aspects of diet quality were derived from one or more dietary screener food items. Intake frequencies were recoded to reflect the recommended intakes from the Norwegian dietary guidelines.

<u>Diet quality score (DQS)</u>

To evaluate diet quality, a DQS was developed using a weighted scoring system based on the health benefits associated with various intake frequencies (details in Paper III, supplementary file 3). The DQS was an adaptation of the WELL diet score [92], which has previously demonstrated a significant positive correlation with the Alternative Healthy Eating Index-2010 derived from a 127-item FFQ. The current DQS was based on nineteen food items in the dietary screener, divided into ten components: vegetables, fruits, whole grain (products), beans and lentils, fish, nuts and seeds (unsalted), sugar-sweetened beverages, sugary foods, meat (processed and red) and salty foods. Each component was scored on a scale from 0 to 10 points. For the first six components, a higher intake frequency resulted in more points. However, for the latter four components, a higher intake frequency resulted in fewer points as they were inversely scored. The total DQS ranged from 0 points (indicating low diet quality) to 100 points (indicating high diet quality).

Semi-quantitative FFQ (Paper III)

In Paper III, a semi-quantitative FFQ was utilized for the relative validation of the dietary screener. This FFQ was also developed by the Lifecourse Nutrition research group at UiA [109], inspired by a similar FFQ used in the assessment of dietary intake among adolescents in the Norwegian Mother, Father and Child Cohort Study [110].

The FFQ aimed to assess the habitual dietary intake of preconception young adults, covering 121 food and beverage items over a four-week period in retrospect. The FFQ includes standard portion size servings based on the Norwegian standard [107], which allows for dietary intake and nutrient calculations using the Norwegian Food Composition Table [111].

Harmonization of dietary data with the dietary screener "MyFoodMonth 1.1"

For the relative validation of the dietary screener, dietary data was harmonized by aggregating 98 food and beverage items from the FFQ into corresponding food items in the dietary screener (details in Paper III, Table 1). Calculated nutrient intakes for iodine and calcium were used to assess the ranking ability of the dietary screener's aspects of diet quality reflecting intake of iodine and calcium. The food groups "Plant-based meat substitutes" and "Nuts and seeds, unsalted" were not assessed in the FFQ, and therefore not included in the relative validation process.

3.4 Ethics

All procedures performed in the included papers involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The papers included in this thesis all obtained the required ethical approvals, as detailed in the respective papers and provided in the appendices (Appendix 3-9).

Participants were first provided information letters regarding their involvement in the PREAPRED study (Paper I and IV), Paper II, and Paper III (Appendix 10-12). This information allowed them to make informed decisions and give their consent.

Incentives were employed to encourage individuals to participate in the studies. These incentives included lottery of gift cards in the PREPARED study (Paper I), gift cards for all participants in Paper II, and a chance to win one of two iPhones in Paper III.

4 Results

The results chapter is structured into two sections. First, the study samples of the included papers are described in section 4.1, followed by summaries of the included papers (Paper I-IV) in section 4.2.

4.1 Study samples of the included papers

Table 6 provides a description of the three study samples featured in the thesis' papers. In Paper IV, the study sample consisted of participants from the baseline dataset collected during the PREPARED study, as outlined in Paper I. For Papers II and III, the study samples were from separate dietary assessment validation studies conducted to evaluate the tools established to inform the PREPARED project.

Table 6. Study samples in the PREPARED study and dietary assessment validation studies.

	The PREAPRED study	Dietary assessment validation studies	
	Papers I and IV (*n*=1362)	Paper II (*n*=41)	Paper III (*n*=172)
Females, %	88%	58%	66%
Age, years	27 (4) †	23 (21, 28) ‡	21 (19, 25) ‡
BMI (kg/m^2)	23.5 (21.5, 26.5) ‡	-	23 (20.9, 25.7) ‡
Level of education, %			
Higher education (university or college)	77%	63%	49% *
Other	23%	37%	51% *

† Mean (SD), ‡ Median (IQR), * Parental level of education. Level of education: Higher education (University or college ≤4 years and University or college >4 years). BMI, body mass index.

Initially, there were 1437 individuals who enrolled in the PREPARED study. However, 41 participants did not meet the inclusion criteria, and an additional 34 were excluded due to reasons such as duplicate registrations and participation in the pilot study. Moreover, participants who identified as a gender other than a woman or a man (*n*=6) were included in the descriptive characteristics but excluded from the analyses.

In Paper II, the study involved 41 participants who physically attended the dietary assessment validation study at UiA Kristiansand campus. Among these participants, ten (24%) had a background in food science or nutrition. All enrolled individuals were included in the analyses.

For Paper III, participants were part of study arm B in the cross-sectional dietary survey of students at UiA, known as “Students diet 2” (details in Paper III). Of the 344 eligible individuals, approximately half (165 participants) were excluded due to not completing the semi-quantitative FFQ. The remaining participants were included in the study analyses.

4.2 Summary of the included papers

Paper I

The aim of Paper I was to provide a detailed protocol paper for the PREPARED randomised controlled trial (RCT) and to outline an evaluation of the effectiveness of a digital dietary intervention targeting preconception young adults. The study aimed to enrol 7000 young adult men and women aged 20 to 35 in Norway, all without biological children, by utilizing social media platforms.

Participants were to be randomized into either an intervention or a control group. The intervention group were to receive a 6-month digital intervention through a website dedicated to promoting a healthy diet for the participants short- and long-term health, as well as that of the next generation. The primary outcome of the intervention is postintervention preconception diet, while the secondary outcomes include health-related quality of life and maternal pregnancy health and neonatal health.

The study employed a series of background questionnaires, including the DOHaD knowledge questionnaire. Diet was assessed using the dietary assessment tools 24HRs in “myfood24” and the dietary screener “MyFoodMonth 1.1”. To ensure comprehensive data collection, participant follow-ups are planned until the birth of their first child or a maximum of 20 years. For those who give birth, the study data will be linked to data on maternal and child perinatal outcomes from the MBRN.

Paper II

The purpose of the study was to develop new digital image-series for portion size estimation of traditional and frequently consumed foods in a Norwegian food culture, to assess the absolute validity of the image-series, and to evaluate potential differences in portion size estimation accuracy.

Twenty-three food item image-series were developed to aid portion size estimation in the web-based dietary assessment system “myfood24”. Forty-one individuals participated in the study, with 58% females, a median age of 23 years, 63% with higher education, and 24% having a food science or nutrition background.

The accuracy of portion size estimations using the image-series was assessed by comparing them with pre-weighed food portions. The results showed that, on average, 55% of the portion size estimations were perfect matches, 38% were partial matches, 6% were partial mismatches, and 0.5% were complete mismatches. The overall mean discrepancy was 2.5%, ranging from -33% to +105%. The ‘flat-slope phenomenon’ was observed, with the smallest portion size images tending to be overestimated (averaging 43%), while the largest portion size images were underestimated (by -21%).

Mann-Whitney *U* tests indicated that females tended to estimate portion sizes more accurately than males (p=0.019). There was little evidence of any other significant differences in portion size estimation accuracy.

Overall, most of the newly developed food item image-series for traditional and frequently eaten Norwegian foods performed satisfactorily using the perception approach to estimate portion sizes of pre-weighed foods. The validation study revealed image-series that performed badly, indicating the need for re-evaluation and revalidation to enhance accuracy.

Paper III

The overall aim of the study was to assess the relative validity of a non-quantitative dietary screener by using a semi-quantitative FFQ as the comparison. Specifically, the objectives were to assess the concordance and ranking ability for all single food items in the dietary screener; aspects of diet quality; and the DQS, and to assess differences in those above by sex.

Approximately half of the eligible sample was excluded due to not completing the FFQ, resulting in a final sample of 172 first-year university student participants. These individuals completed both the dietary screener and the FFQ. The participants had a median age of 21 years, with 66% females, and a median BMI falling within the healthy weight range. About 49% of the participants had higher education among their parents.

The analyses, utilizing Kendall's tau-b, revealed moderate-to-strong concordance for most of the raw measures (ranging from .20 to .79), all aspects of diet quality (ranging from .37 to .70), and all DQS components (ranging from .33 to .64). Weak concordance was observed for the raw measures "Cereal and porridge, sweetened" (0.23, 95% CI: 0.09, 0.38), "Tomato sauce" (0.20, 95% CI: 0.07, 0.31) and "Coffee/tea/iced coffee/iced tea with sugar/syrup/ honey" (0.30 ,95% CI: 0.20, 0.40). Concordance was generally similar between sexes, both for raw measures, aspects of diet quality, and DQS components.

To demonstrate the ranking ability of the dietary screener, a cross-tabulation with the aspects of diet quality from the dietary screener was crossed with the DQS and the calculated intakes from the FFQ. Additionally, box-and-whisker plots were produced to visualise the ranking ability of the dietary screener's intake frequencies with FFQ gram intakes, ensuring transparency of findings.

In conclusion, the relative validity of the non-quantitative dietary screener "MyFoodMonth 1.1" showed moderate-to-strong concordance and was considered satisfactorily in ranking ability for most raw measures, aspects of diet quality, and DQS components compared to an FFQ for both men and women in a young student population. The dietary screener presents a promising and rapid alternative to dietary assessment, particularly among hard-to-reach populations that are challenging to recruit using conventional methods.

Paper IV

The purpose of the study was to describe knowledge of the DOHaD approach (DOHaD$_{KNOWLEDGE}$) and the diet quality in a Norwegian preconception study sample; to assess whether DOHaD$_{KNOWLEDGE}$ was associated with diet quality; and to assess differences in those above by gender. DOHaD$_{KNOWLEDGE}$ was described using statements and a Likert type scale derived from the DOHaD knowledge questionnaire (detailed in Section 3.3.1). Diet quality was described as a DQS and aspects of diet quality derived from the dietary screener "MyFoodMonth 1.1" (detailed in Section 3.3.3).

The study included eligible participants from the PREPARED baseline dataset (n=1362). The mean age of the participants was 27 years, with 88% being women. Within the study sample, 50% of men and 34% of women had overweight, including obesity. Moreover, 9% reported having a non-Norwegian first language, and 77% had higher levels of education.

The mean DOHaD$_{KNOWLEDGE}$ score was 12 out of 20 points, indicating moderate DOHaD$_{KNOWLEDGE}$. Men tended to have higher proportion of extreme views ("strongly disagree", and "strongly agree") for all DOHaD$_{KNOWLEDGE}$ statements compared to women. Gender differences showing higher agreement among men were observed for two DOHaD$_{KNOWLEDGE}$ statements.

The mean DQS was 60 out of 100 points, indicating a moderate diet quality. Women had a higher mean DQS compared to men. Gender differences favouring women were observed for the DQS components: vegetables, fruit, and the inversely scored components SSB, and red and processed meats, while the inversely scored component sugary foods favoured men. Additionally, 14% of participants reported never consuming alcoholic beverages, and 22% reported consuming alcoholic beverages less than twice a month. Furthermore, most participants reported an intake of iodine-rich and calcium-rich foods ≤2.5 times a day.

A linear regression analysis indicated that, on average, a one-unit increase in the DOHaD$_{KNOWLEDGE}$ score was associated with a 0.71-point increase in DQS (95% CI: 0.52, 0.91). This association was slightly attenuated in a multiple regression analysis adjusted for gender, BMI, and education (B: 0.60, 95% CI: 0.41, 0.79).

Little evidence of an interaction effect of gender on the association between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and DQS was observed.

This study revealed moderate $\text{DOHaD}_{\text{KNOWLEDGE}}$ and suboptimal diet quality in a sample of preconception young adult men and women, suggesting room for improvement in both areas. Additionally, evidence of gender differences was also observed. The positive association between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality indicates that increasing $\text{DOHaD}_{\text{KNOWLEDGE}}$ may have the potential to improve diet quality in this population.

5 Discussion

The aim of this PhD was to plan and establish the basis for the PREPARED project, with a specific emphasis on validating dietary assessment methods to be utilized throughout the entire project, while also conducting a specific analysis of DOHaD knowledge and diet quality on the baseline data.

The discussion is structured into two main parts. The first part (5.1) discusses the dietary assessment validation studies (Paper II and III) informing the PREPARED project. The second part (5.2) exclusively discusses the PREPARED project itself (Paper I and IV). Finally, a joint discussion of the included papers' external validity (5.3).

5.1 The dietary assessment validation studies (Papers II & III)

In this first main part of the discussion, the two specific objectives outlined to establish dietary assessment methods informing the PREPARED project are addressed, namely to:

- Develop digital food item image-series to aid portion size estimation accuracy in a 24-hour dietary recall system to be used in PREPARED project, and validate their accuracy by comparing them with pre-weighed food portions (Paper II).
- Validate a dietary screener against a semi-quantitative FFQ for rapid dietary assessment in the PREPARED project (Paper III).

First, in section 5.1.1, methodological considerations of the dietary assessment validation studies are discussed, followed by section 5.1.2 discussing the specific findings from Papers II and III.

5.1.1 Methodological considerations of the dietary assessment validation studies

In this section, several methodological aspects of the dietary assessment validation studies are discussed. First, a discussion on utilizing self-reported dietary measurements for use in the PREPARED study (Paper I and IV). Second, a discussion examining the disparities between absolute and relative validity, specifically within the context of Paper II and III. Third, a discussion of specific aspects and challenges associated with the dietary assessment tools in Paper II and III implemented in the PREPARED study. Last, statistical approaches and an exploration of the concepts of “agreement” and “correlation and concordance” of methods relevant to Paper III are discussed.

Self-reported dietary assessment measurements (Papers II-IV)
The dietary data in Papers II-IV relied on self-reported measurements, including portion size estimations (Paper II), the dietary screener (Papers III and IV), and the FFQ (Paper III).

Self-reported dietary assessment methods have been subject to scientific controversy and debate questioning their validity and value [112-115]. However, the proponents argue that there is a growing evidence of diet-disease relationships based on self-reported data, the use of objective markers to determine the usefulness of self-reported data, and the scientific contributions of these methods [113, 115].

Self-reported methods are susceptible to biases. Social desirability, the desire to present oneself as complying with what is socially approved such as overreporting intake of fruit and vegetables, and errors in misreporting, as intentional or unintentional intrusion or omittance of food items or misestimations due to failing to quantify intake, can all affect the dietary assessment.

In the PREPARED project, the combination of a dietary screener and multiple 24HRs strengthens the dietary assessment by using methods susceptible to different sources of error. The dietary screener offers a rapid assessment of long-term intake for selected dietary aspects by using a closed-ended registration, while the 24HR provides detailed dietary information on short-term intake using an open-ended registration. The dietary screener has limitations regarding systematic error due to its finite list of foods and pre-defined frequencies of intake, while the 24HR is more susceptible to random errors resulting from day-to-day variation. Both methods are prone to memory-related biases, although they differ in generic and specific memory (Table 3), which should be acknowledged in data interpretation. Neither method is considered notably burdensome. However, using multiple dietary assessment methods may increase participant burden and repeated assessments may cause respondent fatigue.

Combining multiple 24HRs with an FFQ has been observed to improve dietary assessment, particularly for foods not eaten every day, showing an increased prediction of true usual intake, power of detecting a diet-disease relationship, and the relative sample size needed to detect a diet-disease relation [116]. Alternatively, multiple-day food records providing real-time dietary information could be used instead of 24HRs. However, participant burden associated with the food record limits the feasibility for large-scale studies like PREPARED. Using retrospective methods such as 24HR, FFQs, or dietary screeners, are less burdensome for the participants, and therefore considered more suitable to counter participant attrition. In the PREPARED study, retrospective methods were employed to increase the likelihood of obtaining dietary data from both the intervention and control groups, which is essential to evaluate the intervention's effectiveness, despite the potential for recall bias.

Validation methods: absolute and relative

Dietary assessment methods are mainly validated either through absolute or relative designs, depending on the reference method employed to determine the true value of dietary intake.

Paper II serves as an absolute validation study, utilizing pre-weighed food portions as objective reference measures. Studies comparing a method to an unbiased reference measure can examine the agreement using proportions of foods or beverages accurately reported relative to the true value [75]. This design allows for the quantification of the total error associated with the test method's estimation of the true portion sizes value. It provides a direct evaluation of the test method's agreement and validity when compared to the reference method, thereby offering a detailed assessment of the image-series feasibility for aiding portion size estimation.

Paper III is a relative validation study. Here, the true value of participants' dietary intake remains unknown, but is estimated by both the test method (dietary screener) and the reference method (FFQ). As the true value of dietary intake is unknown, the validity of the dietary screener can only be inferred in relation to the FFQ's estimate of the true value. The FFQ used as reference method in Paper III has previously been validated against a 7-day weighed food record, demonstrating fair relative validity [109]. However, using a semi-quantitative

FFQ as reference method for relative validation is not ideal [75, 117]. Both the dietary screener and FFQ are susceptible to similar sources of error (details in Section 1.5.1), which may be correlated, potentially inflating the association between the methods. To address this, Paper III aimed for utmost transparency by providing a detailed and nuanced data presentation including concordance with 95% CIs and box-and-whisker plots for all raw measures.

Specific aspects and challenges associated with the dietary assessment tools in Paper II and III

In this section, specific aspects and challenges are first discussed for the image-series developed and validated in Paper II, followed by the dietary screener "MyFoodMonth 1.1" validated in Paper III.

Developing food item image-series to aid portion size estimation accuracy in "myfood24" (Paper II)

In parallel with developing the Norwegian version of "myfood24", the study in Paper II was conducted to develop and validate image-series to aid portion size estimation accuracy for traditionally and frequently eaten foods in Norway.

Using food item image-series to aid portion size estimation accuracy

Portion size estimation represents a major source of misestimation in dietary assessment [118-120]. Retrospectively estimating portion sizes is a challenging cognitive task that relies on memory, conceptualising, and assessment of meal components. The use of a food atlas (a booklet of photographic portion size series) or digital images has demonstrated higher accuracy in portion size estimation compared to other tools such as food models and household utensils [87].

Weight increments for portion size quantities depicted in an image-series

Percent weight increments were applied to all image-series but "Bread" in Paper II. Using a fixed percentage weight increment is considered more visually perceptible than using fixed weight increments in grams. This is particularly relevant for larger portion sizes, where fixed gram increments may be visually less noticeable (e.g., a 10-gram increase from 100 g to 110 g). However, using percent weight increments may present limitations for small quantity food items, such as for spreads in Paper II, where some of the weight increments were as small as 1 gram, which may make it challenging for participants to distinguish the difference in quantity.

Approaches to validating food item image-series

Various psychological constructs are available to evaluate the accuracy of portion size estimation tools. Paper II employed the perception approach, directly comparing the portion size estimation tool with pre-weighed food portions. Other approaches to validate portion size estimation tools include the conceptualisation approach and the memory-based approach. The conceptualisation approach involves estimating portion sizes based on the abstract mental impression of foods seen or eaten using the portion size estimation tool [121], such as participants self-serving and consuming a portion of food, and then estimating the quantity using portion size images. The memory-based approach relies on recollection of the amounts eaten [121]. This approach is commonly used in retrospective dietary assessment methods, which in turn will affect the precision of conceptualising a previously eaten quantity of food. Employing a pre-weighed objective reference measure is preferred for validating portion size estimation tools compared to relative measures (participant self-serving) or comparators (estimated amount from other dietary assessment method) [87].

While the findings from Paper II validate the accuracy of portion size images using perception of pre-weighed foods, it should be noted that this approach does not replicate the conceptualisation and memory-based nature of the 24HR method used in the PREPARED project. Incorporating portion size images into a 24HR for assessing yesterday's dietary intake relies on a combination of perception, conceptualisation, and memory, with particular emphasis on the latter two to accurately to recall dietary intake [121]. Therefore, extrapolating the findings from Paper II may limit the validity for use in a retrospective dietary assessment. Previous studies have shown a slight reduction in accuracy when portion size estimations require conceptualisation and memory recall compared to the perception of foods [122]. Consequently, the portion size estimation accuracy using the image-series validated in Paper II may be slightly reduced when incorporated into the "myfood24" 24HR method.

The rapid and low-burden dietary screener "MyFoodMonth 1.1" (Paper III)

The dietary screener validated in Paper III was designed to facilitate a rapid and simple dietary assessment imposing a low level of burden on participants.

A non-quantitative approach to dietary assessment

In Paper III, the dietary screener uses a non-quantitative approach to facilitate a rapid dietary assessment. Including portion sizes in the dietary screener would likely increase cognitive demands, as the individual food items encompass various portion sizes (e.g., the food item “red meat” does not differentiate between cold cuts and dinner meats). If portion sizes were assigned to the food items, participants would have to conceptualize their intake frequency relative to consumed portion sizes. This would likely prolong the time required to complete the dietary screener, potentially affecting the recruitment and retention of participants.

Standardized portion sizes based on age- and gender could have been assigning *a posteriori*, as done by Block, Gillespie [123]. However, this approach was not adopted to avoid introducing additional estimation error and creating a false impression of the dietary screener’s accuracy, as this would fail to capture the between-person-variation in portion sizes [124].

While the non-quantitative approach, which solely relies on intake frequencies, offer limited dietary details compared to incorporating portion sizes, it does allow for the description of dietary intake, the exploration of associations with diet as either the independent or dependent variable, and the examination of intervention effects [125].

Reducing the burden of dietary assessment using a non-quantitative dietary screener

In Paper III, about half of the eligible participants completed the dietary screener but not the FFQ. This highlights the potential benefits of utilizing a non-quantitative design for a rapid and low-demanding dietary assessment, which can enhance participant recruitment and retention when compared to other, more comprehensive dietary assessment methods. However, it should be noted that the dietary screener was distributed before the FFQ, which may explain the difference in response rates (details in Paper III). Another potential benefit of utilizing a non-quantitative dietary screener is to counteract sample bias by reducing the perceived burden of study participation, thereby attracting individuals who would otherwise not participate. Although the non-quantitative design compromises on the level of dietary details collected, it can still provide valuable data that would otherwise be unattainable.

Applying a Diet Quality Score to the dietary screener

The DQS derived from the dietary screener in Paper III provides valuable insights into the diet quality of the study sample. Considering the food intake frequencies alongside their associated health benefits allows for inferences to be drawn regarding the quality of dietary components.

One of the strengths of utilizing diet quality indices or scores is the ability to evaluate the impact of an intervention and easily identify low diet quality in specific population subgroup. Additionally, they are applicable even when limited dietary information is available [79]. However, limitations include the focus on specific dietary aspects which may not fully capture overall diet, and that grouping dietary variables may not adequately consider correlations between the variables being used [79].

Statistical considerations in dietary assessment validation studies

Statistical approaches for validating dietary assessment methods vary based on factors such as the specific methods used, data level of measurements, validation design (absolute or relative), and the intended use of the test method. In this thesis, both an absolute and relative validation design was employed. In Paper II, an absolute validation design was employed to assess the agreement of participants estimated portion sizes using portion size image-series with actual weights using pre-weighed food portions. The relative validation design employed in Paper III assessed the concordance and ranking ability of participants reported intake frequency using the dietary screener with intakes in grams calculated from the FFQ.

Statistical approaches used in dietary assessment validation studies

Different statistical approaches were used to evaluate validity in the included dietary assessment validation papers. The agreement between methods in Paper II was evaluated using classification and percent discrepancy of portion size estimation accuracy. In Paper III, concordance and ranking ability between methods was evaluated using Kendall's tau-b correlation analysis, cross-tabulation, and box-and-whisker plots.

In a literature review by Lombard, Steyn [126], twenty-one different combinations of six statistical tests were identified among 60 studies validating quantitative FFQs. The number of tests typically ranged from one to three, which the authors state may not provide comprehensive insight into validity. Another review, by Cade, Burley [127], found that 85% of the 227 included validation studies used correlation coefficients as the sole method for measurement tools. Correlation analyses are not recommended to be the sole analysis of a relative validation study [75, 128].

Statistical agreement and association

When evaluating the validity of a dietary assessment method by comparing it with an un-biased or biased (error-prone) reference method, the terms "agreement" or "correlation" are often used.

<u>Agreement</u>

Agreement refers to the reproducibility of outcomes and requires that the variables measure the same construct, such as the dietary intake in grams or the quantity of a specific nutrient [129]. The dietary data in Paper II qualifies for assessment of agreement, as both the test measure (portion size image-series) and reference measure (pre-weighed food portions) measured grams. Agreement was assessed at an individual level by classifying the participants' estimated portion size image relative to the actual weight presented (Fig. 5) [126]. Additionally, agreement at a group level was assessed by calculating the percent discrepancy between the participants' portion size estimates and the actual portion size weights in grams, revealing the degree of misreporting, or disagreement, observed using the image-series for portion size estimations [126].

<u>Correlation and concordance</u>

The terms correlation and concordance both refer to the relatedness between methods. However, the terms express this relatedness in different ways. In Paper III, the concordance between the dietary screener "MyFoodMonth 1.1" and the FFQ was evaluated using Kendall's tau-b rank correlation analyses to provide a distinct measure of association.

Correlation is used when variables do not measure the same construct, expressing the relationship between variables [129]. This differs from agreement between methods, as extensively explained by Bland and Altman [130].

Concordance, on the other hand, can be defined as how well the rank-order is preserved between two methods. The calculation of Tau is based on the number of concordant and disconcordant pairs, indicating whether observations follow the same trend in ranking [129]. Kendall’s tau analysis is appropriate for non-continuous outcomes and can evaluate non-linear relationships, similar to the Spearman’s rho analysis, which provide a measure of correlation between the rankings of two variables. However, Kendall’s tau captures the consistency in ranking more directly and is also more robust to outliers in ranking compared to Spearman’s.

5.1.2 Findings from the dietary assessment validation studies

In the following section, the findings from the dietary assessment validation studies are discussed. First, a brief reiteration of the main findings from Paper II and III. Second, the main findings from Paper II are discussed relative to the literature, followed by a discussion of the image-series that inaccurately and accurately estimated portion sizes. Last, a discussion of the main findings from Paper III compared to the literature, including the dietary screener's overall performance, food items that demonstrated weak and strong concordance with the FFQ, estimates of calcium and iodine intake, and transparency of the study findings.

The 23 digital food item image-series developed to aid portion size estimation accuracy in Paper II was generally satisfactory for most image-series compared to pre-weighed food portions, except those depicting "Bread", "Marzipan cake", and "Caviar spread". The 'flat-slope phenomenon' was apparent, as small portion sizes tended to be overestimated, and large portion sizes underestimated. Females estimated portion sizes more accurately than males.

The rapid non-quantitative dietary screener "MyFoodMonth 1.1" in Paper III showed moderate-to-strong concordance for most raw measures and all aspects of diet quality and DQS components compared to an FFQ. The concordance was generally similar between sexes. The food items "Cereal and porridge, sweetened", "Tomato sauce", and "Coffee/tea/iced coffee/iced tea with sugar/syrup/honey" performed badly.

Paper II

The validation of the portion size image-series in Paper II contributes to establish the groundwork for the PREPARED project and achieves the second specific objective of this thesis.

Classification of portion size estimations compared to similar studies

Studies validating the use of portion size images or photos for estimating pre-weighed food portions have reported that around 50% of participants portion size estimations were perfect matches (portion size estimated to the correct portion size image or photo) [131-133]. Furthermore, the proportions of estimations that were either a perfect or partial match (correct or adjacent portion size image or photo) have shown ranges between 70-95% [131, 132, 134, 135]. A recent study by Liu, Wang [136], using image-series to estimate the perceived portion size norms of real foods, corroborates these findings. Paper II showed similar accuracy for the newly developed food item image-series. On average, 93% of participants portion size estimations were either a perfect or partial match relative to the presented food portions, of which 55% were perfect matches and 38% partial matches (classification illustrated in Fig. 5).

Based on the findings from Paper II and the literature, this suggests that young adults estimate portion sizes with the correct portion size image in roughly half of cases using food item image-series. However, in Paper II this was achieved in a staged setting and may not be representative for a real-life setting. The large proportions of participants that estimated the correct or adjacent portion size image is considered a strength in quantifying intake, as it narrows the range of misestimation, likely providing a more accurate portion size estimation compared to using standard portion sizes, e.g., only providing the standard portion size of 80 g for carrot cake [107]. This justifies the use of image-series in dietary assessment tools.

Percent discrepancy between participants estimated portion sizes and actual portion sizes in grams compared to similar studies

The misestimation in Paper II showed an average discrepancy, or error, of 2.5% between the estimated and actual portion sizes. This is similar to Bernal-Orozco et al., who reported an average estimation error of 2.5% using a food atlas [137]. However, the findings in Paper II masks a varying degree of misestimation for the individual food items tested in the study, ranging from -33% (for Marzipan cake and Mexican stew with beans) to +105% (for Caviar (spread)). The range of misestimations was considerably larger in Paper II compared to similar studies reporting a range of misestimation between -13.1% to +39% using food photos (sets of physical portion size photographs) [122, 138]. This discrepancy in misestimation may be explained by Paper II including seven portion size images in each image-series, compared to Szenczi-Cseh et al. using between four and six images with ten equal intermediate quantities between portion size images, and Tueni et al. including only three images with four intermediate quantities (e.g., the portion size alternative “C” was the intermediate quantity between portion size image “B” and “D”). Additionally, the extent of misestimation in a study may be influence by the number of food portions estimated by the participants. In the studies by Szenczi-Cseh et al. and Tueni et al., the participants estimated 7 and 10 food portions, respectively, whereas in Paper II, participants estimated 46 food portions, which could potentially lead to participant fatigue. Moreover, participants in the study by Tueni et al. estimated portion sizes of traditional Lebanese dishes, which may limit the comparability with the findings in Paper II. Furthermore, neither studies included portion size estimations of spreads, which were among the food item image-series that performed worst in Paper II.

The 'flat-slope phenomenon'

The mean percent discrepancy for the seven portion size images in the 23 image-series from smallest to largest in Paper II were as follows: +43%, -1%, +4%, -4%, -6%, -1%, and -21%, respectively. This indicates the precence of the 'flat-slope phenomenon', meaning that small portion sizes tend to be overestimated and large portion sizes tend to be underestimated. This has also been observed in similar studies [132, 138-141]. Given that the smallest and largest portion size images only have one adjacent portion size image, misestimations will inevitably skew towards one direction, namely that portion sizes reflecting the smallest image will be overestimated and vice versa for the largest image. Furthermore, difficulties in distinguishing the difference in quantity between small portion sizes (e.g., for spreads depicted with small differences in quantity), and that increasing portion sizes tend to increase underreporting [142], may have contributed to the degree of over- and underestimation observed. Nevertheless, it is worth mentioning that Subar et al. raised speculations whether the increasing tendency to underreporting with larger portion sizes is attributable to participants' challenges in recalling bigger portion sizes or societal pressure to consume less. However, it is important to note that neither of these factors is applicable to the study design in Paper II.

Differences in portion size estimation accuracy by sex, education, and food presentation

In dietary assessment validation studies, confounding is approached differently than in epidemiological research, primarily because there is no causal pathway between the variables under examination [143]. Nonetheless, covariates can be incorporated to assess factors that could potentially impact both the methodological measurements and to investigate their potential influence on the extent of bias in misclassification rates.

In Paper II there was little evidence to indicate that level of education made any difference in portion size estimation accuracy, similar to other studies [132, 133]. This strengthens the use of the image-series in the PREPARED study, which was overrepresented of highly educated participants, indicating that the portion size estimations using the image-series will not differ between participants with high or low level of education. However, evidence of a difference by sex in portion size estimation accuracy was observed, indicating that females estimated portion sizes more accurately than males. This has been observed in similar studies [133, 140], wheras others have not observe a difference by sex [132, 141]. A possible explanation for the observed difference by sex is that Norwegian women cook more frequently than men, and therefore may possess more knowledge of food items and portion sizes [144].

There was little evidence indicating a difference in participants' portion size estimation accuracy relative to being presented food items with an identical or altered weight relative to a portion size image. Similar findings were reported by Naska, Valanou [132]. This indicates that participants were generally able to select the correct or adjacent portion size image regardless of whether food portion sizes identically match the weight of a portion size image or not.

Image-series that did not accurately estimate portion sizes

The validation study revealed which image-series that performed badly when used to estimate portion sizes. The image-series for bread, caviar spread, and marzipan cake performed particularly bad, showing more than 30% of participants portion size estimations as partial or complete mismatches.

The image-series for "Bread" was depicted differently compared to the other image-series. Contrary to the other image-series presenting only one example of a food item, two pieces of bread were presented in each portion size image. This was done to illustrate differences relative to whole-grain content. This may be the cause of the bad performance of the image-series, as participants expressed difficulties applying the image-series to estimate a single piece of bread presented during the study. In Norway, bread, and often whole grain bread, is a staple food, and by far the largest group of grain products, contributing approximately 30% of the energy intake and nearly half of the dietary fibre in Norwegian diets [145]. The central part bread plays in the Norwegian food culture is an argument to re-evaluate and revalidate the image-series for evaluating portion sizes of bread.

"Caviar spread", and image-series for spreads in general, were among the image-series most often misclassified in Paper II. Other studies have also reported low proportions of correct estimations for spreads [133, 141]. This may be due to the minimal changes in quantity depicted in the smallest portion size images for spreads, which can make it visually challenging to distinguish between the portion sizes. Alternatively, a reduced number of portion size images for spreads, as demonstrated by Biltoft-Jensen, Holmgaard Nielsen [146], could have been employed. This approach would have increased the gram increments between portion size images, simplifying the differentiation for participants.

The image-series for "Marzipan cake" depicted both rectangular and triangular pieces, as small triangular portion sizes would not remain upright, and were therefore depicted lying down. This may have influenced the participants' ability to accurately estimate portion sizes. Furthermore, it is possible that social desirability may have contributed to underreporting "unhealthy foods". However, the perception approach should mitigate this issue, as participants did not report their own diet.

Image-series that accurately estimated portion sizes

The validation study also revealed which image-series that performed particularly well to estimate portion sizes. Interestingly, some image-series performed well estimating both food portions presented during the study, while others performed well estimating only one of the portions presented, and less optimal, and even badly, for the second food portion. It is unclear why these image-series performed so well relative to other image-series, especially for those image-series that performed well for only one of the two food portions presented.

The image-series for "Carrot cake", "Chicken", and "Strawberries" all showed a mean discrepancy of <10% between participants portion size estimates and the presented food portion and 100% classifications as either a perfect or partial match (except one portion size estimation of “Strawberries”, which had 2% of estimates classified as partial mismatches). The food portions presented for “Carrot cake”, “Chicken”, and “Strawberries” all reflected quantities corresponding to portion size images 2-5. An explanation for the observed performance may be that participants counted the number of strawberries or pieces of chicken in the presented food portions and made size estimates by comparing them to the number of pieces shown in the portion size images. However, this approach was not applicable to estimate the portion sizes of carrot cake.

The image-series depicting “Beans” and “Raspberries” both performed well for one of the two portion sizes presented for each food item. The second portion size estimations performed less than optimal compared to the presented food portions, with estimates for “Beans” showing a mean discrepancy of -13% and 5% classified as partial mismatches, and “Raspberry” showing a mean discrepancy of -14% and 2% complete mismatches. These food items could also be estimated by comparing the number of pieces in the presented portion with the number of pieces depicted in the portion size images. However, the estimations that showed less than optimal accuracy corresponded to portion size images 5 and 7 (where 7 represents the largest in the image-series). The observed discrepancy may be due to participants having to estimate the quantity of the presented portion sizes rather than simply comparing the number of pieces.

The image-series for “Candy (without chocolate)”, “Meat” and “Peanuts” performed well for one of the two portion sizes presented for each food, but badly for the other, showing mean discrepancies ranging between -31% and +44% and partial and complete mismatches between the participants’ estimated portion sizes and the presented food portions. For “Meat” and “Peanuts”, this may be due to the “flat-slope phenomenon”, as the portion size estimations that performed badly were both presented as the smallest portion size image (image 1). However, this was not the case for “Candy (without chocolate)”, where the estimation that performed well was presented as the smallest portion size image, and the estimation that performed badly was presented as portion size image 4. Why this discrepancy was observed for the image-series “Candy (without chocolate)” is unclear.

Paper III

The relative validation of the dietary screener "MyFoodMonth 1.1" in Paper III contributes to establish the groundwork for the PREPARED project, informs the dietary assessment in the PREPARED project, and achieves the third specific objective of this thesis.

The limited literature on validating a non-quantitative dietary screener with a semi-quantitative FFQ makes it challenging to compare the results from Paper III to other studies. The overall performance of the dietary screener is compared to studies employing a similar study design to provide context for validation studies of questionnaire-based dietary assessment tools. Moreover, dietary screener components are compared to similar studies to enable an evaluation of the validity compared to the FFQ**.** The validation studies used for comparison employed different methodological approaches, including applying portion sizes to both the test and reference method, indices based on portion size or quantities, and dichotomous scores (scored 0/1 relative to a cut-off).

Overall performance of the dietary screener compared to the literature

The dietary screener performed good compared to similar studies, showing an overall concordance of 0.48, ranging from 0.20 (95% CI: 0.07, 0.31) for "Tomato sauce" to 0.79 (95% CI: 0.71, 0.86) for "Whey cheese". The overall correlation or concordance observed for similar studies was reported around 0.5 [147, 148] and ranges between 0.0-0.9 [149, 150]. However, it should be notated that this may not be fully comparable due to differences in the test method (dietary screener or short FFQ), dietary components of interest (foods or nutrients), and validation approached employed.

Dietary screener food items that showed weak concordance and ranking ability with the semi-quantitative FFQ

The dietary screener items "Cereal and porridge, sweetened", "Tomato sauce", and "Coffee/tea/iced coffee/iced tea with sugar/syrup/honey" showed weak concordance (concordance (τ) <0.30) with the FFQ. Inspecting the box-and-whisker plots corroborates this, showing that increasing intake frequencies in the dietary screener did not coincide with increasing quantity in the FFQ (Paper III, Supplementary file 4, Figure S1, S18, and S29, respectively). Therefore, these food items should be altered for future use of the dietary screener.

The poor performance of the food item “Cereal and porridge, sweetened” may be explained by participants struggling to distinguishing between sweetened or unsweetened cereals and porridges. The food item was included in the component “Sugary foods” for both aspects of diet quality and the DQS, and is therefore recommended to remain in the dietary screener. However, alterations should be made to clarify what constitutes as sweetened and unsweetened cereals and porridges. An approach to achieve this is by including the “Keyhole” scheme, a well-known label intended to help consumers choose healthy options in the Nordic Region [151]. The nutritional requirements for cereals and breakfast cereals to qualify for the “Keyhole”-label fits well with the nutritional content of “Cereal and porridge, unsweetened” [152], clarifying the difference with the sweetened options.

The food item “Tomato sauce” may have been too broad to effectively assess intake of tomato-based condiments and sauces, and therefore performed poorly. The food item was not included in any components of aspects of diet quality or the DQS, and will therefore not affect their performance if excluded. Hence, in future use of the dietary screener we recommended to specify that tomatoes should be reported in the “Vegetables” category and exclude the food item “Tomato sauce”.

The food item “Coffee/tea / iced coffee/tea with sugar/syrup/honey” may have been designed too heterogeneous, and therefore performed poorly. It was not included in any components of aspects of diet quality or the DQS, based on the difference in sugar content between two sugar cubes (4g) in a small cup of coffee (150 g) and 10/100 grams sugar in regular sugar-sweetened soda. We recommended to omit the coffees and teas with low sugar content from future use of the dietary screener, and to include iced tea in the SSB food item due to its similar sugar content to soda.

Dietary screener food items that showed strong concordance and ranking ability with the semi-quantitative FFQ

The food items “Whey cheese” (τ 0.79), “Energy drinks with sugar” (τ 0.76), “Plant-based milk” (τ 0.69) and “Beans, lentils, chickpeas, and peas” (τ 0.64) all showed strong concordance with the FFQ, probably due to the high proportions of non-consumers, as visualized in the box-and-whisker plots (Paper III, Supplementary file 4, Fig S6, S28, S9 and S13, respectively). The concordance observed for “Beans, lentils and chickpeas” was considerably stronger compared to de Rijk, Slotegraaf [147]. Foods that are never or rarely consumed is easier to report than those eaten sometimes or often, as the more a respondent consumes the more difficult it is to report consumption accurately [142]. “Water” also showed a strong concordance of 0.61, probably due to the high proportions of participants frequently consuming water (Paper III, Supplementary file 4, Fig S31).

For both “Fatty fish (salmon/mackerel)” (τ 0.68) and “Cereal and porridge, unsweetened” (τ 0.59) the ranking ability of the dietary screener was clearly visible relative to the FFQ, as visualised in Fig S12 and Fig S2, respectively (Paper III, Supplementary file 4). The concordance for fish showed similar findings to others [148, 149, 153], but higher concordance compared to Hebestreit, Yahiaoui-Doktor [150]. This may be explained by Hebestreit et al. using a dichotomous score based on cut-off values in their validation study. According to Fig S12, there were no high consumers of fatty fish (not including fish as spread). Most participants reported a fish intake between 2-3 times a month to 2-4 times per week. It is not unreasonable to assume that participants have fish for dinner approximately once a week, e.g., “Fish Monday”, thereby providing quite accurate information. The pooled whole-grain variable in Paper II (including “Cereal and porridge, unsweetened”) performed consistently with other studies assessing fairly comparable foods [147, 149].

Combining calcium- and iodine rich food items from the dietary screener to infer nutrient intake of calcium and iodine

The findings from Paper III suggest that combining dietary screener food items high in calcium and iodine, separately, can be used to provide a rough estimate of participants nutrient intake of calcium and iodine compared to the FFQ. The dietary trends in Norway show a decline in fish and milk consumption [154], which are the primary sources of iodine and calcium. Furthermore, it is particularly concerning that young women, pregnant women, and those breastfeeding exhibit low iodine intake. This shift in eating habits underscores the need for preliminary estimates of iodine and calcium intakes as an initial indicator for more comprehensive nutritional assessments. In a study by van Lee, Feskens [148], an association was observed between calcium intake measured by a dietary screener and an FFQ, nonetheless, the association disappeared when adjusted for estimated energy intake.

Utilizing cross-tabulation and box-and-whisker plots to describe ranking ability of the dietary screener with the FFQ and to achieve transparency of findings
To ensure the credibility of the findings in Paper III, a multi-faceted approach to transparency was employed. This included utilizing Kendall's tau-b correlation analyses presented with 95% CIs, cross-tabulation, and individual box-and-whisker plots to elucidate the association between the dietary screener and the FFQ.

Ranking ability of the dietary screener was described in a cross-table showing aspects of diet quality derived from the dietary screener crossed with DQS components and gram intakes from the FFQ. This description of ranking ability corroborates the concordances observed between methods. The cross-table showed that increasing intake frequencies in the aspects of diet quality coincided with an increase in both the DQS scorings and intakes in grams, illustrating that the dietary screener distinguishes between high and low intake (details in Paper III, Table 4).

Additionally, the box-and-whisker plots produced for the dietary screener raw measurements relative to intakes in grams from the FFQ provides detailed insights into the ranking ability of the dietary screener (Paper III, supplementary file 4).

5.2 The PREPARED study (Papers I and IV)

In this second main part of the discussion, the specific objectives directly related to the PREPARED project are addressed:

1. Develop a study protocol outlining the research process for the PREPARED project (Paper I).
2. Assess preconception young adults' DOHaD knowledge and diet quality, and the association between the two, using the baseline data from the PREPARED study (Paper IV).

First, in section 5.2.1, methodological considerations of the PREPARED study are discussed, followed by section 5.2.2 discussing the specific findings from Paper IV considering Paper I in particular.

5.2.1 Methodological considerations of the PREPARED study

In this section, methodological considerations of the PREPARED study are discussed. First, a brief discussion of the PREPARED project and the study designs of Paper I and IV. Second**,** a discussion of the $\text{DOHaD}_{\text{KNOWLEDGE}}$ questionnaire, its comparison with other DOHaD knowledge assessments, and quantification of the $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale.

The PREPARED project

The PREPARED project aims to investigate the potential effects of a digital dietary intervention during preconception using an RCT study design, continuing to assess participants preconception diet year-by-year, and the maternal and child outcomes in a future pregnancy. The relatively large sample size and long study duration are strengths of the project, making it an important cohort to provide unique long-term data on young adult's diet during the preconception years. However, loss to follow-up is a methodological challenge that is expected. This may occur due to the project's duration, participant fatigue, the burden of using multiple dietary assessment methods, and repeated dietary assessments. Additionally, targeting a population aged 20-35 years, where participants may find themselves in various life phases, could pose challenges of conducting follow-up assessments.

Paper I study design

The RCT study design employed in the PREPARED study is considered the "gold standard" in assessing intervention effects due to the random allocation of participants, allowing a causal estimate of the effect free of confounding [155]. The PREPARED intervention does not involve blinding, that is, participants not knowing whether they receive the intervention or not, as participants either receive or do not receive the digital intervention. The analysis plan follows an intention-to-treat approach, including all participants in the data analyses, regardless of completing the intervention or dropout [156].

Paper IV study design

Paper IV adopts a cross-sectional design, providing a snapshot of both the exposure and outcome at a single point in time. However, it is important to note that a cross-sectional study design cannot establish a causal relationship between exposure and outcome since both variables are assessed simultaneously. Additionally, it cannot confirm a causal pathway between the variables. The assumption is made in Paper IV that $\text{DOHaD}_{\text{KNOWLEDGE}}$ serves as the exposure variable, influencing changes in diet quality as the outcome. However, this assumption cannot be verified. It is plausible that a change in diet quality, acting as the exposure variable, could influence $\text{DOHaD}_{\text{KNOWLEDGE}}$. For instance, if an individual improves their diet quality, they may experience enhanced well-being, leading them to develop a greater interest in learning about diet and nutrition, thereby improving their $\text{DOHaD}_{\text{KNOWLEDGE}}$.

The $\text{DOHaD}_{\text{KNOWLEDGE}}$ questionnaire

The DOHaD questionnaire developed by McKerracher, Moffat [71] was adapted for a Norwegian preconception population to create a $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale. While the scale is not validated, it demonstrated internal reliability with a Cronbach's α value of .82 [71], stronger than the minimum recommended value of 0.7-0.8 [157], suggesting that it effectively measures a coherent mental construct. However, it is unlikely that the scale captures a broader understanding of the theory and evidence of DOHaD, given the primary focus on preconception nutrition and the risk of developing obesity in the offspring. Translating the scale into Norwegian may have influenced its internal reliability, although efforts were made to ensure the meaning of the statements using a standard forward-backward translation process.

A recent study in Norway revealed that young adults within the fertile age range generally lack awareness regarding the concept of the preconception period and possess limited knowledge concerning the potential influence of diet and lifestyle on the future health of their children [2]. The $\text{DOHaD}_{\text{KNOWLEDGE}}$ questionnaire expands on the assessment of preconception individuals' knowledge and awareness, targeting the concept of DOHaD and its link to risk of obesity in the offspring, encompassing the role of diet during preconception, pregnancy, and while breastfeeding.

The $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale used in the PREPARED project compared to other assessments of DOHaD knowledge

There have been a few approaches to assess DOHaD knowledge in various populations. The $\text{DOHaD}_{\text{KNOWLEDGE}}$ statements developed in Paper I and assessed in Paper IV predominantly focus on the intergenerational effects of parental diet during preconception, pregnancy, and while breastfeeding on the offspring, particularly in relation to the risk of developing obesity in the offspring.

Bay, Mora [68] conducted a school-based educational intervention to assess adolescents' understanding of DOHaD concepts. Their study encompassed various DOHaD statements, including the relationship between diet during adolescence and future health, the impact of a woman's diet during pregnancy on the health of the baby, and the long-term health implications when the baby is grown up. On the other hand, Oyamada, Lim [69] assessed DOHaD knowledge among undergraduate students in Japan and New Zealand. These statements covered a range of DOHaD aspects, such as the general health and well-being of both women and men, the influence of a woman's nutrition during pregnancy on the health of the fetus or child, the effects of a child's nutrition on health throughout childhood and adulthood, and the associations between an individuals' diet and the risk of developing NCDs. These studies apply a wider approach to evaluating DOHaD knowledge compared to the $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale used in this thesis, limiting comparability.

While the $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale has a more specific focus compared to the studies mentioned above, concentrating on the risk of obesity in offspring, it embodies the fundamental concept of DOHaD. It does so by evaluating participants knowledge about the impact of parental diet during preconception, pregnancy, and while breastfeeding, using the risk of obesity in offspring as a specific outcome.

Quantifying the DOHaD$_{KNOWLEDGE}$ statements using a Likert-scale

In Paper IV, the DOHaD$_{KNOWLEDGE}$ statements were combined into a continuous scale using the Likert approach, facilitating calculations and parametric testing.

A theoretical construct, such as DOHaD, can be formulated and operationalised into statements to measure individuals' attitudes towards the construct. The statements included to capture DOHaD$_{KNOWLEDGE}$ were designed as a 5-point Likert scale. Combining the statements provide a measure of attitudes [158], utilizing the Likert scale approach to quantify the ordinal attitudes data into a continuous DOHaD$_{KNOWLEDGE}$ scale. While there is some controversy surrounding the treatment of ordinal data as continuous, applying parametric tests to Likert scale responses has been deemed sufficiently robust in providing accurate results [159].

5.2.2 Findings from the PREPARED study

In this section, the main findings from Paper IV are discussed and compared with the literature. First, a brief reiteration of the main findings from Paper IV. Second, the findings for $\text{DOHaD}_{\text{KNOWLEDGE}}$ are compared with the literature and interpreted. Third, the overall diet quality and dietary guideline adherence are compared with the literature and discussed. Finally, the findings of an association between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality are discussed.

Baseline data in the PREPARED project was collected in line with the PREPARED study protocol (Paper I), which included employing the dietary screener “MyFoodMonth 1.1”. Preconception young adults in Paper IV demonstrated moderate $\text{DOHaD}_{\text{KNOWLEDGE}}$ and suboptimal diet quality. Women were found to have a higher diet quality than men. A positive association was observed between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality, regardless of participants gender, BMI, and education.

$\text{DOHaD}_{\text{KNOWLEDGE}}$ of preconception young adults

The literature on the publics’ knowledge about the theory and evidence of DOHaD is limited. Furthermore, only three studies that included males in the preconception age group were identified [68, 69, 160]. The study by Oyamada et al. included males that most resembled the study sample in Paper IV, with the majority falling in the 16-24 years age range. However, the male sample size was small, accounting for only 5%, 7%, and 5% of 151 undergraduate students in years 1-3, respectively. As elaborated in the introduction chapter “1.4 DOHaD knowledge”, about one third of a study sample in the Australian public had heard of “DOHaD”, however, their understanding of the concept was low [70]. McKerracher, Moffat [71] found a mean $\text{DOHaD}_{\text{KNOWLEDGE}}$ score of 9.4/20 points (SE ±0.25) in a sample of pregnant Canadian women. The $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale developed by McKerracher et al. was adapted to a Norwegian preconception population in Paper I (Section 3.3.1), and assessed in Paper IV, observing a moderate $\text{DOHaD}_{\text{KNOWLEDGE}}$ score with a mean of 12/20 (SD 3.7) points.

The $\text{DOHaD}_{\text{KNOWLEDGE}}$ score of the PREPARED study sample indicates a higher level of knowledge about DOHaD compared to the studies above. However, while the scale utilized in Paper IV is different compared to the assessment of

DOHaD knowledge used by Lynch et al., and therefore may not reflect the same aspects of DOHaD (Section 5.2.1), the comparison with McKerracher et al. is based on the same DOHaD$_{\text{KNOWLEDGE}}$ scale. This indicates that the study sample of preconception young adult men and women in Norway have slightly more knowledge about the theory and evidence of DOHaD compared to a sample of pregnant Canadian women. However, the overrepresentation of people with a higher level of education in the PREPARED study sample could potentially contribute to a higher score.

Little evidence of a difference by gender was observed for the total DOHaD$_{\text{KNOWLEDGE}}$ score. However, evidence was observed for men having a higher level of agreement for the statements: “Before pregnancy, both what the mother and the father eat affects the growth and health of their baby” and “What a woman eats before pregnancy affects the child’s risk of becoming obese as an adult”. These are the only statements in the DOHaD$_{\text{KNOWLEDGE}}$ score concerning preconception. It might be that more men agree with the first statement as this represents their opportunity to influence and contribute to the health and disease trajectory of a child, while women may be more focused on the importance of health and nutrition during pregnancy. It is unclear what might explain the difference observed for the second statement. It might be that women more than men see the development of obesity in adulthood as a result of individual choices rather than a woman’s preconception diet.

Diet quality in preconception young adults

The introduction sub-chapter *Current state of preconception nutrition* (Section 1.3.2) serves as a basis for comparison of the DQS observed in preconception young adults in Paper IV. Generally, modest or suboptimal diet quality has been observed globally [29, 30, 48], in Western Europe [34, 52-55], and in Norway [31, 56-58].

In Paper IV, the overall mean DQS of 60/100 points indicate a higher diet quality compared to the studies above. However, differences in study design, targeting a preconception population, and using a non-qualitative dietary screener assessing selected dietary components may limit comparability. Three of the studies reported diet quality for adolescents and young adults, similar to the study sample in Paper IV, of which two showed a lower diet quality [52, 53] and one observed similar score [54].

This differences in diet quality could also partly be explained by the overrepresentation of women and highly educated participants in the PREPARED study sample.

The proportion of 88% women in Paper IV compared to the ≈50% in the studies above (except for Valen et al. with ≈70%) has likely increased the total DQS, as females generally tend to have a higher diet quality than men [29, 52]. The findings in Paper IV corroborates that gender influences diet quality, as women had a higher total DQS compared to men, exhibiting a mean difference of +5.45/100 points (95% CI: 3.17, 7.72). These gender-related differences were also evident across the DQS components vegetables (p<0.001) and fruit (p<0.001), and for the inverted DQS components SSB (p<0.001) and red and processed meats (p<0.001). The inverted DQS component sugary foods, however, favoured men (p=0.003).

Furthermore, individuals with more education have been associated with a higher diet quality compared to those with lesser education [29]. The proportion of 77% reporting a higher level of education in Paper IV may have increased the diet quality of the study sample.

Despite these differences, the overall DQS in Paper IV was below optimal levels, consistent with all the previously mentioned studies.

Dietary guideline adherence in preconception young adults

A review study by Caut et al. in 2020 investigated dietary guideline adherence in men and women during preconception and pregnancy, suggesting that most women in the preconception period may not meet dietary guidelines for vegetables and cereals [51]. Their findings for vegetables are corroborated by Paper IV, showing a mean DQS score of 8/10 points for women, reflecting an intake frequency of consuming one vegetable per day. However, contrary to the findings by Caut et al., there were 73% of women in Paper IV that reported an intake frequency of whole grain that adhered to the dietary guideline recommending daily consumption (detailed in Paper IV, Supplementary file 1).

This discrepancy may partly be explained by the difference in the Norwegian food culture compared to the studies conducted in Polish and Spanish populations [51], as previously elaborated (Section 5.1.2). The intake frequency of whole grain in Paper IV corroborates the findings from the Norwegian National Public Health Survey 2020, were 69% of participants reported consuming one or more whole grain product per day [31].

Association between DOHaD$_{KNOWLEDGE}$ and diet quality

The association between DOHaD$_{KNOWLEDGE}$ and diet quality observed in Paper IV aligns with findings by McKerracher, Moffat [71], who observed the same association in a sample of pregnant Canadian women (B: 0.35, 95% CI 0.13, 0.56).

An explanatory regression model was employed to test the hypothesis that DOHaD$_{KNOWLEDGE}$ explains some of the variation in diet quality. The distinction between explanatory modelling and predictive modelling is relevant when using regression models to assess an exposure-outcome relationship. Explanatory modelling aims to test causal hypothesis about theoretical constructs, while predictive modelling aims to generate predictions [161]. The model was subsequently adjusted for potential confounding variables to evaluate the direct effect independent of factors known to affect diet. Adjusting the model for gender, BMI, and education slightly attenuated the findings, but remained statistically significant, indicating that the association was independent of these factors. It is crucial to identify, measure, and control for confounding variables in analyses to ensure that they do not offer an alternate explanation for observed associations (detailed in Section 3.3.1). While "ethnicity (non-Norwegian mother tongue)" did not exhibit evidence of a confounding effect, it is worth acknowledging that uncontrolled variables may still introduce residual confounding. Furthermore, there was limited evidence of a gender interaction effect on the relationship between DOHaD$_{KNOWLEDGE}$ and diet quality. In this context, an interaction effect occurs when a third moderator variable influences the relationship between the independent and dependent variable [162]. This means that, regardless of gender, BMI, and level of education, a higher DOHaD$_{KNOWLEDGE}$ was associated with higher diet quality in the study sample.

Due to the cross-sectional study design of Paper IV, it is not possible to comment on a causal pathway or a causal relationship between $DOHaD_{KNOWLEDGE}$ and diet quality (Section 5.2.1), meaning that the direction and whether there is a dose-response between the two variables is unknown. Furthermore, participants health literacy and pregnancy intentions were not assessed in Paper IV, which could potentially be confounding factors affecting both $DOHaD_{KNOWLEDGE}$ and diet quality. Nevertheless, this clearly merits further investigation, and presents a potentially exciting approach to indirectly enhance diet quality of preconception young adults, and perhaps, other populations.

5.3 External validity (Paper I-IV)

In this final part of the discussion the external validity of the included papers is discussed. First, in section 5.3.1, the target populations of the thesis and included papers are reiterated. Second, in section 5.3.2, the recruitment strategies and study samples are discussed. Finally, in section 5.3.3, the study samples from the dietary assessment validation studies are compared to the PREPARED study.

External validity refers to the extent to which study findings can be generalised to the target population. In survey sampling, a statistical generalisation is fundamental for the resulting sample to be statistically representative of the target population [163]. For the findings of the included papers to be externally valid and applicable to preconception young adult men and women in Norway, it is important to evaluate the internal validity of the studies. Internal validity refers to the extent to which the observed study results represent the truth of the population being studied, without being distorted by methodological errors [164]. In this context, representativeness of the study sample is crucial. This thesis incorporates three distinct study samples, focusing on young adults and university students, as detailed in Table 4.

5.3.1 Target populations

This thesis specifically targets preconception young adult men and women in Norway. Similarly, the target population of the PREPARED project was men and women aged 20-35 years old in Norway, regardless of relationship status, who did not have biological children (Paper I).

Papers II and III, which were dietary assessment validation studies conducted to inform the PREPARED project, targeted young adults and university students, respectively. However, both studies encompassed a broader age range compared to the target population of the PREPARED project. Additionally, Paper II excluded individuals’ non-literate in Norwegian, while Paper III targeted individuals’ literate in Scandinavian, as indicated in Table 4.

5.3.2 Recruitment strategies and study samples

Convenience sampling was employed as the recruitment method for all three study samples in this thesis (Table 6). Recruitment method influences the representativeness (and hence, the internal validity) of study samples. Sampling methods can be categorised as probability or non-probability samples. Probability samples, considered the gold standard, ensure that each individual in a population has an equal chance of being selected, allowing for generalisability [165]. Non-probability samples, on the other hand, lack a known probability selection, introducing selection bias [165]. Convenience sampling is a non-probability method that enables reaching a broad audience within the target population, giving all eligible participants the opportunity to volunteer.

Study sample in the PREPARED study (Paper I and IV)

The study sample in the PREPARED study was relatively large, comprising 1362 participants. The sample represented all counties in Norway, with the majority coming from Oslo, Agder, Trøndelag, Vestland, and Viken (unpublished work). Furthermore, the sample reflected the targeted age group, as well as the proportions of overweight, including obese, individuals within that age group. It also included individuals with varying levels of education (details in Paper IV). However, the study sample did not exhibit an equal distribution of gender, and the education level was skewed towards higher education, with an underrepresentation of participants with lower educational level and an overrepresentation of participants with vocational- and higher education, relative to national statistics [166].

Study samples in Paper II and III

Both Paper II and III, similar to the PREPARED study sample, were overrepresented of female participants. In Paper II, there was also an overrepresentation of participants with higher education, likely due to the study's implementation at a university and targeted advertisement. The study sample in Paper III comprised individuals from all counties in Norway, with the majority coming from Agder, Rogaland, Viken, and Vestfold and Telemark (unpublished work using "Students diets 2" data). The educational level was not assessed in Paper III, as it specifically targeted new first-year university students. However, the reported parental educational level in Paper III indicated a relatively equal distribution of "higher education" and "other".

While Paper II and III did not specifically target a preconception population, that is, participants in these studies may have had children, it is reasonable to assume that the study samples reflect inclusion of preconception individuals based on the participants' age. Ideally, the dietary assessment validation studies should have been conducted in a sub-sample of the PREPARED study to better align with the main sample's characteristics, thus enhancing the validity of the dietary assessment tools for the target population and their applicability to the PREPARED study. However, this was not feasible, since the dietary assessment methods needed to be developed before initiating the PREPARED study (Paper I).

Bias associated with convenience sampling

Although a convenience sampling strategy has the strength of inclusivity, since it is not restricted to a predefined list, it introduces selection bias, limiting internal validity and representativeness, thus compromising the external validity of findings to the target population. Describing the characteristics of the study sample enables comparison with the target population and evaluation of generalisability.

Selection bias can occur when factors influencing individuals' participation affect the sample, thereby impacting study outcomes [167]. This can lead to sample bias, where the intended sample does not adequately reflect the characteristics of the target population it aims to represent [167]. Another potential source of error or bias in convenience sampling is self-selection bias, also known as volunteer bias. This occurs when participants self-select for enrolment in a study, potentially resulting in differences in relevant characteristics between participants and non-participants [167]. Volunteering participants may exhibit better health or health consciousness, affecting internal validity and exposure-outcome relationships, thus limiting the representativeness of study findings [168].

The study samples in this thesis demonstrate signs of sample bias by being overrepresented of females and highly educated participants (Table 6). While this is not uncommon in health behaviour-related studies [169-171], these characteristics are generally associated with higher diet quality [29]. This may attenuate the effects of the PREPARED digital intervention by limiting the potential for dietary improvements. Furthermore, volunteer bias may have influenced the outcomes of Paper IV, as health-conscious participants may possess better knowledge about diet and its effects, potentially overestimating the observed $DOHaD_{KNOWLEDGE}$.

It is important to acknowledge that Paper III did not test for nonresponse bias, which assesses whether there is a systematic difference between responders and non-responders [172]. Approximately half of the eligible study sample was excluded due to non-completion of the relative validation FFQ reference measure, potentially limiting generalisability.

5.3.3 Comparing the study samples from the dietary assessment validation studies (Papers II and III) to the PREPARED study (Papers I and IV)

Both Papers II and III reflected slightly younger samples compared to the PREPARED study sample. However, only Paper III had an interquartile range (IQR) that extended beyond the age range of the study sample in Paper IV. Additionally, while the dietary assessment validation studies primarily focused on the University of Agder in southern Norway, Paper III included a nationwide study sample, mirroring the scope of the PREPARED study. In the case of Paper II, the participants' county of origin was not evaluated. Nonetheless, given that university students and staff come from all over the country, there is no compelling reason to believe that the sample in Paper II significantly differs from that in Paper III. Furthermore, Paper II included individuals with varying levels of education, similar to Paper IV. In Paper III, the proportions of higher education among parents was similar to the population of Norwegian students in higher education aged 19-24 years old in 2022 [173]. Although Paper II did not assess participants BMI, the median and IQR values in Paper III closely resembled those presented in Paper IV.

Considering the similarities in age, geography, level of education, and BMI values between Paper III and the PREPARED study, it is reasonable to infer that the dietary data obtained using "MyFoodMonth 1.1" is valid for the study sample in Paper IV.

As a result, it can be reasonably concluded that the findings of this thesis (Papers II-IV) are generalisable to the broader population of preconception young adult men and women in Norway. However, the findings may be most relevant for females and individuals with higher education.

6 Conclusion

The overall aim and specific objectives were all achieved through the work included in this thesis. The overall aim of this thesis was to plan and establish the basis for the PREPARED project, with a specific emphasis on validating dietary assessment methods to be utilized throughout the entire project, while also conducting a specific analysis of DOHaD knowledge and diet quality on the baseline data.

In Paper I, a study protocol outlining the research process of the PREPARED project was developed. The project's primary aim is to evaluate the efficacy of a digital dietary intervention designed for young adults in the preconception period, utilizing an RCT study design. Additionally, the PREPARED project aims to assess the influence of parental preconception diet and nutrition on pregnancy and child neonatal outcomes within the DOHaD framework.
To achieve this, two dietary assessment validation studies were conducted to establish dietary assessment tools, “myfood24” and “MyFoodMonth 1.1”, to inform the PREPARED project.

Twenty-three digital food item image-series were developed to aid portion size estimation accuracy in “myfood24”. The accuracy of portion size estimations was generally satisfactory for most image-series compared to pre-weighed foods, except those depicting “Bread”, “Marzipan cake”, and “Caviar spread”. The ‘flat-slope phenomenon’ was apparent, as small portion sizes tended to be overestimated, and large portion sizes underestimated. Females estimated portion sizes more accurately than males. Re-evaluation and revalidation are considered for the image-series that performed badly.

The rapid non-quantitative dietary screener “MyFoodMonth 1.1” showed moderate-to-strong concordance for most raw measures and all aspects of diet quality and DQS components compared to a semi-quantitative FFQ. This was corroborated by the ranking ability of the dietary screener described using cross-tabulation and box-and whisker plots. The concordance was generally similar between sexes. Transparency of findings was ensured by presenting concordance coefficients with 95% CIs, cross-tabulation, and box-and-whisker plots for the raw measurements. The food items “Cereal and porridge, sweetened”, “Tomato sauce”, and “Coffee/tea/iced coffee/iced tea with sugar/syrup/honey” performed poorly and should be modified for future use of the dietary screener.

Baseline data in the PREPARED project was collected in line with the PREPARED study protocol (Paper I), which included employing the dietary screener “MyFoodMonth 1.1”. Preconception young adults in the PREPARED baseline data had moderate $\text{DOHaD}_{\text{KNOWLEDGE}}$ and suboptimal diet quality. Women were found to have a higher diet quality than men. A positive association was observed between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality, regardless of participants’ gender, BMI, and education. Adopting a public health preconception perspective that includes both women and men yields valuable insights irrespective of gender and pregnancy planning, aspects frequently overlooked in DOHaD research.

7 Implications

The dietary assessment validation studies (Papers II and III)

The food item image-series developed and validated in this thesis holds valuable potential to enhance nutrition research by aiding portion size estimation accuracy beyond this thesis and the PREPARED project. Including the image-series in the digital dietary assessment system "myfood24" available to all in Norway (for a fee), offers substantial opportunities to contribute to dietary studies. Furthermore, the image-series are available to all under creative commons law.

The dietary screener "MyFoodMonth 1.1" validated in this thesis presents a rapid and low-demanding dietary assessment tool with potential to positively enhance participant recruitment and potentially retention. Deriving the data from the dietary screener into aspects of diet quality and a Diet Quality Score enables a simple and intuitive evaluation of selected dietary recommendations and health-related dietary components. The dietary screener holds the potential to function as a main dietary assessment tool, to supplement other dietary assessment tools, or to be employed in studies where diet is a secondary outcome. Additionally, the dietary screener may be a viable option compared to comprehensive dietary assessment tools for longitudinal studies by compromising dietary details for reduced participant attrition.

The PREPARED study (Papers I and IV)

The PREPARED digital dietary intervention study, if proven successful, has the potential for a triple dividend in health. This implies enhancing the short- and long-term health of the individual and that of their offspring through improving preconception diet quality. One of the ways the effectiveness of the digital dietary intervention study will be evaluated is by employing the dietary assessment tools validated in this thesis. Furthermore, the PREPARED project will generate longitudinal data on the dietary trajectories across the preconception period using the dietary screener validated in this thesis, advancing the knowledge on preconception diet. The digital dietary intervention was designed for scalability and has the potential to be implemented as a public health initiative accessible to the entire preconception population. This potential extends far beyond the limits of this thesis and the PREPARED project.

To the best of my knowledge, this thesis contributes with one of the first studies on $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality among preconception young adults. The association observed between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality, strengthening the findings by McKerracher, Moffat [71], suggests an alternative approach to indirectly improve diet quality. Effectively translating and disseminating the theory and evidence of DOHaD and preconception nutrition knowledge to the public could be and effective approach to improving diet quality. These findings underscore the importance of knowledge and awareness in influencing dietary choices during the critical preconception period.

Including both preconception women and men in the PREPARED project provides a valuable gender perspective to the research field, an aspect of DOHaD research that has previously been mostly overlooked. The association between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and diet quality observed in men may be a significant finding considering the growing evidence of the potential effects of male preconception diet. This is particularly important because evidence suggest that men generally have lower diet quality than women. The findings of this thesis present a potentially exciting opportunity to improve both the health and disease trajectory of women, men, and their future offspring.

8 Future perspectives

- Future research should prioritize validating the Norwegian version of "myfood24". This validation could be achieved through the implementation of a feeding study design and/or the utilization of biomarkers to compare self-reported dietary intake against actual food and nutrient consumption.
- It is advisable to reevaluate and re-validate the food item image-series for "Bread", "Caviar spread", and "Marzipan cake". Moreover, developing and validating additional food item image-series have the potential to enhance portion size estimation accuracy for future use of "myfood24".

- In future application of the dietary screener "MyFoodMonth 1.1" it is recommended that modifications be made to the food items "Cereal and porridge, sweetened", "Tomato sauce", and "Coffee/tea/iced coffee/iced tea with sugar/syrup/honey" (detailed in Section 5.1.2). Additionally, caution and prudence should be exercised when using the food items "Plant-based meat substitutes" and "Nuts and seeds, unsalted", as these were not validated.

- In forthcoming studies within the PREPARED project, examining the potential causal link between $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ and diet quality should be elucidated. Additionally, attention should be given to covariates, such as health literacy, relationship status, and pregnancy intention, to evaluate potential confounding or mediating variables within the studied relationship.
- Nutrition research concerning the preconception period and/or DOHaD should consider including both male and female participants, when contextually relevant, to better understand the potential health and disease risk for both sexes and the next generation.
- Furthermore, studies targeting preconception populations should explore alternative recruitment approaches to effectively engage individuals of diverse educational backgrounds, as well as both sexes.

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Appendices

Paper I

Øverby, N. C., Medin, A. C., Valen, E. L., Salvesen, L., Wills, A. K., Engeset, D., Vik, F. N., & Hillesund, E. R., *Effectiveness of a digital dietary intervention program targeting young adults before parenthood: protocol for the PREPARED randomised controlled trial*. BMJ Open, 2021. **11**(12): p. e055116.

BMJ Open

Effectiveness of a digital dietary intervention program targeting young adults before parenthood: protocol for the PREPARED randomised controlled trial

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ABSTRACT

Introduction The importance of preconception health for lifelong physical and mental health in the next generation has gained increasing recognition in recent years. Preconception paternal and maternal risk factors such as obesity and inadequate diet affect the metabolic and cardiovascular health of their offspring later in life. This highlights the importance of diet and dietary behaviour in the years before parenthood. In our project, PREPARED, we will evaluate the effectiveness of a digital intervention targeting young adults. Our primary aim is to improve participants' preconception diet, and our secondary aim is to improve preconception quality of life and maternal and child perinatal outcomes.

Methods and analysis We plan to recruit 7000 men and women individually, aged 20–35 years without children, to be randomised to an intervention or a control group. The intervention group will receive access to a digital resource for 6 months promoting a healthy diet for their health now, later in life and for the next generation. Follow-up is up to 20 years or until they have their first child. To evaluate intervention effects, we will collect dietary data (2×24-hour dietary recalls and a screener). For those participants for which birth ensues, we will link study data with data from the Medical Birth Registry of Norway on maternal and child perinatal outcomes.

Ethics and dissemination The study is approved by the Regional Ethics Committee, the Norwegian Data Protection Service and our Faculty Ethical Committee (REC: 78104, NSD: 907212, FEC 20/10119). Participation is voluntary and all participants will provide informed consent. Participants can withdraw their consent without giving any reason. Findings will be communicated to the public through a project website and social media, and to professionals through conferences and peer-reviewed papers.

Trial registration number ISRCTN44294662.

Strengths and limitations of this study

- ► This is one of the first studies to evaluate the effects of a digital dietary intervention carried out during the preconception years using a randomised controlled design.
- ► Pregnancy and child outcomes will be evaluated by linkage to the unique Medical Birth Registry data of Norway.
- ► If the intervention proves to be effective, it can be implemented at scale targeting young people to improve their current health and health for the next generation.
- ► Challenges relate to recruitment and retention which could compromise statistical power and validity.

INTRODUCTION

The importance of preconception health for lifelong physical and mental health in the next generation has gained increasing recognition in recent years.[1] Preconception paternal and maternal risk factors such as obesity, inadequate diet, undernutrition, diabetes mellitus and hyperglycaemia affect the metabolic and cardiovascular health of their offspring later in life.[1 2] In 2018, a Lancet series on preconception health reviewed the existing literature from biological, epidemiological and behavioural research and highlighted the importance of adequate nutrition in this phase.[1 3 4] Combined, maternal and paternal periconceptional nutritional status provide a legacy for offspring health and development through its influence on egg and sperm integrity and thereby the very foundation for subsequent embryo development.[3 5 6] The parental periconceptional nutritional status could be viewed as the biological capital acquired from a long-term diet and is a composite entity.

The preconception phase is not straightforward to define, as the exact time of conceiving is unknown, and the fertile age is wide. Stephenson *et al*[1] proposed three definitions for this phase: (1) the biological perspective—the days to weeks before conception and embryonic development; (2) the individual perspective—starting with a conscious intention to conceive, typically weeks to months before the pregnancy occurs; and (3) the public health perspective—the months or years from puberty with the possibility to address preconception risk factors such as diet. The preconception phase may thus range from early adolescence to late adulthood. Barker *et al* suggest that public health preconception initiatives should be broader and more general compared with those targeting people planning pregnancies, as many will not be motivated for health change solely by the thought of affecting a potential future child.[4] There are, however, few interventions addressing this general public health perspective.[4 5] Existing studies typically relate to improving diet in couples with compromised fertility or target women who are actively planning pregnancy.[7 8] Research in low-income and middle-income countries settings has evaluated the effects of providing dietary supplements.[9] Some studies are also in the planning, among them The Healthy Life Trajectories Initiative, the HELTI-project, which is a consortium of four studies evaluating whether an integrated intervention starting preconceptionally will reduce non-communicable disease (NCD) risk in participants' future children.[9 10] HELTI primarily recruits women (one study partner also recruits partners), and women who are planning to have children. In our study, we recruit men and women individually, regardless of partnership and plans for children. Public health actions towards the general preconception population are scarce,[4] but could yield high returns at low cost and are, therefore, highly warranted and called for.[1 4 11]

Poor diet is a leading risk factor for NCDs, which accounts for 80%–90% of the disease burden in Western countries.[12] By addressing preconception diet a triple dividend is envisioned, with the potential to affect the current and future health of the targeted person as well as the health of future children.[1] Aside from official recommendations on folate supplements and abstaining from alcohol while planning pregnancy, diet is hardly addressed in preconception care in Norway. National surveys suggest significant opportunities for dietary improvements in the intake of fruits, vegetables, whole grains, nuts/seeds, fish and milk as well as reduced intake of processed meat and salt among Norwegian young adults.[13] In addition, our recent study of the diet of Norwegian students identified a reason for concern, showing low diet quality compared with recommendations, with a more deficient diet among men than women.[14] Students constitute a large proportion of the preconception population in Norway. Hence, there is an opportunity for being better prepared for one's health and the health of the next generation.[15]

In our project, PREPARED, we will evaluate a newly developed digital intervention targeting young men and women aged 20–35 individually, in a randomised controlled trial. Our primary aim is to improve participants' diet and secondary aims are (1) to improve participants' quality of life and (2) improve maternal and child perinatal outcomes by following participants up to 20 years or until they have their first child.

METHODS AND ANALYSIS

This protocol paper has been written according to the Standard Protocol Items: Recommendations for Interventional Trials guidance.[16]

Aim

The study aims to evaluate the effectiveness of a digital dietary intervention among young adults before parenthood. We hypothesise that being exposed to the intervention will lead to improved male and female knowledge and skills concerning diet and lead to healthier preconception diet, improved health-related quality of life with potential sustained effect in future pregnancy as documented by the reduced prevalence of pregnancy complications and improved newborn anthropometry relative to the control group.

The PREPARED study is a nationwide, randomised controlled digital dietary intervention trial. Participants will be followed from inclusion until their first child is born, or a maximum of 20 years. With this long duration of data collection and yearly follow-up questionnaires regarding diet, the study provides updated information on parental diet as proximal as possible to parenthood. Data collected with this type of design can also be used to investigate diet-outcome associations.

Participants

We will recruit men and women aged 20–35 years without biological children. *Inclusion criteria:* participants will be eligible for the study if they are born in the years 1986–2001, have no biological children, possess an 11-digit Norwegian identification number, are literate in Norwegian/Scandinavian as the intervention content is in Norwegian only and have access to a smartphone or another digital device.

Participants will be recruited individually, regardless of whether they are in a relationship or not. As the project relates to family planning and future parenthood, one could envision that couples would like to participate together. We will inform participants in advance that only one person per couple may participate. Participants will be asked whether they are in a relationship and whether their partner participates in the study. This will be done to be able to run sensitivity analyses, omitting possible contamination of data from couples taking part in the study together and being in different intervention groups. Due to the long timeframe for this study, the current partner situation may not be the same as when participants decide to start a family. We will therefore continue to ask regularly if the partner participates in the study. We will not request the identity of the partner.

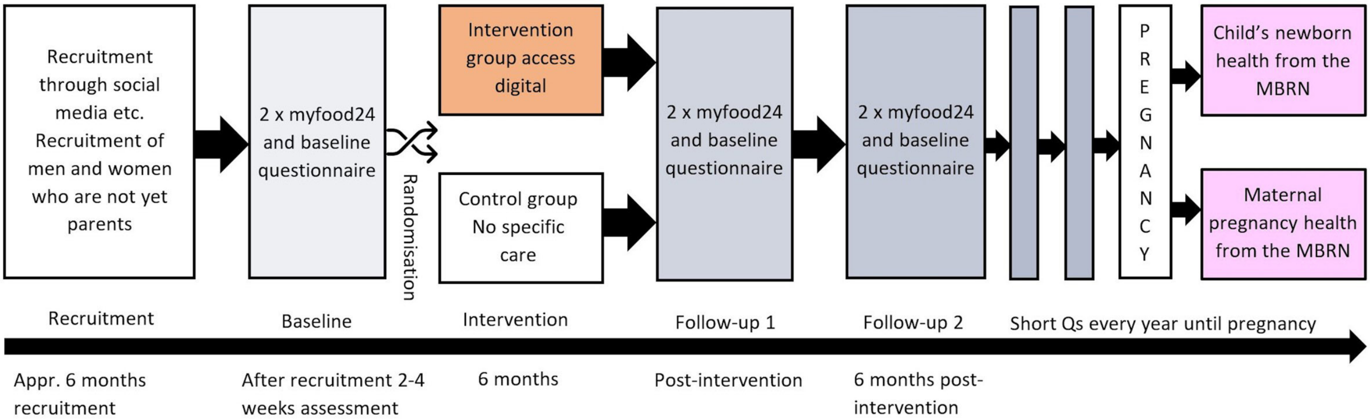

Figure 1 Timeline for the PREPARED project. MBRN, Medical Birth Registry Norway; Qs, questionnaires.

Detailed study outline, recruitment and randomisation

We will recruit among all Norwegian residents who belong to the target population and holds a Norwegian identification number. We originally planned to apply a dual recruitment strategy, targeting potential participants via both postal mail and social media. In the pilot study (see aim below), we only recruited through postal letters (August 2021). This was not a successful strategy. We will therefore recruit only through social media in the main study as we have experience of this being successful from other studies.[17] The main study will start recruiting in October 2021 and continue throughout April 2022. With assistance and surveillance from the University of Agder (UiA) Communication Division, we will recruit participants through tailored social media advertisement, with text and video content adjusted according to the response. Given the use of social media recruitment, we cannot exclude recruitment of Norwegians living outside Norway. As long as they fulfil inclusion criteria they will be included. All data will be collected digitally.

An overview of the project timeline is provided in figure 1. Participants will be enrolled in the study continuously following self-registration and providing their informed consent online when logging into the baseline questionnaire.

Participants will be randomised after they have filled in a baseline questionnaire (see table 1) and completed 2×24-hour dietary recalls at least 14 days apart. Knowing

Table 1 Overview of primary (PO) and secondary (SO) outcomes and methods for the randomized controlled trial (RCT)

Outcome	Variable	Measure	Instrument	Sample size* (incl. dropout)†
Preconception diet (PO)‡	Overall diet Diet quality	Food and nutrient intake Diet score	2×24 hour recall (myfood24) Food propensity questionnaire	211 (264)§
Preconception Health-related quality of life (SO)	Health-related Quality of life	Self-reported quality of life	Satisfaction with life scale RAND-12 Health Status Inventory	–
Pregnancy health (SO)	Gestational weight gain (GWG)	GWG (absolute measure and relative to guidelines)	Data retrieved from MBRN as recorded in pregnancy records and birth certificate	1100 (1375)¶
	Hypertensive disorders	Preeclampsia yes/no		–
	Gestational diabetes	Gestational diabetes yes/no		2517 (3147)**
Neonatal health (SO)	Growth measures at birth	Birth weight, length and head circumference	Data retrieved from MBRN.	–
		LGA/SGA		1044 (1305)**
	Gestational age-adjusted weight/length	Birth weight≥4000 g		–
	Newborn adiposity Preterm delivery	Ponderal index (kg/cm‡)<37 weeks of gestation		461 (577)**

*Numbers needed in each group. Calculated with a statistical power of 80% and type 1 error of 5%.
†Accounted for a 25% dropout rate in line with other interventions.[30]
‡Measured at baseline, post intervention and follow-up.
§Healthy Eating Index from The Norwegian Mother, Father and Child cohort (MoBa) (mean score 49.8±7.3 (SD)) used as a proxy for the planned PRECDIET score. As even small improvements in diet are relevant to public health, we assume an increase of 2 points to have a public health impact.
¶Estimation based on the 1 kg decrease in GWG with SD from.[28]
**Based on proportions from Medical Birth Registry of Norway (MBRN), assuming improvement in line with previous group differences in pregnancy.[30]
LGA, large for gestational age; SGA, small for gestational age.

that it is difficult to get participants to fill in 2 24 hour recalls, we will also randomise those who have only filled in one 24 hours recall after two reminders of filling in the second. Block randomisation with a 1:1 allocation ratio of eligible participants from a computer-generated list will be used. A statistician (M LeBlanc) with no other role in the data collection has generated the allocation sequence. An email will be sent automatically, informing the participant about which group he/she has been allocated to. In line with the nature of the intervention, this is an open-label study where participants are aware of their intervention status, but the statistician and all involved researchers only have access to anonymised datasets. The automatic recruitment system, which is a separate system from data collection and the intervention, is set up so that only one researcher (ELV) have access can see the email addresses of those who accept to participate. This is not connected to the entry of any data; however, one can see the e-mail-address and the group the person has been automatically drawn to. The list can only be accessed by two persons, one developer and ELV. Blinding of data will only be reversed in the case that a participant withdraws his/her consent for participation. In such cases, data withdrawal will be performed by a project worker and still be anonymised for the researchers performing the analysis.

Following randomisation (see figure 1), participants randomised to the intervention group will be given access to a digital intervention for 26 weeks counted from the day of first access. The control group will receive an email informing about group allocation, highlighting the importance of control groups in research and the value of their continued responses to questionnaires. In addition, as an incentive to participate, all participants finishing the baseline and two first follow-ups will be included in a lottery of 10×5000 Norwegian Kroner (NOK) gift cards.

Follow-up assessments by questionnaires will be done 6 and 12 months after the intervention. Yearly assessments will be performed until the first child is born, or a maximum of 20 years. If a participant indicates that he/she is becoming a father/mother, we will ask for consent to use data from the Norwegian birth registry from both parents, regardless of whether the partner has participated actively in the project or not. After the birth of the first child, a final questionnaire will be sent by email to the participating parent.

We will strive to promote participant retention in the study by sending promotional reminders. We will communicate to all participants that continued participation is important for maintaining good retention rates. We will make short, animated films to motivate this. These films will not be sent to the pilot participants.

Pilot study

We are piloting the study in August–November 2021. The aim of the pilot study is to trial recruitment strategy, assess compliance and retention, testing our data collection instruments, evaluate the automated data-sampling flow and help develop data management and entry processes. We will further assess at what stages participants drop out and speculate on possible reasons for this and identify whether there are questions that are not responded to. We will use these data to plan strategies for how to reduce dropout, how to handle questionnaires with few entries and more. Further, we will explore group differences between those participating and not regarding gender, age and where they live. We have sent postal invitations to 1000 individuals. The pilot sample is drawn by Statistics Norway to be nationally representative of the population relevant for this study. Preliminary results show that this is not a preferred recruitment method as (1) several addresses are no longer correct and the letters are returned (n=140) and (2) the number of people who have agreed to participate is low (no reminders have been sent). We will analyse the pilot data using the same statistical methods as in the main study. We will not include data from the pilot in the main study.

Development and description of the dietary intervention

A digital dietary intervention, aiming at promoting the importance and usefulness of a healthy diet for health now, later in life and in the next generation has been developed. The intervention is designed to target both men and women, with a special focus on reaching men due to the less communicated relevance of male preconception diet for the health of prospective children. To aid the intervention development, we conducted short interviews with 34 men and women in the target group about what content they would like from a digital resource aiming to improve diet and what they perceived would motivate them to modify dietary habits (in manuscript). Based on findings from these interviews, we decided to apply self-determination theory to guide the development of promotional messages, aiming to meet participants' need for autonomy, competence and relatedness through the intervention content.[18 19]

The Determinants of Nutrition and Eating framework was used to decide on determinants to be targeted through the intervention.[20] We targeted modifiable determinants at the individual level with relatively high population-level effect, being *Self-regulation, Food Knowledge, Skills and Abilities, Nutrition Knowledge, Health Cognition, Food Habits, Food Beliefs* and *Eating Regulation.*

The resulting digital resource is designed as a webpage with informational videos and texts highlighting the dividends of healthy eating, illustrated recipes and practical information related to meal planning and healthy cooking. All content is in line with official Norwegian dietary recommendations and highlights the importance of food choice for health and well-being. The webpage is designed for weekly advance to a new level with additional information material and recipes to be accessed. Intervention participants will be approached weekly by email, including a short motivational message aimed at inspiring them to visit the website to access new educational content. No other strategies to improve adherence will be used. The duration of the digital intervention is 6 months and is partly due to (1) costs and timeframe,[21] (2) stakeholders asking for short messages over some time instead of long messages over a short period and (3) the general perception that less than 6 months is too short to see long-term changes for public health interventions. We will monitor the number of times participants visit the different content on the website and time spent there.

As PREPARED is a low-intensity intervention aiming to promote healthy dietary behaviour and for the general public harm seems unlikely. For vulnerable groups, such as persons with disordered eating could have unintended effects. However, the intervention focuses on the fundamental need for food to thrive and there is no focus on energy balance. Therefore we have not included criteria for discontinuing the intervention, other than at participant request. Further, we will not assess nor prohibit participant participation in other interventions during the intervention period.

Control group

The control group will not be given access to the intervention website and will not receive any other form of intervention. Neither the intervention group nor the control group will receive feedback regarding individual results.

Outcome measurements

Primary and secondary outcomes are presented in table 1 including suggestive power calculations for each outcome.

Primary outcomes

The primary outcome of the trial is the postintervention preconception diet (overall diet and diet quality). Diet quality is assessed by the degree of adherence to Norwegian nutrition and food-based guidelines, indicating a healthier diet. Dietary intake will be assessed using two different tools. At baseline, at the end of the intervention (after 6 months), and 6 months after the intervention is completed, participants will be asked to complete 2×24-hour dietary recalls using the validated instrument myfood24.[22 23] This will yield data on nutrient and food intake (both diet quality measures). In addition, a questionnaire comprising a short newly validated (not yet published) food propensity questionnaire will be used to assess the intake frequency of selected food items relevant to evaluate diet quality by adherence to food-based guidelines at all time points (once a year until the first child is born). This food propensity questionnaire includes frequency questions (times/day) on 33 food items (bread, cereal, spread, dinner foods, sweets and sugary foods and drinks). Nine response alternatives are given, ranging from six times a day or more to never. The questionnaire is designed to capture 6 of the 12 Norwegian dietary guidelines. A score will be developed to quantify adherence to the dietary guidelines.

Secondary outcomes

The secondary outcomes are health-related quality of life measured by the satisfaction with life scale[24] and RAND-12.[25] Maternal pregnancy health (gestational weight gain, preeclampsia, gestational diabetes) and neonatal health (birth weight, birth length, head circumference, gestational age-adjusted weight/length, newborn adiposity and preterm delivery). Maternal pregnancy health and neonatal health are retrieved from the Medical Birth Registry of Norway (MBRN) (see table 1).

Other study parameters

Several variables will be assessed as potential confounders and effect modifiers. The presented variables in this section are all self-reported. Gender (man/woman/other), ethnicity (your native tongue, your parents' native tongue), socio-economic status (SES) (economy (house owner, manages unexpected bills), education, work status), area of residence (number of people in city/county), family structure, sleep, physical activity/sedentary behaviour/screen time (how often and duration), use of tobacco products, having been breastfed as a child, birth weight of the participant (categorical), current height and weight, quality of life (two different scales (see table 1)), Developmental Origins of Health and Disease-knowledge (how they agree on statements on the importance of diet during pregnancy and link to obesity and growth) and whether they are currently trying to conceive.[26] The questions on birth weight and being breastfed are exploratively used. As we have not included these questions before, response is optional. Our impression is that this is information many knows.

Process evaluation

We will perform a process evaluation in line with the Medical Research Council (MRC) guidance of 'Process evaluation of Complex interventions'[27] and will assess implementation, context and mechanisms of impact. Regarding implementation, we will assess fidelity (whether the intervention was delivered as intended, measured by use of the intervention web-site (routine monitoring data, whether they enter the web-page when receiving an e-mail, whether they watch all content or just some of it)), dose (the quantity of intervention implemented (routine monitoring data, for how long are they staying at the intervention page, how often do they enter on a group level)) and 'reach' of intervention (whether the intended audience encounters the intervention, and whether we reach both genders and all age groups). We will explore mechanisms of potential change using quantitative (outcome assessment) and qualitative methods (interviews with users). To evaluate the influence of contextual factors on intervention effects we consider quantitative background variables such as socioeconomic factors, participant being in a relationship or not, and whether actively planning parenthood or not.

Sample size calculation

Sample-size estimations for selected outcomes are presented in table 1 (25% dropout included). For our primary outcome, preconception diet, we will assess changes in diet in male and female participants separately, necessitating the recruitment of 528 people of both genders. For quality of life (QoL) outcomes, we will need 916 of both genders. Sample size calculation was carried out for most secondary outcomes on pregnancy and child health outcomes (see table 1). The highest number needed to identify a possible effect of the intervention on these outcomes is 2517 in each group, necessitating a total of 5034 participants, equalising 6294 with a 25% dropout rate. Because of the long follow-up, and uncertainty regarding what time (if) participants get pregnant, we will recruit as many as possible, aiming for at least 7000 participants, hopefully leaving us with the needed numbers in the final analyses. There are several assumptions behind the sample size calculation. First, there is no clear definition of the needed size of a dietary change relevant for public health, so those are decisions based on collective knowledge and literature. Second, a dropout rate of 25% is somewhat modest, however in line with some of our previous interventions.[17 28] It is, however, important to mention that by linking data to the MBRN, the drop-out will be minimal for secondary outcomes from MBRN, as most will respond to the baseline questionnaire, and intention-to-treat analyses do not rely on follow-up measures of diet for these outcomes. Third, we do not know the effect of the long-term follow-up period on attrition, as few studies have done this before. We, therefore, aim to recruit at least 7000 for baseline.

Statistical analysis

Analyses will be carried out on an intention to treat basis. Descriptive statistics for baseline characteristics and diet in the two arms will be presented according to sex. Attrition in the two arms will be presented and compared, also stratified by sex.

Measures of diet 6 and 12 months after randomisation (post intervention and 6 months post intervention) are the primary outcome of the study and will be captured by a score type variable; other outcomes include continuous (eg, birth weight) and binary variables (eg, pre-eclampsia). All will be analysed with an appropriate general linear model, the selection of which will be aided using model diagnostics. Change score analysis that determines the group effect based on the difference between the baseline and the post-treatment score will likely be used for the main outcome—this improves power when the correlation between baseline and follow-up is high as expected for diet outcomes[29] but we will adjust for baseline if there are unexpected baseline differences in the outcomes. While a statistically principled approach will be used to develop the finer details of the analytical approach, sensitivity analyses will be performed to test the robustness of findings to such decisions.

Per-protocol analyses (predetermined minimum use or fidelity of the digital resource) may also be carried out, but only to get an indication of the power of the intervention components. We will assess formal statistical interactions (eg, sex, age, education and pregnancy intention). Findings from such subgroup analyses will be used to generate potential new hypotheses that need to be tested.

Data management

A detailed plan for data entry, coding security and storage has been developed. In short, all person-sensitive data will be stored at the Services for sensitive data (TSD), University of Oslo, a secured server. See figure 2 for an overview of the data storage and handling. When participants register for participation, they will use a two-factor authentication system to enter their data in TSD. All data combined with a person identifying variable will be stored in TSD. Data from myfood24 will be stored at servers at DigitalOcean in Amsterdam temporarily and then stored at TSD, with a secure backup in London (The General Data Protection Regulation (GDPR) compliant). Participants' e-mail addresses and secondary key codes will be collected from TSD and saved on a cloud storage application at the university with a two-factor authentication log-in to recruit for dietary assessment, also in line with GDPR. Further, all data will be stored at TSD. Data will be checked for double registrations routinely, and all variables will be checked for validity/plausibility. Self-reported data entry fields have a restricted range of legal values to minimise errors and outliers, that is, height and weight.

Data monitoring

We have not included a data monitoring committee in this project. We address the general public (not patients) with messages aimed at motivating dietary change and for the general public harm seems unlikely. The resulting dietary changes are expected to be small, although potentially important. As we believe harm is unlikely (see above), a data monitoring committee was not considered needed. An interim analysis will therefore not be done only for the sake of checking how the intervention is working. We will start evaluating our main hypothesis and combine data from the MBRN when the number of pregnancies in the cohort reaches 1100. We expect this to take 3–5 years, depending on the age distribution in the recruited sample. No external auditing group will be established.

Participant and public involvement

We have involved the target group at several stages in the development of the study. First, we had initial discussions with six students in the relevant age group regarding how to communicate sensitive issues how your diet today may affect your children later. This helped us with the framing of the project of not giving advice, merely focusing on information and how the system around food works at different levels. To gain insight into target group opinion and priorities as we were exploring topics for the intervention, we carried out brief interviews in three public places in January 2020. A total of 34 young adults provided informed consent to be interviewed and responded to questions related to motivation for healthy eating, what they needed from a digital intervention to be inspired,

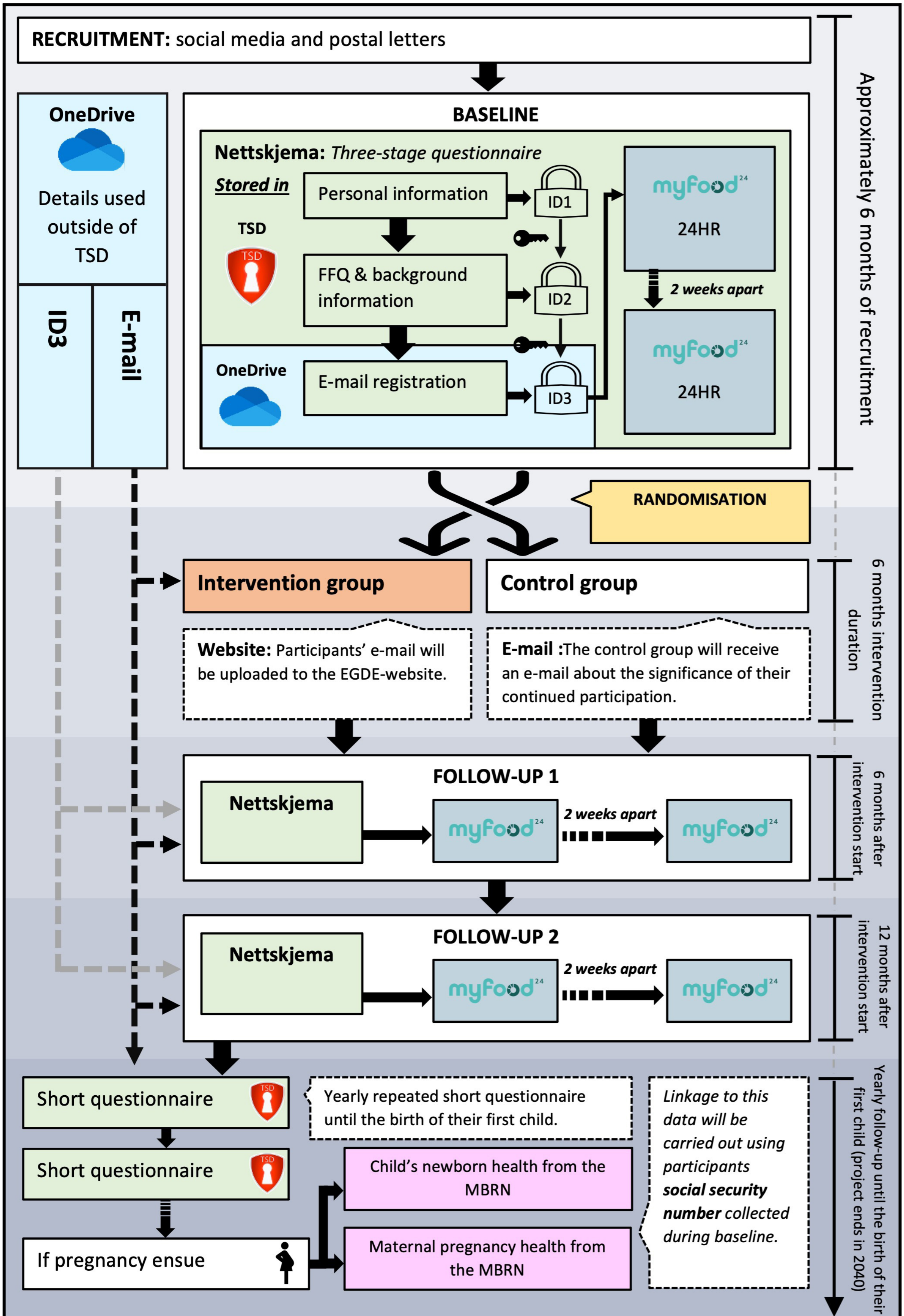

Figure 2 Timeline including data on data safety and storage. MBRN, Medical Birth Registry of Norway; TSD, services for sensitive data.

whether they believed preconception diet affected future children, and what they thought would motivate the target population to participate in our project. We also carried out 13 focus group discussions where 57 university students consented to participate, addressing preconception diet and how courses or interventions might be carried out to improve diet in these phases.

Further, we involved representatives of the target group in overseeing texts and videos to discover elements or passages that could seem unclear and adapted content accordingly.

The research questions and outcome measures and recruitment strategy were partly informed by information gained in the target group interviews and the focus group discussions, however mainly from the literature pointing to the importance of nutrition and diet in the preconception phase. We will involve the target group when results are to be communicated to participants and the public to secure communication that is non-condemning/blaming/hurting and just informative.

ETHICS AND DISSEMINATION

The project has been approved by the Regional Ethics Committee (REC) and our Faculty Ethical Committee (FEC) and the Norwegian Data Protection Service (NSD) (id-numbers: REC: 78104, FEC 20/10119. NSD: 907212). Required protocol modifications will be submitted to the REC the NSD and the trial registry ISRCTN. Participation is voluntary, and participants must first choose to participate on the website before they can provide identification, then digitally actively consent to participation and then start completing the questionnaire. Participants can withdraw their consent without giving any reason. The participants consent to the use of the data in ancillary studies.

As this is an intervention aiming to promote healthy dietary behaviour, harm seems unlikely for the general population. For vulnerable groups, such as persons with disordered eating the intervention could have unintended effects. However, the intervention focuses on the fundamental need for food to thrive and there is no focus on energy balance.

One of the secondary aims of PREPARED is to evaluate the long-term effect of the dietary intervention on maternal and child outcomes. We will collect new consent from both parents for their preconception data to be merged with pregnancy and birth data in the MBRN.

Personal information will be stored in TSD and no personal data will be shared from this project. Only anonymised data will be shared.

For the general public and our participants, we plan to communicate results through a project website and our research group's Twitter account. For healthcare professionals and the research society, we will publish our results in peer-reviewed journals and conferences.

Data sharing plan: We plan to share anonymised data in the UiA deposit Dataverse. This will be done no later than the acceptance for publication of the main findings from the final dataset. We will retain our data for 5 years after data collection has stopped (meaning that data from our baseline will be available no later than 2027 or on publication of main findings). Standard meta-information about the data will be uploaded.

DISCUSSION

The PREPARED study is one of the first to investigate the potential effects of a dietary intervention during preconception years on participant year-by-year diet and maternal and child outcomes in a future pregnancy. This study has a public health perspective targeting both men and women aged 20–35 in general in line with definitions from Stephenson *et al*.[1] Most studies to date have targeted persons planning a pregnancy or specific vulnerable groups. The PREPARED study is planned as an intervention that, if feasible and successful, can be easily scaled up as a public health initiative at a national level and be implemented in other settings. The digital and low cost approach is an advantage for scaling up and makes it easy to include new elements if deemed necessary in potential updated versions.

One strength of this study is the possibility of combining repeated diet information with maternal and child data from the birth registry for participants' future children.

The long duration of the project is one of its strengths, but it also involves methodological challenges regarding loss to follow-up. There is a risk of loss to follow-up in several phases; therefore, there is a need to build a sense of identity to the study to make the participants continue responding to a short questionnaire every year. We will make the follow-up questionnaires less time-consuming (5–10 min). In addition, our choice of dietary methods, 2×24-hour dietary recalls in combination with a short dietary screener provide less systematic errors and is no more time consuming than an Food frequency questionnaire (FFQ), but the fact that one has to respond twice at 2 week intervals gives a risk of loss to follow-up. We therefore want to randomise those with only one dietary recall if they have not filled in the second after two reminders.

The age range that we target may be a limitation of our study, since it is very broad and include participants in different phases of life. The age range was decided on using two principles: (1) broad reach and (2) 'do not harm' addressing these issues. With the broad approach, we first wanted to include 18–45 year-olds as this roughly corresponds to fertile age above the age of majority.[18] However most 18–19 year-olds still attend public schools and live at home, and as we wanted to approach the young adults themselves (not their parents), we chose the lower age limit to be 20 years. We discussed the upper age limit with several persons from our target population and concluded that being approached with a study focusing on your first child might seem strange or difficult if you do not yet have, and truly want, children. We, therefore, chose 20–35 years of age as the most appropriate age group to target. Still, this age span includes participants in potentially very different phases of life. Emerging adulthood has recently been proposed as a new life stage between adolescence and young adulthood, lasting from ages about 18–25. This period is characterised by identity exploration, trying out various life experiences and not yet taking the responsibility as is normative in adulthood. We also include ages 25–35, where more take on adult responsibility. The average parental age of the first child is around 32 in Norway, this period is, therefore, crucial to include. Another limitation is the intervention period of 6 months, which may be a bit short to achieve lasting changes. This might also have been approached more thoroughly by early phase trials, as suggested by Voils *et al*.[21] However, we believe that this is new knowledge for young adults and can therefore motivate change even if it is only provided for 6 months.

This study is one of the first to evaluate the potential effects of a dietary intervention targeting adults aged 20–35 without biological children. We will evaluate the effect of the intervention on aspects of diet, and the long-term effect on newborn health of their future children. The long follow-up time and the large sample size also make this study an interesting and important cohort. Findings regarding potential intervention effect on adult diet will be reported in 2–3 years, while preliminary effects on child health are expected in 5–10 years. This study will, if successful, provide an easily scalable intervention to approach the general young adult population to promote a healthy start for their future children. In addition, the study will provide unique long-term data on young adults' diet in preconception years.

AUTHORSHIP ELIGIBILITY GUIDELINES

All included authors of the protocol paper will be invited to contribute as coauthors for the first result paper. For future papers, Principal Investigator (PI) and co-PI will be asked to be included and will adhere to author guidelines, others will be asked on request and must qualify for authorship by participating in analyzing, writing or interpretation.

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Contributors NCO, ERH and FNV conceived the main conceptual ideas and applied for funding. FNV led the work on planning the recruitment strategy, assisted by ELV. ERH led the work on the development of the intervention, assisted by ELV, NCO, ACM and LS. ACM led the work on the choice of methods, developing questionnaires, assisted by ELV, LS, NCO. NCO led the work on developing the flow and system of the project (see figure 2) and the data management, assisted by ELV, LS, DE, ACM. NCO is the PI in collaboration with ERH as co-PI. AKW has been advising on the choice of statistical approaches and study design. NCO drafted the protocol paper, and all authors have critically reviewed, commented and revised it. All authors have approved the last version of the paper.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

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Paper II and supplementary files

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RESEARCH ARTICLE

Development and evaluation of image-series for portion size estimation in dietary assessment among adults

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Abstract

Portion size images are advantageous in dietary assessment. The aim of the present study was to develop and validate new culturally specific image-series for portion size estimation to be used in a new Norwegian version of a British web-based dietary assessment tool (myfood24). Twenty-three image-series of different foods, each containing seven portion size images, were created and validated in a group of adults (*n* 41, 58 % female) aged 19–44 (median 23), out of which 63 % had higher (tertiary) education. The participants compared 46 portions of pre-weighed foods to the portion size images (1886 comparisons in total). Portion size estimations were either classified as correct, adjacent or misclassified. The weight discrepancy in percentage between the chosen and the correct portion size image was also calculated. Mann–Whitney *U* tests were used to explore if portion size estimation accuracy differed across sample characteristics, or if it depended on how the foods were presented. For thirty-eight of the forty-six presented food items, the participants selected the correct or adjacent portion size image 98 % on average. The remaining eight food items were on average misclassified by 27 % of the participants. Overall, a mean weight discrepancy of 2·5 % was observed between the chosen and the correct portion size images. Females estimated portion size more accurately than males ($P = 0{\cdot}019$). No other significant differences in estimation accuracy were observed. In conclusion, the new image-series performed satisfactorily, except for the image-series depicting bread, caviar spread and marzipan cake, which will be altered. The present study demonstrates the importance of validating portion size estimation tools.

Key words: Dietary assessment: Validation: Methodology: Portion size estimation: Images

Introduction

Improving diet quality could potentially prevent one in five deaths globally[1]. In Norway, diet is one of the modifiable risk factors that cause the most deaths, along with high blood pressure and smoking[2]. Clearly, there is a need for effective strategies to improve diet, which depend on accurate data on dietary intakes which require valid dietary assessment methods. Portion size estimates is a critical element in dietary assessment[3–6]. A recent systematic review by Amoutzopoulos *et al.* shows that there is a lack of validated portion size estimation tools, and consequently a pressing need for more validation studies[7].

Self-administered web-based dietary assessment methods represent a favourable option to the standard methods of assessing diet by paper or telephone. They are readily available for the participant at any time and place, and reduces the cost of conducting a dietary assessment and the burden for both the participants and the researchers[8,9].

An example of a digital version of the traditional 24-h recall method, is the self-administered web-based 24-h recall system myfood24, developed in Leeds, England[10]. The myfood24-system has been validated in various settings[11–13] and adapted to several country-specific versions (Australia, Denmark and Germany[14]). Norway lacks a self-administered web-based 24-h-recall-system for adults. Hence, we have recently adapted the British myfood24 for Norway, including the image-series for portion size estimations.

In terms of validity, the web-based dietary assessment tools and standard methods have been shown to be in close

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agreement[13,15]. Along with the development of web-based dietary assessment tools over the last years, the traditional portion size estimation tools, e.g. food models and household measures, have been largely replaced by digital images of portion sizes. Importantly, food images have been shown to be more accurate compared with food models and household utensils in the review by Amoutzopoulos *et al.*[7] Further, two studies included in their review compared digital images and printed images, and reported no statistical difference in accuracy between these image types[16,17]. It is established that the number of images in an image-series affects the portion size estimation accuracy, favouring a high number of images[18,19], which is more convenient when using a digital format *v.* printed images.

Reporting accuracy in dietary assessment is affected by a number of factors, such as demographics (sex, age, education and body mass index) and the dietary assessment method used. Previous research shows conflicting results regarding estimation accuracy between the sexes when using photographs or images to estimate portion size, where some found greater underestimation among male participants[18,20], while others found no statistical difference[21,22]. Moreover, previous studies have not observed associations between the educational level and the perception of portion size[20,21].

The overall aim of the present study was to develop new culturally specific image-series for portion size estimation and assess their validity. As part of validating the image-series, we explored whether portion size estimation accuracy differed by sex, level of education, and whether participants had studied food science or nutrition. Furthermore, we explored whether presenting the food items differently in relation to how the food was depicted in the image-series would affect how accurately the participants estimated the portion sizes.

Methods

The method section is divided into three parts: part one describes the myfood24-system; part two describes the development of image-series to aid portion size estimation in a Norwegian version of myfood24; part three describes the design of the validation study in which the new food portion image-series were assessed.

The myfood24-system

The dietary assessment tool myfood24, short for 'Measure Your Food On One Day', is a web-based 24-h recall system[10]. The system is self-administered by the participant and is structured around pre-defined meals, and includes features such as searching the available database for food items, aids for portion size estimations with images and a recipe-builder.

In adapting myfood24 to a Norwegian setting, a food composition database tailored for the Norwegian population was compiled using the Norwegian Food Composition Database 2019[23] supplemented with food composition data for missing traditional Norwegian dishes from other sources. Portion size images for the Norwegian version were tailored to a Norwegian food culture.

Development of new food portion image-series for myfood24 for Norway

Deciding what food items to depict. The need to add new image-series for typical and frequently eaten Norwegian food to the Norwegian version of myfood24 was identified after a preliminary examination of the fifty-nine image-series from the British myfood24.

The choice of which foods to develop image-series for in this study was guided by the selection of image-series used in the national dietary survey, Norkost 3, conducted among adults in Norway[24]. In addition, first-hand experiences using these image-series in previous studies among adults[25], and the portion size photo booklet 'Matmallen'[26], a meal model tool developed by the Swedish National Food Administration, were looked at.

All food items selected to be included in the new image-series had to be listed in the Norwegian food composition table. Each image-series' potential to be used for portion size estimation for more than one food item (a proxy for similar foods) were considered, favouring those suitable as a proxy for image-series development (e.g. muesli being a proxy for different types of breakfast cereals).

Dishes that may vary largely regarding the ingredient list (e.g. for tacos) were regarded as unsuitable to be included in the image-series.

Deciding the sizes of each portion. A high number of portion size images has shown to provide more accurate portion size estimation; for example, eight images presented simultaneously is shown to be more accurate compared to a single 'average' image[18] or four images[19] in previous studies. Hence, the newly developed image-series included seven images with increasing portion sizes, in line with the existing British image-series[27].

Four different criteria were used during the development of the portion sizes for the image-series. First, one of the three middle portion sizes (images 3–5) should be an approximate of the Norwegian or Swedish standard serving[28–30]. Second, the portion size extremes were selected based on experiences as nutritionists and what was considered a plausible portion size. Third, when applicable, the food packaging or food container was taken into account (e.g. a can of beans). Finally, fixed percentage weight increments were applied to the image-series, in line with the image-series in the British myfood24 (e.g. for blueberries, we applied a fixed percentage weight increment of 50 %, resulting in the following portion sizes for blueberries in grams: 22, 33, 50, 74, 112, 168, 251). The rationale for using a fixed percentage increment is that it makes the difference between portion sizes clearly visible. In the present study, a fixed percentage increment was used for all but one of the image-series. The exception was the image-series for bread, in which a fixed increment in gram was used, to apply the Norwegian standard servings for a thin, medium and thick slice of bread as the middle portion size images (images 3–5)[28].

Photographing and editing the image-series. An in-house professional photographer at the University of Agder (UiA) was engaged to photograph the food and create the image-series (Supplementary File S1, Table S1 and Supplementary File S2, Figs. S1 and S2). Photographing was done in two separate sessions. Food items that needed cooking or preparations (e.g. mince and stews) were prepared immediately before photographing. Two identical kitchen weights with 1-g increments (Swordfish SFKSW14E) were used to ensure correct weight. Food items were placed naturally on the plate, as done in real life, meaning that they were not arranged in an aesthetical manner. During the post-processing of the images, the background for each image-series was made transparent. To assist participants in identifying the different portion size images during the study, the letters A–G were embedded next to the food items on each image in the image-series (Fig. 1). In total, twenty-three image-series were developed (image-series not presented in the paper are available in Supplementary File S3, Figs. S1–S18).

Validation of portion size image-series for the Norwegian version of myfood24

Design of the validation study. The perception approach was applied to evaluate the image-series[18]. This entails presenting participants with pre-weighed food items in real time and having them estimate the portion sizes using the amounts depicted in images. This approach does not require the need for participants to conceptualise or rely on their memory.

The validation study was performed at four different time points, all in one day. The location was a large training kitchen at the university campus at UiA, in South of Norway. Each of the foods or dishes depicted in the twenty-three newly developed image-series were presented twice during the validation study, of which ten were presented with a different plate or bowl than depicted. The participants estimated the forty-six portion sizes in real time by observing the presented food items and choosing the portion size image they perceived as the same quantity. Participants were instructed not to discuss the portion size estimations with the other participants, nor to taste or eat the presented foods.

A digital questionnaire was developed in SurveyXact[31] to be used on handheld computers (Chromebook) or tablets (iPad) during the data collection. The questionnaire displayed the image-series corresponding to the presented food items as forty-six separate questions (example in Fig. 2). Portion size image weight was not shown. Successively, participants were asked questions covering demographic information: sex, age, level of education, and whether the participant had studied food science or nutrition.

Recruitment. Forty-one participants were recruited at the university campus, using convenience sampling over a period of 14 d. A variety of different approaches was used in the recruitment phase, including social media and personal networks. Posters and flyers were placed and handed out on strategic places throughout the university campus (e.g. in the cafeteria, bulletin boards and classrooms). Recruitment was also carried out in lectures and among students, colleagues and employees at the university.

To be included in the study individuals had to be between the age of 18–45, speak Norwegian and be willing to be present at the university campus at one of four scheduled times. Individuals who had recorded their diet (e.g. using a food diary) during the last year were excluded from the study.

Participation in the study was voluntary. Written informed consent was obtained from all subjects. A gift card at a coffee shop, valued at 66 NOK (equivalent to approx. 7 Euros), was used as an incentive to recruit participants. Participants did not provide any person-identifying information during the study. All procedures involving research study participants were approved by the Norwegian Centre for Research Data (reference number: 637822) and the ethics committee of the Faculty for Health and Sport Sciences, University of Agder.

Preparations for the validation study. Each of the twenty-three food items depicted in the image-series were presented twice in the kitchen facility; hence, a total of forty-six servings of foods were presented for the participants in the present study. Each food item was presented once with identical weight relative to a portion size image, and once with an altered weight of 25 % of the differential to the adjacent portion size (e.g. two servings of brownies were presented: one weighing the exact same as a corresponding portion size image weight of 134 g, and the other weighed 148 g). The foods presented were numbered as an aid for the participants. The presentation of the portion sizes was randomised as follows: 50 % of the food items were presented as a middle portion size (images 3–5); 25 % as a smaller portion size (images 1–2) and 25 % as a larger portion size (images 6–7). Fourteen food items were presented with an increased weight relative to depicted. However, none of the presented portion sizes was smaller than image 1 or larger than image 7.

Food items that needed cooking were prepared the day before and stored in a cold storage room. Foods that could stay overnight were weighed and prepared the day before the study (e.g. candy and muesli). The same kitchen weights as used during the development of the image-series were used to ensure correct portion sizes (Swordfish SFKSW14E). All remaining dishes and spreads were weighed and prepared the morning of the study, but spreads were replaced before the last study round for visual reasons. Foods were plastic-covered and refrigerated between study rounds. Ten food items were presented with a different plate or bowl than depicted in the image-series to examine the effect of presentation method on estimation accuracy. No cutlery was presented with the food items.

Statistics. Descriptive analyses were conducted to explore the participants' characteristics. Sex, level of education and participants having studied food science or nutrition are presented as frequency and percentage. Participants' age and years of studying food science or nutrition are presented as

Fig. 1. Examples of image-series with the letters A–G edited in to assist portion size image identification: (a) candy and (b) strawberry.

median (25 %, 75 %), as these data were not considered as normally distributed.

Participants' estimates of portion sizes assisted by the image-series were classified into correctly classified, adjacent, lightly misclassified or grossly misclassified. A portion size estimate classified as correct is defined as a perfect match between the portion size image chosen by the participant and the portion size of that same food or dish presented to the participant. A portion size estimate classified as adjacent is defined as a partially match, that is, when the participant selected the portion size image closest to the image corresponding to the presented portion size. A lightly misclassified estimate is defined as a partially mismatch, that is, when the participant chose an image of a portion size situated 2–3 images distant from the correct portion size image for the presented serving of food. A grossly misclassified estimate is defined as a complete mismatch, that is, when the participant selected a portion size image 4 or more images distant from the image corresponding to the presented portion size. For food items presented to the participants with an altered weight compared to the depicted in the image-series, the portion size image closest in weight was considered as its perfect match.

Participants' estimates of portion sizes were also used to calculate the weight discrepancy in percentage between the chosen portion size image and the portion size presented to the participants. The following formula was used for each of the forty-six foods presented to the participants: [(mean estimated weight (g) – presented portion size (g))/presented portion size (g) × 100]. The weight of the nearest portion size image was used to calculate percent discrepancy for food items presented with altered weight.

Possible differences in portion size estimation accuracy were tested by comparing the mean proportion of correctly classified estimates (correctly classified, as defined above) for all presented food items per participant across sex, level of education (dichotomised into higher (tertiary) education (short, ≤4 years and long, >4 years) and all other), and whether participants had studied food science or nutrition. The non-parametric Mann–Whitney *U* tests were used as the mean proportion of correctly classified estimates per participant were not considered to be normally distributed.

Furthermore, we tested if differences in the food presentation resulted in differences in the accuracy of the portion size estimates. The accuracy of estimates for food items presented

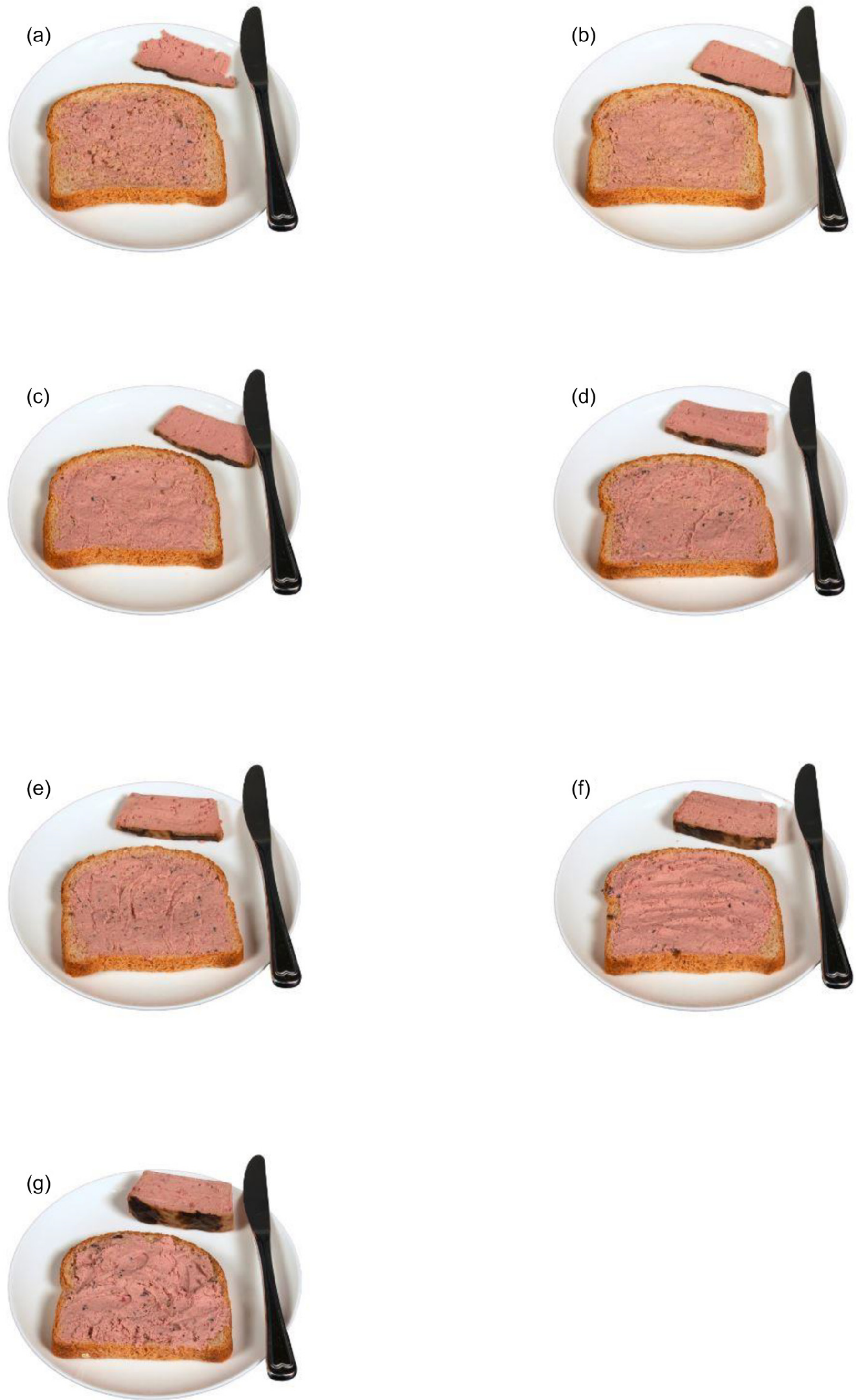

Fig. 2. Example of an image-series used to estimate portion size in the digital questionnaire for ‘Dish 21. Liver-pâté’.

with identical *v.* altered weight relative to the portion size image was compared. Also, a similar comparison was made for food items presented as depicted in the image-series *v.* foods presented with a different plate or bowl. Mann–Whitney *U* tests were used comparing the mean proportion of correctly classified estimates made by the participants per food/dish, as data were not considered to be normally distributed.

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, NY, USA). Statistical significance level was set at $P < 0{\cdot}05$.

Results

The distribution of sex in the sample was relatively balanced (58 % female). The median age was 23 years, ranging from 19 to 44. A majority of the participants (63 %) reported having higher (tertiary) education (short, <4 years or long, ≥4 years). About a quarter of the participants had studied food science or nutrition (median duration: 1¾ years; range: 0·5–10; Table 1). All 41 participants completed 46 portion size estimations each, resulting in a total of 1886 comparisons between the presented portion sizes of foods and portion size images.

Across all foods, 55 % (range 7–95 %) of the participants' portion size estimates were correct, meaning that they matched the portion sizes presented to them with the correct portion size image. Moreover, 38 % of the estimates were matched with the adjacent image, while 6 % were lightly misclassified and 0·5 % grossly misclassified by the participants. For thirty-eight of the forty-six presented food items, 90–100 % (mean of 98 %) of estimates were made with the correct or adjacent portion size image. The remaining eight food items were estimated as lightly or grossly misclassified by a mean of 27 % (Table 2 and examples in Fig. 3).

Table 3 shows the discrepancy in percentage between the portion sizes for foods presented to the participants and the mean of participants' portion size estimations in gram. Moreover, Table 3 shows the changes in weight made to portion sizes presented with altered weight relative to depicted. The overall mean percent discrepancy between the presented portion sizes and the participants' portion size estimations was 2·5 %, ranging from −33 % for marzipan cake and Mexican stew with beans (presented with decreased weight) to 105 % for caviar, spread (presented with increased weight). Sixteen food items had a percent discrepancy >20 % (Table 3). Food items presented with the weight of the smallest portion size image in an image-series (*n* 6) were all overestimated, with a mean of 43 %. Similarly, all food items presented with the largest portion size image weight (*n* 4) were all underestimated, with a mean of 21 %. The mid-images (images 2–6) had a mean discrepancy <7 % (range: −6 to 4 %), although individual food items show a greater degree of discrepancy (from 50 % for muesli to −33 % marzipan cake).

Table 1. Self-reported characteristics of the study participants in the image-series validation study, the Norwegian version of myfood24

Variable	Total (*n* 41)
Sex, *n* (%)	
Female	24 (58 %)
Male	17 (42 %)
Age	
Range	19–44
Median (25 %, 75 %)	23 (21, 27·5)
Level of education, *n* (%)	
Upper secondary education	13 (32 %)
Tertiary vocational education	2 (5 %)
Higher (tertiary) education, short[a]	15 (36 %)
Higher (tertiary) education, long[b]	11 (27 %)
Participants having studied food science	
Nutrition, *n* (%)	10 (24 %)
Range, years	0·5–10
Median (25 %, 75 %), years	1·75 (1, 3·5)

[a] Higher (tertiary) education, short, defined as ≤4 years.
[b] Higher (tertiary) education, long, defined as >4 years.

Portion size estimation accuracy differed across the sexes. Table 4 shows that female participants (*n* 24, median: 0·60) chose the correct portion size image more often than male participants (*n* 17, median: 0·52; $P = 0·019$). No statistically significant difference was observed either for participants with higher (tertiary) education (*n* 26, median: 0·57) or other education (*n* 15, median: 0·54) in choosing the correct portion size image ($P = 0·613$), nor for those that had studied food science or nutrition (*n* 10, median: 0·58) compared to those not having studied food science or nutrition (*n* 31, median: 0·54; $P = 0·122$) (Table 4).

The difference in portion size estimation accuracy per food item showed no statistically significant difference in choosing the correct portion size image for foods presented as depicted (*n* 36, median: 0·60) compared to those presented with a different plate or bowl (*n* 10, median: 0·63; $P = 0·416$), nor for food items presented with identical weight relative to a portion size image (*n* 23, median: 0·59) compared to those presented with an altered weight relative to depicted (*n* 23, median: 0·61; $P = 0·597$) (Table 5).

Discussion

We have recently adapted the British myfood24 for Norway, including the image-series for portion size estimations. During this process, we developed twenty-three image-series, each containing seven portion size images, for typical and frequently eaten Norwegian foods. The validity of the image-series was assessed through a comparison of pre-weighed portions of food to portion size images in the image-series in real time. We observed that most of the portion size estimates were satisfactory, as either the correct or adjacent portion size image was chosen by the participants. Overall, the mean weight discrepancy shows an overestimation of 2·5 % between the reported and correct portion size image (ranging from −33 to 105 %). Female participants estimated the correct portion size more often than male participants. The image-series developed for bread, caviar spread and marzipan cake performed poorly. All newly developed image-series, except bread, are included to aid portion size estimation in the Norwegian version of myfood24. New image-series are considered for those that performed poorly.

A few other researchers have published results from validation studies of portion size images that are compared to pre-weighed foods, and subsequently classified as correct, adjacent or misclassified. Findings from three of the studies are in line with the proportion of correct estimates observed in our study[20,21,32]. One study, among adults in an African population, reports a higher degree of correct estimates compared to our study[22], while estimates with the correct or adjacent portion size image in our study show similar results to what other have found (ranging from 70 to 95 % of estimates with either the correct or adjacent portion size image[21,32–34]). A Danish study found a somewhat lower accuracy when assessing self-served portion sizes in adults and children compared to our study, estimating pre-weighed foods[35].

The flat-slope phenomenon, in which small portion sizes tend to be overestimated and large portions underestimated,

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Table 2. Proportion of participants' portion size estimations using the image-series per presented food item in percent classified as correct or adjacent, adjacent, lightly misclassified or grossly misclassified in the image-series validation study, the Norwegian version of myfood24

Food item	Correct or adjacent (%)	Adjacent (%)	Lightly misclassified (%)	Grossly misclassified (%)
Beans	95	27	5	0
Beans[a]	100	5	0	0
Blueberries	98	64	0	2
Blueberries[b]	100	78	0	0
Brownie	95	34	2	2
Brownie[a]	98	37	0	2
Butter (spread)	88	64	12	0
Butter (spread)[a]	81	44	19	0
Candy (without chocolate)	98	69	2	0
Candy (without chocolate)[a]	100	10	0	0
Candy with chocolate	98	13	2	0
Candy with chocolate[a]	98	37	0	2
Carrot cake	100	15	0	0
Carrot cake[a]	100	15	0	0
Caviar (spread)	88	56	12	0
Caviar (spread)[a]	51	27	47	2
Chicken	100	22	0	0
Chicken[a]	100	20	0	0
Jam	100	71	0	0
Jam[b]	76	42	24	0
Liver pâté	88	29	7	5
Liver pâté[a]	100	76	0	0
Marzipan cake	68	58	32	0
Marzipan cake[b]	90	29	10	0
Meat	90	44	7	3
Meat[b]	100	5	0	0
Mexican stew	98	49	2	0
Mexican stew[b]	100	29	0	0
Mexican stew with beans	93	76	7	0
Mexican stew with beans[b]	90	83	10	0
Mexican stew with meat	98	35	2	0
Mexican stew with meat[a]	98	13	2	0
Muesli	100	37	0	0
Muesli[a]	98	83	0	2
Peanuts	100	15	0	0
Peanuts[a]	95	41	5	0
Potato chips	100	37	0	0
Potato chips[b]	100	22	0	0
Raspberries	100	7	0	0
Raspberries[b]	98	37	0	2
Slice of bread	44	29	56	0
Slice of bread[a]	98	35	2	0
Stew (potato based)	95	49	5	0
Stew (potato based)[a]	93	66	7	0
Strawberries	100	12	0	0
Strawberries[b]	98	5	2	0

Correct or adjacent defined as a perfect or partially match, in that participants chose the matching or the closest portion size image corresponding to the portion size of the same food or dish presented to them. Adjacent defined as a partially match, in that participants chose the closest portion size image corresponding to the presented portion size. Lightly misclassified defined as a partially mismatch, in that participants chose an image of a portion size situated 2–3 images distant from the correct portion size image for the presented serving of food. Grossly misclassified defined as a complete mismatch, that is when participants chose a portion size image 4 or more images distant from the image corresponding to the presented portion size.
[a] Presented portion weight increased by 25 % of the differential to the adjacent portion size image.
[b] Presented portion weight decreased by 25 % of the differential to the adjacent portion size image.

was observed in the present study, which is in line with what others have found[18,21,22,36]. While the smallest portion sizes were overestimated and the largest portion sizes were underestimated, the remaining portion sizes (representing images 2–6) were on average underestimated by 2 %. The large degree of misestimations for the smallest and largest portion sizes may partly be attributed to the fact that there is only one possible direction for misestimation, compared to the remaining five mid-images with both smaller and larger adjacent images, allowing both over- and underestimation. The five mid-images show an overall tendency to be underestimated, rather than overestimated, although this is not true for all the foods presented. This implies that the mid-images provide an acceptable accuracy at a group level, but that they should be interpreted with caution at an individual level.

Despite the tendency of underestimation observed for the mid-images, an overall overestimation of 2·5 % was observed in our study, which is similar to Hernández *et al.*[16] Compared to Vereecken *et al.*, who found an overall underestimation of 15 % when adolescents assessed pre-weighed foods[33], our results show a more accurate overall estimation, which may be explained by our study sample being older[37]. This is

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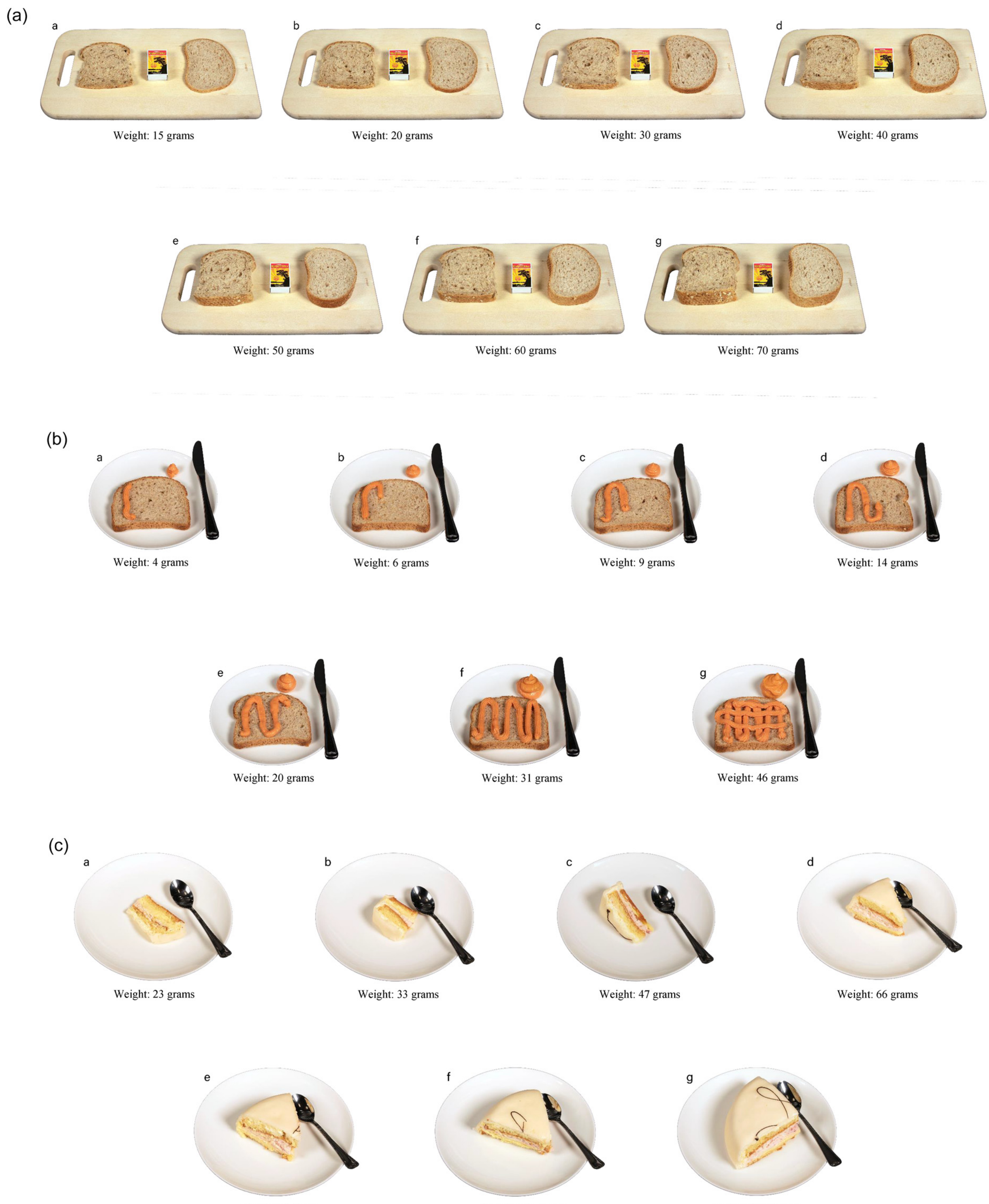

Fig. 3. Example of image-series that performed poorly in estimating portion size: (a) bread, (b) caviar spread and (c) marzipan cake.

further supported by the study by Lillegaard *et al.* including children and adolescent showing a wider range in both under- and overestimation (0 to 142 %), compared to our results[34]. Other studies validating food images in adults have found both greater and lesser degree of misestimation compared to our results[20,38].

In the present study, we observed a statistically significant difference in choosing the correct portion size image for sex, but not for the level of education or whether they had studied food science or nutrition. Both Ovaskinen *et al.* and Nelson *et al.* found that male participants underestimated portion sizes compared to female participants[18,20], while Naska *et al.* and Venter *et al.* found no significant difference for sex[21,22]. We did not observe any difference in the accuracy of portion size estimations for level of education (higher education (short, ≤4 years and long, >4 years) and all other),

Table 3. Percentage discrepancy between the presented portion size image weight and the mean of participants' portion size estimations in gram, and the weight alterations for portion sizes presented with altered weight relative to a portion size image in the image-series validation study, the Norwegian version of myfood24

	Presented with identical weight as a portion size image			Presented with altered weight relative to a portion size image			
Food item	Presented portion size (g)	Participants mean estimations (g)	Discrepancy between mean estimation and presented portion size (%)	Presented portion size (g)	Nearest portion size image (alteration) (g)	Participants mean estimations (g)	Discrepancy between mean estimation and nearest portion size image (%)
Beans	98	86	−13	29	25 (+4)	26	3
Blueberries	112	88	−21	68	74 (−6)	55	−25
Brownie	134	121	−10	148	134 (+14)	147	10
Butter (spread)	7	7·3	4	5·3	5 (+0·3)	4·9	−2
Candy (without chocolate)	65	45	−31	14	12 (+2)	13	8
Candy with chocolate	78	77	−1	18	15 (+3)	22	47
Carrot cake	47	45	−4	104	94 (+10)	98	4
Caviar (spread)	14	17	21	4·5	4 (+0·5)	8·2	105
Chicken	68	67	−1	77	68 (+9)	72	5
Jam	10	8·6	−14	27	29 (−2)	23	−21
Liver pâté	60	50	−17	11	10 (+1)	7·9	−21
Marzipan cake	94	63	−33	124	134 (−10)	115	−14
Meat	30	42	41	208	227 (−19)	223	−2
Mexican stew	690	567	−18	73	80 (−7)	85	6
Mexican stew with beans	461	325	−30	633	690 (−57)	460	−33
Mexican stew with meat	80	79	−2	58	50 (+8)	57	15
Muesli	25	27	7	202	174 (+28)	261	50
Peanuts	9	10	11	6	5 (+1)	7·2	44
Potato chips	14	19	34	44	50 (−6)	57	13
Raspberries	74	75	2	230	251 (−21)	215	−14
Slice of bread	50	63	25	33	30 (+3)	28	−6
Stew (potato based)	352	327	−7	666	621 (+45)	547	−12
Strawberries	97	104	8	33	36 (−3)	37	2

Each food item was presented twice; once with identical weight relative to a portion size image, and once with portion size weight altered by ±25 % of the differential to an adjacent portion size image.Percentage discrepancy between the mean of participants' portion size estimations and the presented portion size images calculated as [(mean estimated weight (g) − presented portion size (g))/presented portion size (g) × 100] (food items presented with altered weight used the nearest portion size image to calculate percent discrepancy).

Table 4. Comparison of portion size estimation accuracy across participant characteristics in the image-series validation study, the Norwegian version of myfood24

Difference in portion size estimations	Correct estimation		
	Median	IQR	*P*
Sex			
Female (*n* 24)	0·60	0·11	0·019*
Male (*n* 17)	0·52	0·09	
Level of education			
Higher (tertiary) education[a] (*n* 26)	0·57	0·14	0·613
Other education (*n* 15)	0·54	0·13	
Studied food science or nutrition			
No (*n* 31)	0·54	0·13	0·122
Yes (*n* 10)	0·58	0·06	

Mann–Whitney *U* test. Correct estimation referring to the mean proportion of correctly classified portion size image estimates by the participants for the forty-six presented food items, correctly classified defined as a perfect match between the portion size image chosen by the participant and the portion size of that same food or dish presented to the participant. Median represents the central tendency of the participants mean correct estimates, with interquartile range (IQR) representing the measure of variability.
[a] Higher (tertiary) education defined as short, ≤4 years or long, >4 years.
* $P < 0·05$.

which corroborate findings from other studies[20,21]. We speculate that this may reflect that although the level of education is associated with knowledge and skills, the task of estimating food intake is not a skill taught through the educational system.

The image-series developed for bread performed poorly, similar to a previous study using natural size printed photographs of bread[20]. One possible explanation for this result is that we used weight increments fixed in grams rather than percentage to include the Norwegian standard serving sizes for a thin, medium and thick piece of bread[28]. Using increments in gram rather than percentage makes distinguishing the difference between portion sizes challenging, as an increase from 20 to 30 g (150 % increase) is visually easier to detect than 60 to 70 g (116 % increase). Further, the image-series depicted two pieces of bread (to illustrate the same weight for different types of bread) placed on a wooden cutting board with a matchbox as a reference measure (Fig. 3). It is difficult to conclude what caused the poor performance, as the image-series differed from the others in multiple ways. Participants expressed difficulty in applying the image-series, as the two depicted pieces of bread were presented separately during the validation study.

Table 5. Comparison of portion size estimation accuracy across the type of food presentation in the image-series validation study, the Norwegian version of myfood24

Difference in portion size estimations	Correct estimation		
	Median	IQR	*P*
Food presentation			
As depicted (*n* 36)	0·60	0·51	0·416
Not as depicted[a] (*n* 10)	0·63	0·43	
Presented weight			
Identical weight (*n* 23)	0·59	0·49	0·597
Altered weight[b] (*n* 23)	0·61	0·59	

Mann–Whitney *U* test. Correct estimation referring to the participants' mean proportion of correctly classified portion size image estimates per dish/food item, correctly classified defined as a perfect match between the portion size image chosen by the participant and the portion size of that same food or dish presented to the participant. Median represents the central tendency of the mean correct estimates per dish/food item, with interquartile range (IQR) representing the measure of variability.
[a] Presented with a different plate or bowl than depicted.
[b] Presented with ±25 % of the differential to an adjacent portion size image.

Spreads represent six of the eight food items most often misclassified in our study, specifically: jam, liver-pâté, butter and caviar (Table 2). Other studies have also reported poor estimates[20] and high percentage of error[22] when assessing portion sizes of spreads. Image-series of spreads were depicted on a piece of bread with an equal amount alongside to illustrate the quantity. Caviar was depicted as squeezed out of the tube packaging (Fig. 3). Spreads had the smallest portion sizes and lowest percent weight increment relative to other image-series developed in this study. During the validation study, spreads were only presented as spread on a piece of bread (caviar included). The small weight increments used for spreads could explain the degree of misestimation. For butter, the three smallest portion size images are 3, 4 and 5 g, respectively. The differences are visually noticeable in the image-series, but in a real-time setting, without the amount of spread illustrated alongside, it may be difficult to estimate. Additionally, estimating spreads on a piece of bread is challenging to quantify compared to more tangible food items, such as pieces of candy. Some participants expressed difficulties estimating portions of spreads, as it was unclear whether they should consider both the spread depicted on the piece of bread and the amount alongside.

The image-series for marzipan cake also performed poorly, similar to other findings using digital pictures of pies to assess portion size[21]. The three smallest images in our series differed from the remaining four (Fig. 3), in that the small portions were depicted lying on the side, while the larger portions were depicted as upright triangular pieces.

In the present study, bread, some spreads and marzipan cake performed poorly. What foods are most critical to assess accurately in dietary assessment will always depend on the research question of interest. Bread, and subsequently spreads, are frequently consumed in Norway[24], emphasising the importance of developing accurate tools to estimate portion sizes for these foods.

Strengths and limitations

A strength in the present validation study is the use of pre-weight foods as the reference tool, which is in line with Amoutzopoulos *et al.* recommendations for validating portion size estimation tools[7].

Evaluating the validity of image-series is in several other studies conducted using the perception or conceptualisation and memory approach[39]. This study evaluated the newly developed image-series using the perception approach. The advantages of using this approach are that it excludes participant biases related to memory and recall and provides direct feedback on the image-series applicability to estimate portion sizes. Furthermore, as the participants were not assessing their own diet, but rather a selection of random portion sizes presented to them, one could hypothesise that this reduces the degree of social desirability.

We excluded individuals having recorded their diet during the last year, based on the assumption that people who had registered their diet would estimate portion size more accurately than the general public. Hence, we argue that there is no reason to believe that our results are better than in the general population. Moreover, our study had a relatively even distribution of sex and a fair representation of the age group (58 % female and age range of 19–44 years, respectively). Yet, the sample size and education level of participants limits the generalizability. Recruitment at the university can explain why a majority of the participants had higher (tertiary) education. Additionally, the proportion of highly educated participants may be under-reported, as an unclear phrasing of the said question may have caused participants to select a lower level of education. Using the perception approach to evaluate the image-series in this study may limit the generalizability of the results to a situation relying on participants memory and conceptualisation for dietary assessment. A potential study limitation is the unnatural setting in a large university kitchen, with other participants working their way through the presented food items. This may not reflect the same results as estimating portion sizes individually in a natural setting.

Conclusion, implication and further research

The newly developed image-series for traditional and frequently eaten Norwegian foods performed satisfactorily in estimating portions of pre-weighed foods using a perception approach, except for a few food items (bread, caviar spread and marzipan cake). The participants matched more than half of the forty-six presented portion sizes with the correct portion size image, and more than 90 % with either the correct or the adjacent portion size image. Overall, there was an overestimation of 2·5 % (ranging from −33 to 105 %). The 'flat-slope' phenomenon was observed for the largest and smallest portion sizes, and although the remaining five mid-images in the twenty-three image-series show an overall acceptable accuracy (<7 %), they mask a varying degree of misestimation. All newly developed image-series, except for bread, were included to aid portion size estimation in the Norwegian version of myfood24. This study adds to the importance of validating portion size estimation tools.

The finding that the image-series for bread and spreads performed poorly is of significant importance, as bread is a staple food in the Norwegian diet. The accuracy of portion size estimation in the present study is comparable to what others have found. By conducting this study, it was revealed which of our new image-series need to be modified and re-validated. New image-series are planned for those that performed poorly.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/jns.2020.58.

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L. S. and A. C. M. designed the study; L.S. planned and conducted the data collection, with assistance from A. C. M; L. S. carried out all data analyses and drafted the paper; A. C. M., D. E. and N. C. Ø. assisted in interpreting the data and revised drafts of the paper. All authors have read and approved the contents of the submitted manuscript.

The authors declare that they have no conflicts of interest.

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Supporting information

Supplementary Table S1: Photography specifications for the new images-series in the Norwegian version of myfood24

Supplementary Figure S1: Photography set-up

Supplementary Figure S1-S18: Image-series developed but not presented in Salvesen L, Engeset D, Øverby NC and Medin AC "Development and evaluation of image-series for portion size estimation in dietary assessment among adults"

Supplementary file 1

Table S1. Photography specifications for the new images-series in the Norwegian version of myfood24

Equipment	Specifications
Photographer	Morten Rosenvinge, University of Agder
Camera	Canon EOS7D
Optics	Canon 24-70mm ultrasonic
Background	Black cotton cloth with crossed horizontal and vertical lines
Lighting	Two Litepanels LED-lights (with additional plastic film)
Camera angle	40°
Distance	Camera lens to middle of plate: 58 cm
Image editor	Adobe Photoshop

Supplementary file 2

Fig. S1. Photography set-up

Fig. S2. Example of photographing the image-series for bread

Supplementary file 3. Image-series developed but not presented in Salvesen L, Engeset D, Øverby NC and Medin AC “Development and evaluation of image-series for portion size estimation in dietary assessment among adults”

Fig. S1. Image-series for butter

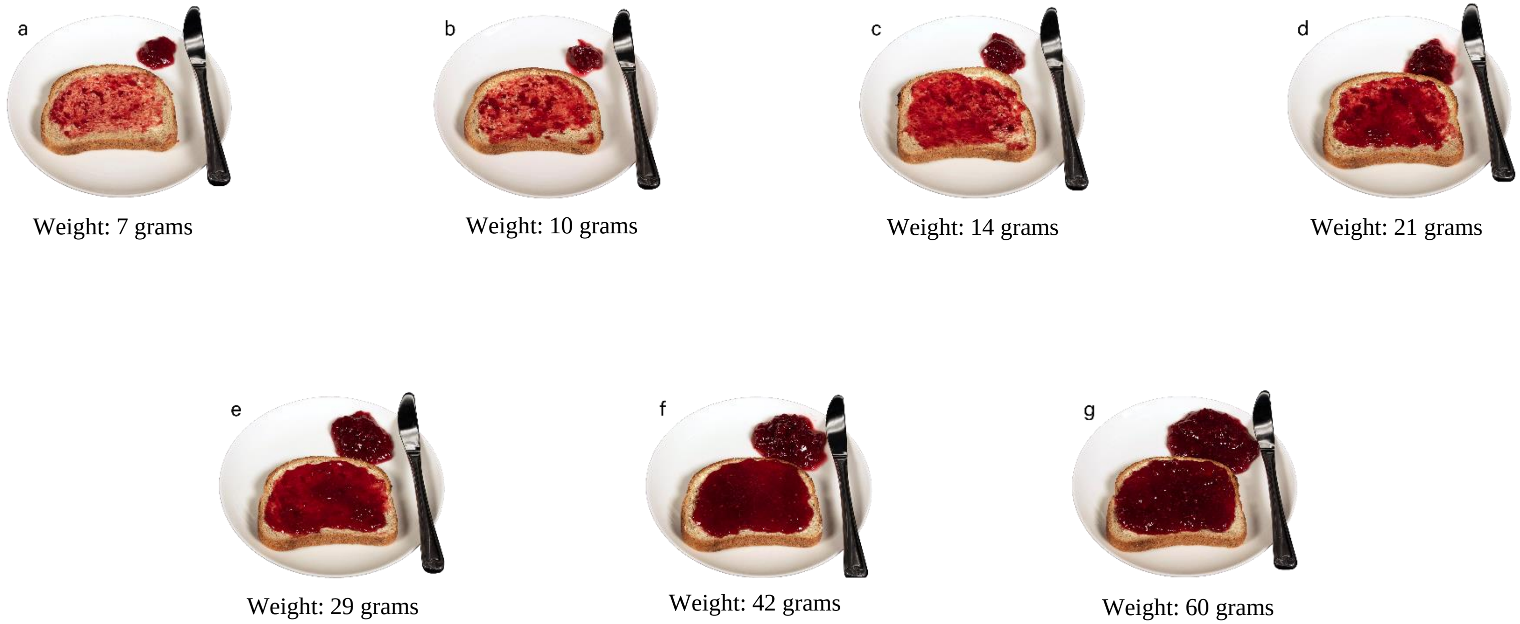
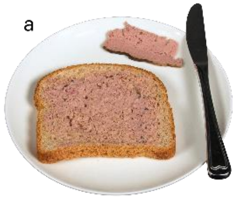


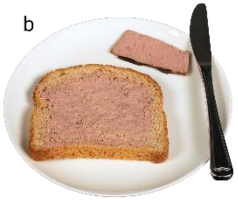
Fig. S2. Image-series for jam

a



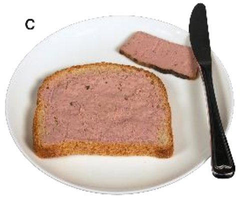
Weight: 7 grams

b



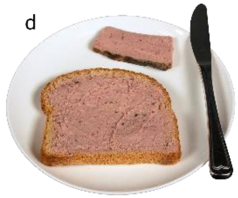
Weight: 10 grams

c



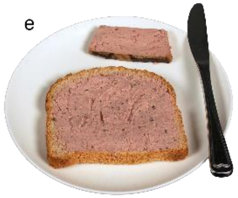
Weight: 14 grams

d



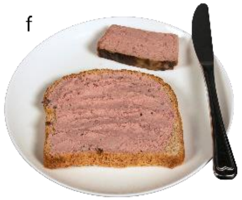
Weight: 21 grams

e



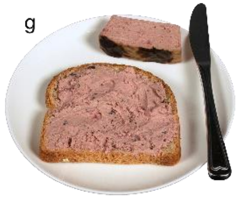
Weight: 29 grams

f



Weight: 42 grams

g



Weight: 60 grams

Fig. S3. Image-series for liver-pâté

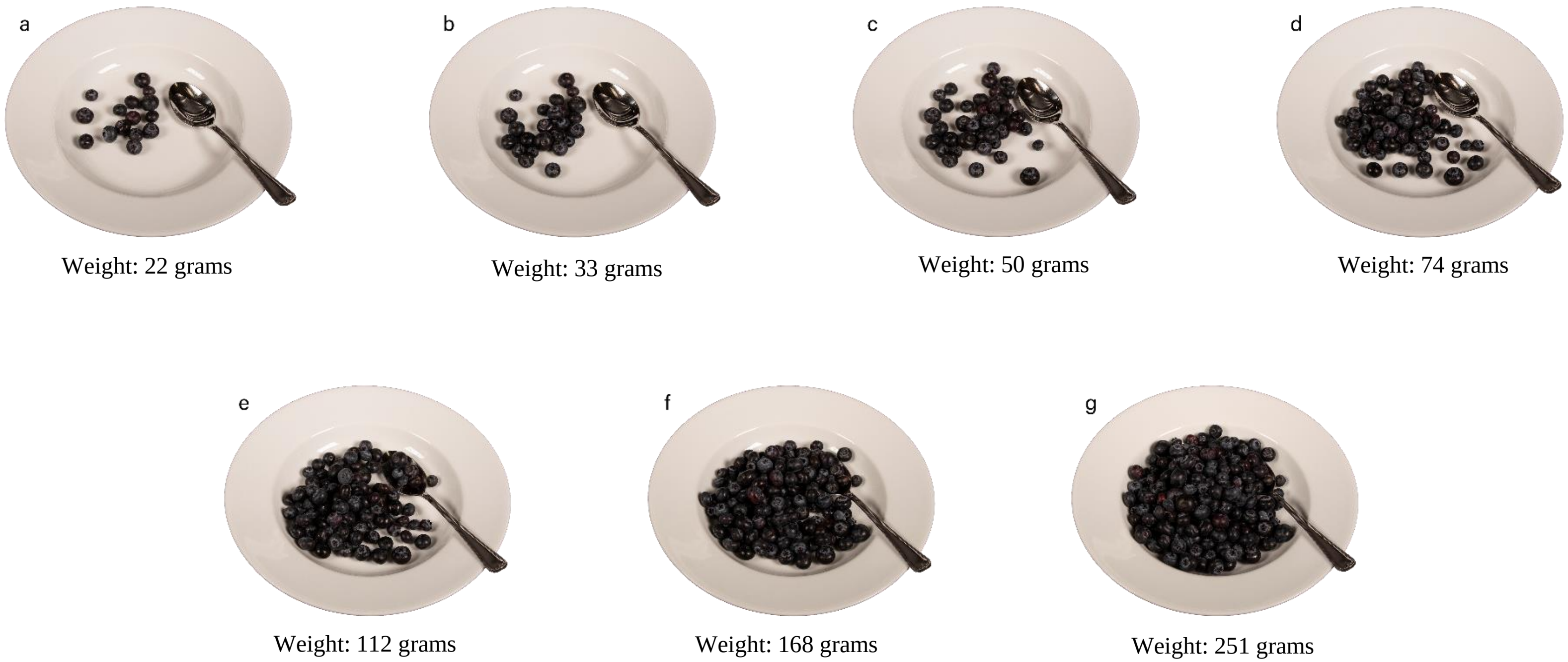


Fig. S4. Image-series for blueberries

a

Weight: 22 grams

b

Weight: 33 grams

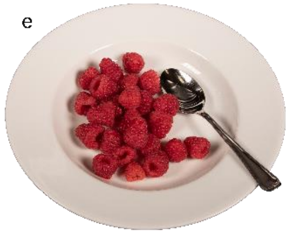
c

Weight: 50 grams

d

Weight: 74 grams

e

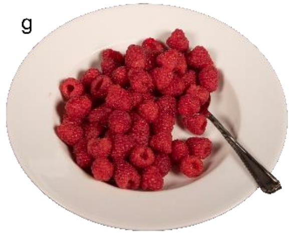


Weight: 112 grams

f

Weight: 168 grams

g



Weight: 251 grams

Fig. S5. Image-series for raspberries

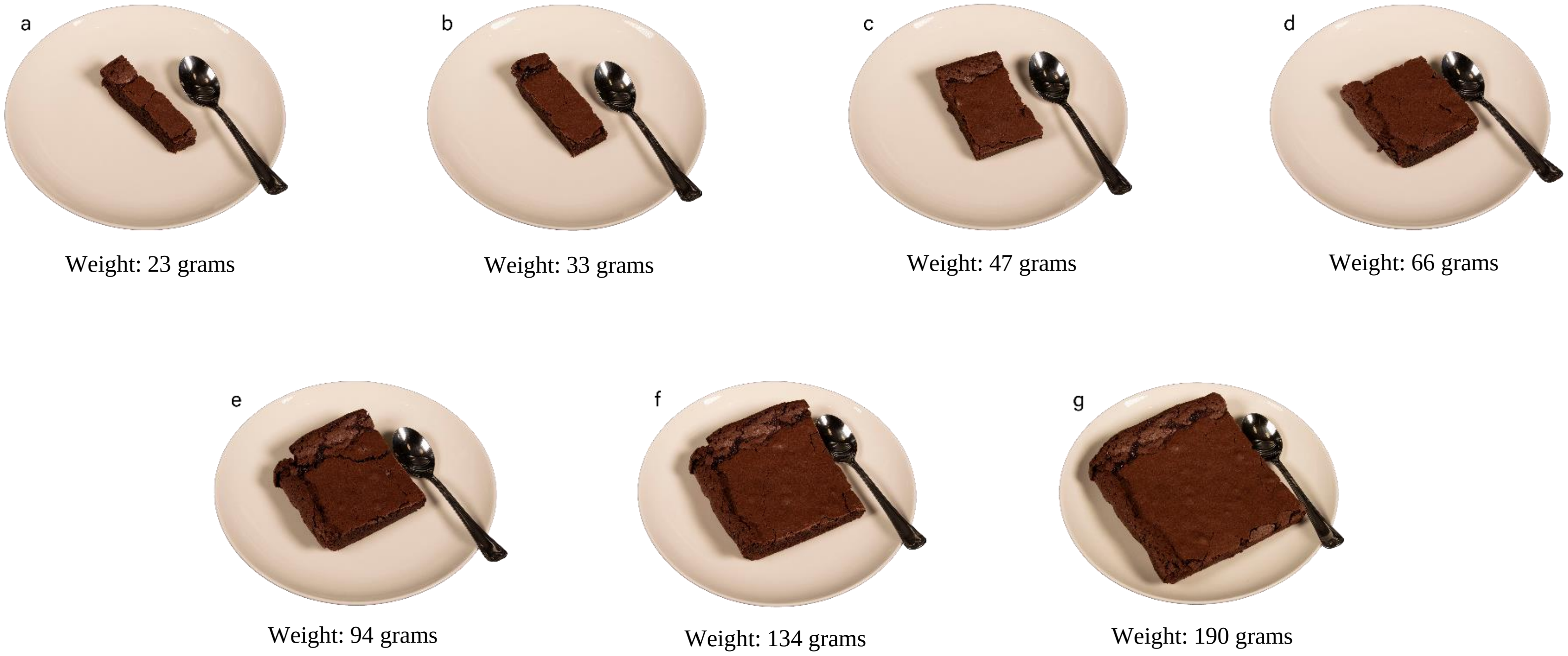


Fig. S6. Image-series for brownie

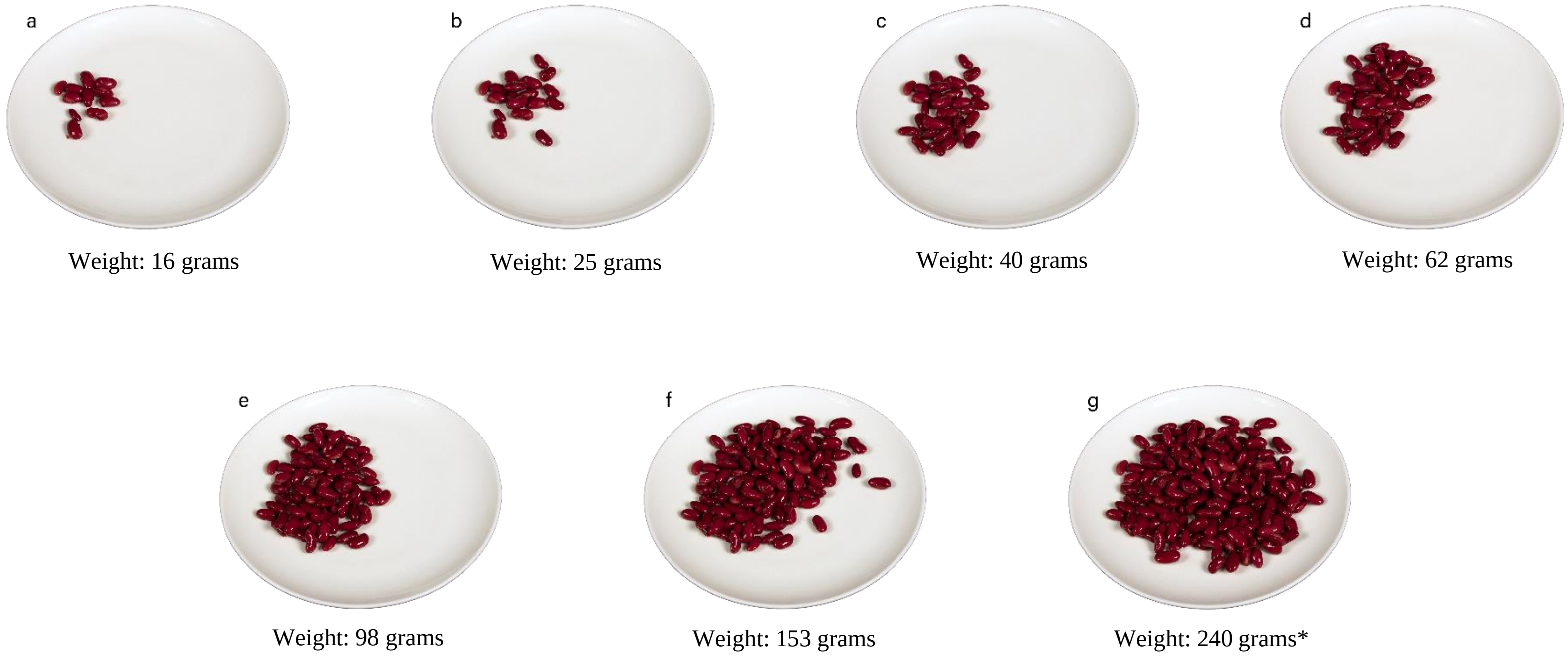


Fig. S7. Image-series for beans, kidney, *percent increment 57%; equals one box of canned kidney beans

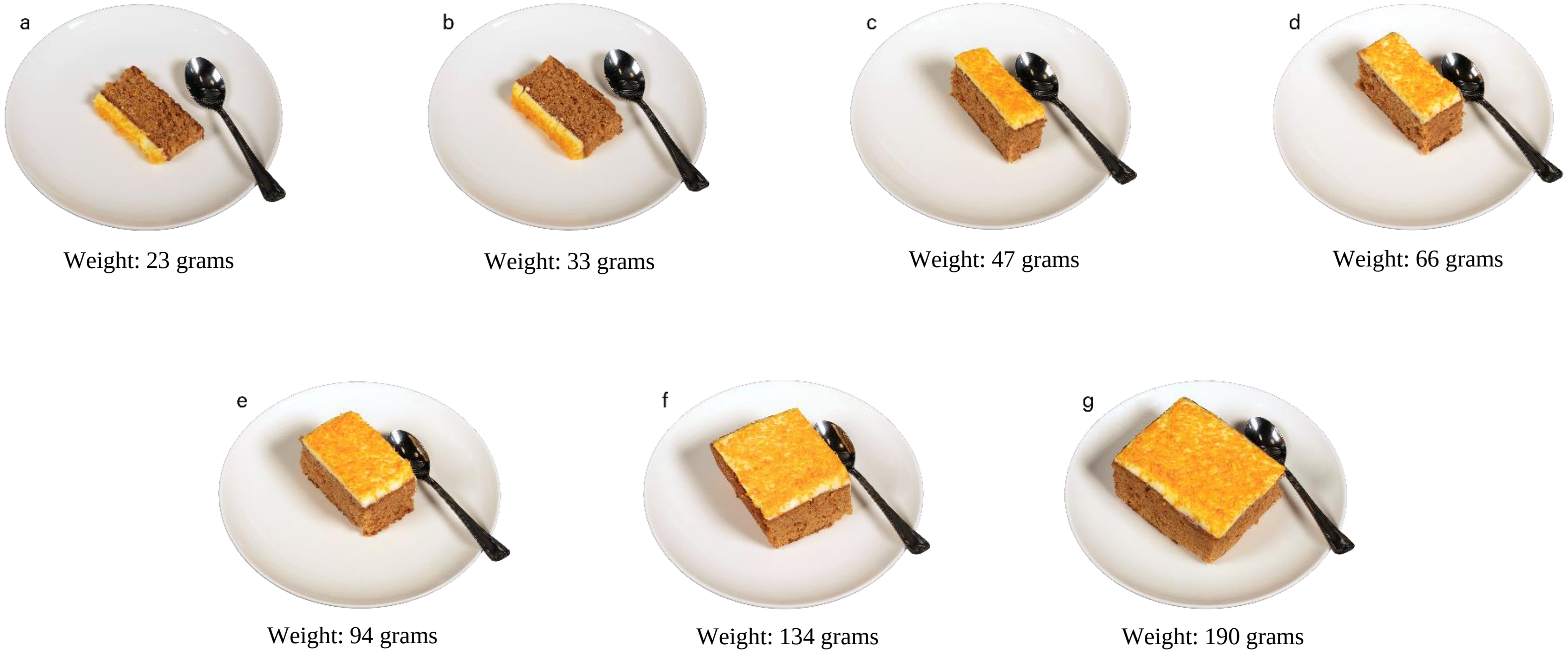


Fig. S8. Image-series for carrot cake

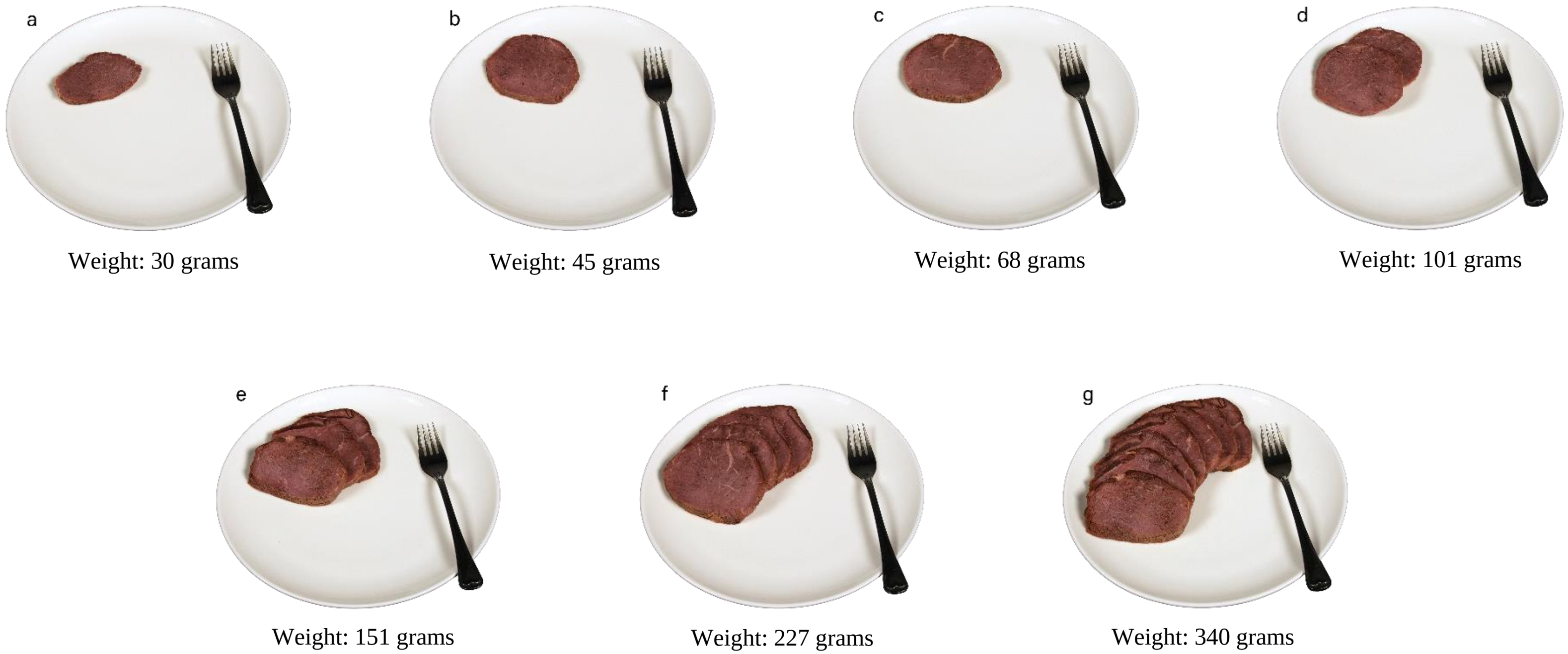


Fig. S9. Image-series for meat

a

Weight: 30 grams

b

Weight: 45 grams

c

Weight: 68 grams

d

Weight: 101 grams

e

Weight: 151 grams

f

Weight: 227 grams

g

Weight: 340 grams

Fig. S10. Image-series for chicken

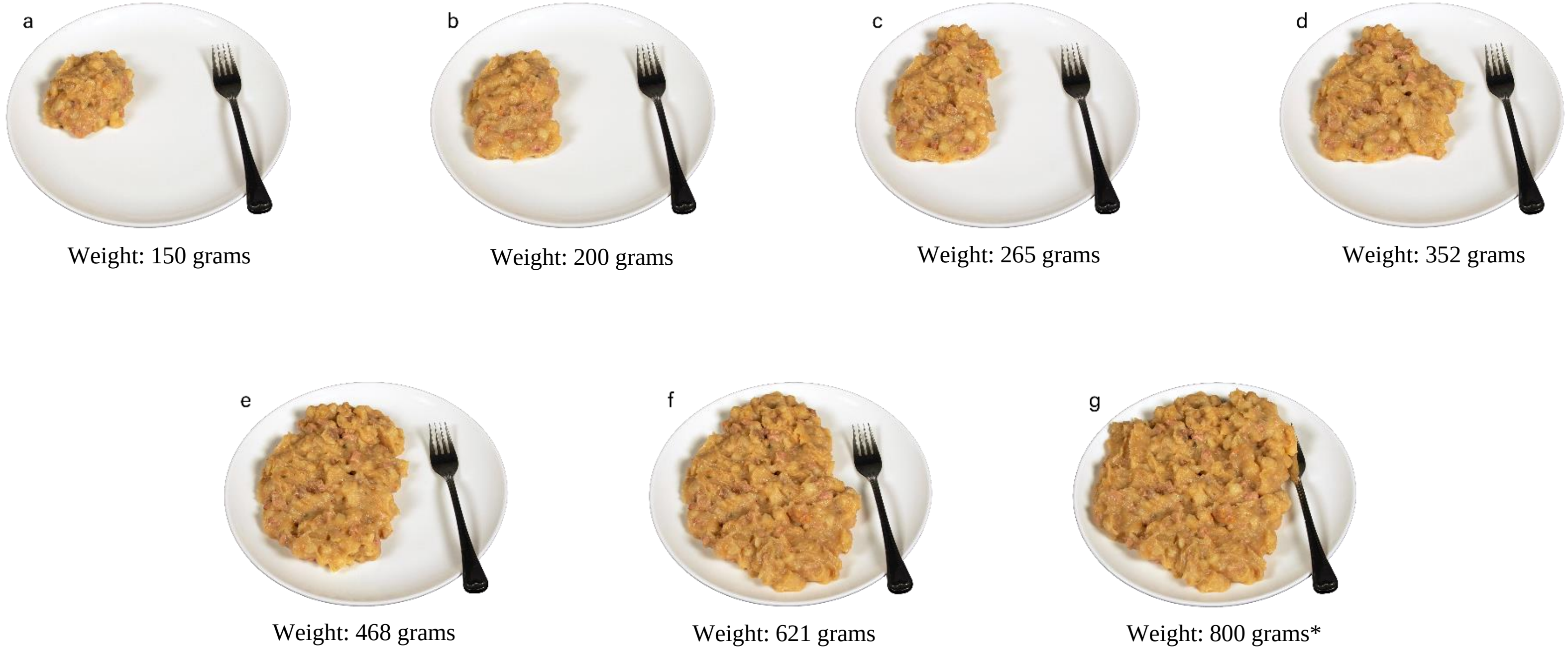


Fig. S11. Image-series for stew (potato based), *percent increment 29%; 800 grams equals one can of stew

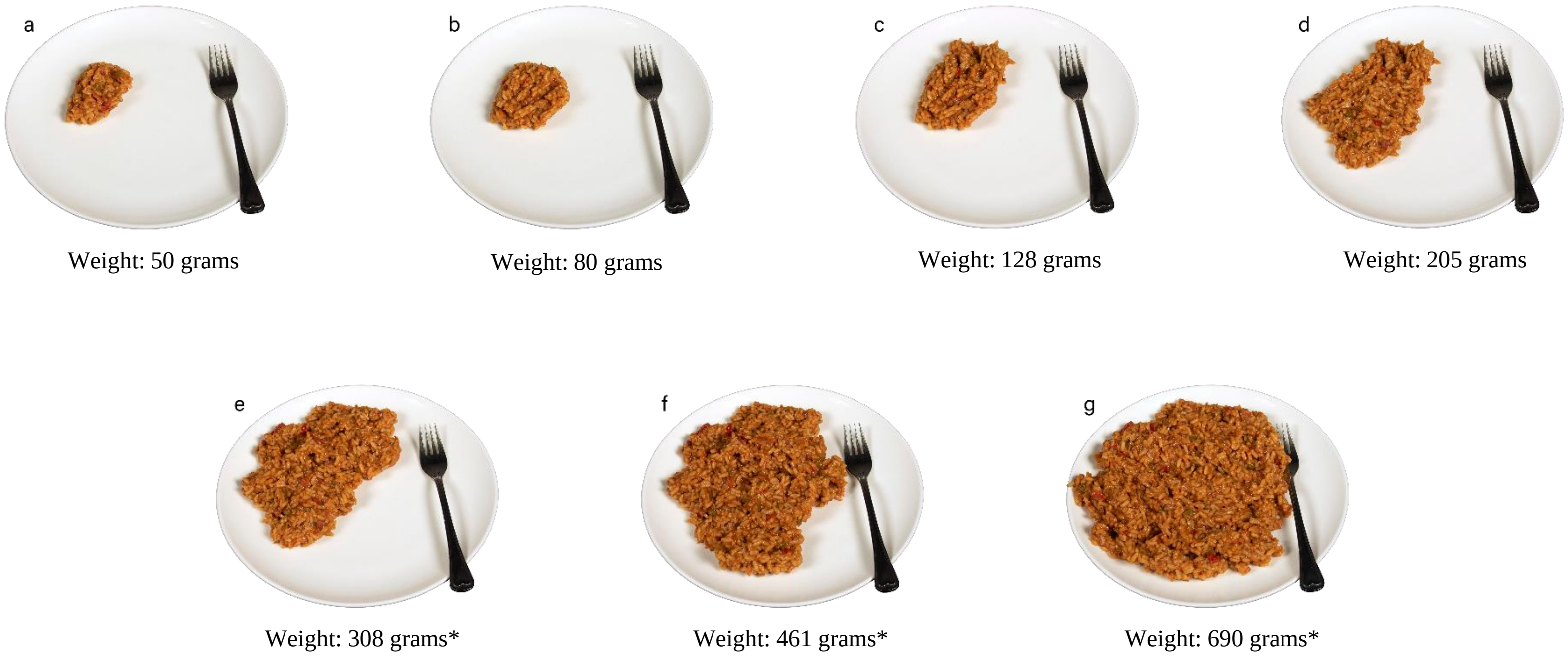


Fig. S12. Image-series for Mexican stew, *percent increment 50%

a

Weight: 50 grams

b

Weight: 80 grams

c

Weight: 128 grams

d

Weight: 205 grams

e

Weight: 308 grams*

f

Weight: 461 grams*

g

Weight: 690 grams*

Fig. S13. Image-series for Mexican stew with beans, *percent increment 50%

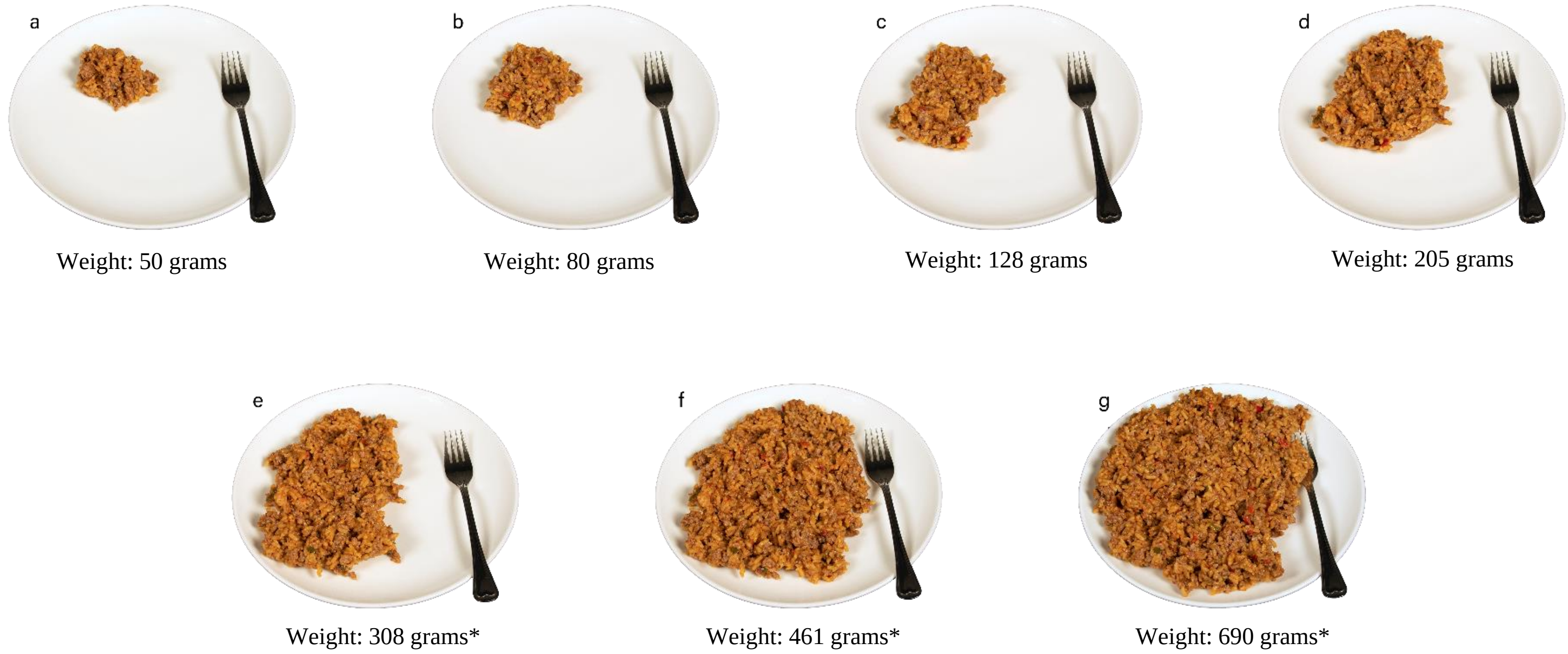


Fig. S14. Image-series for Mexican stew with meat, *percent increment 50%

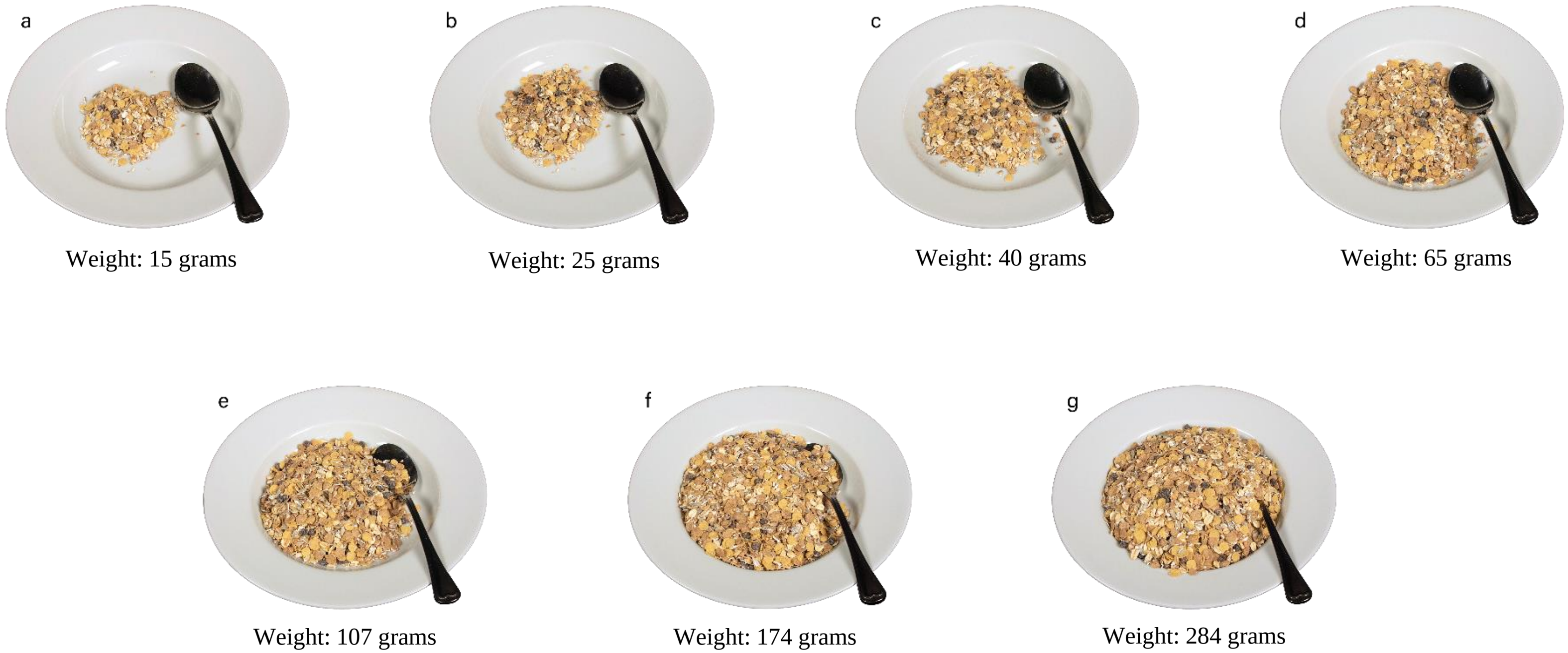


Fig. S15. Image-series for muesli

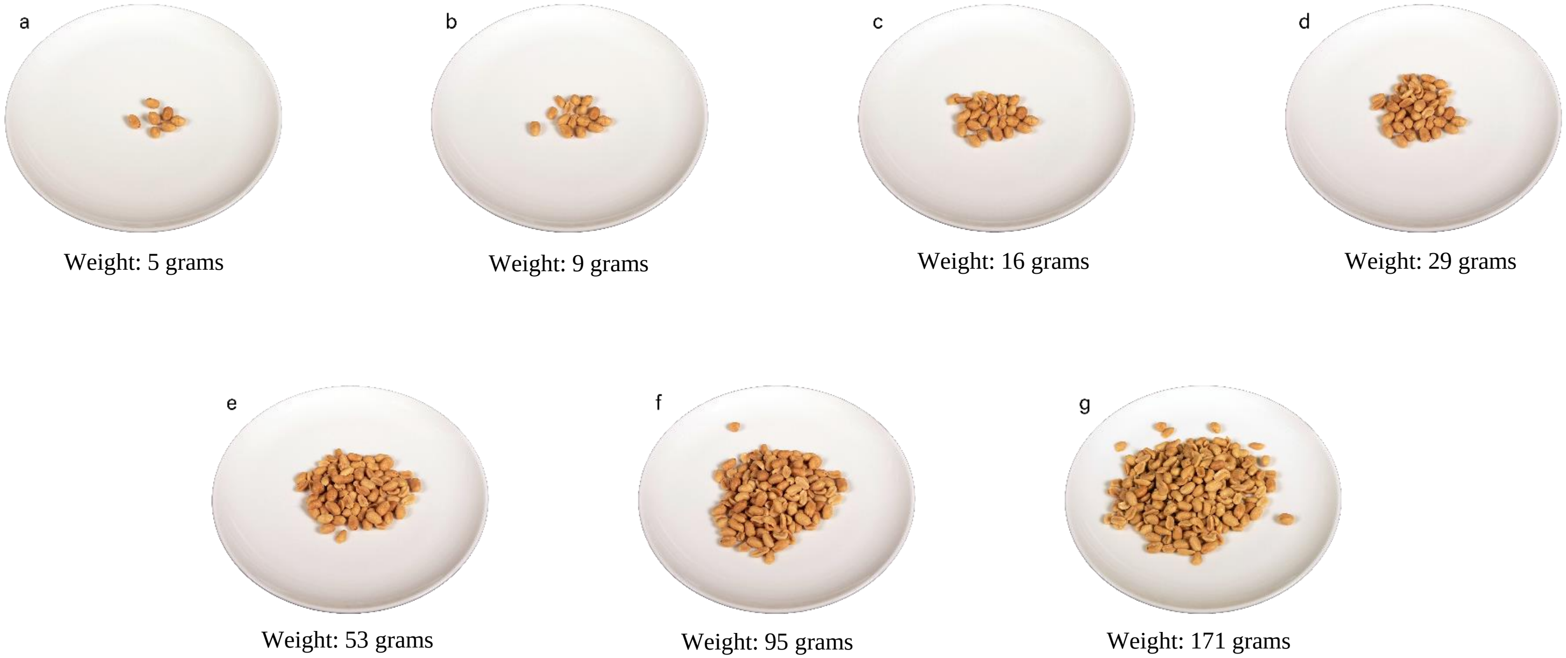


Fig. S16. Image-series for peanuts

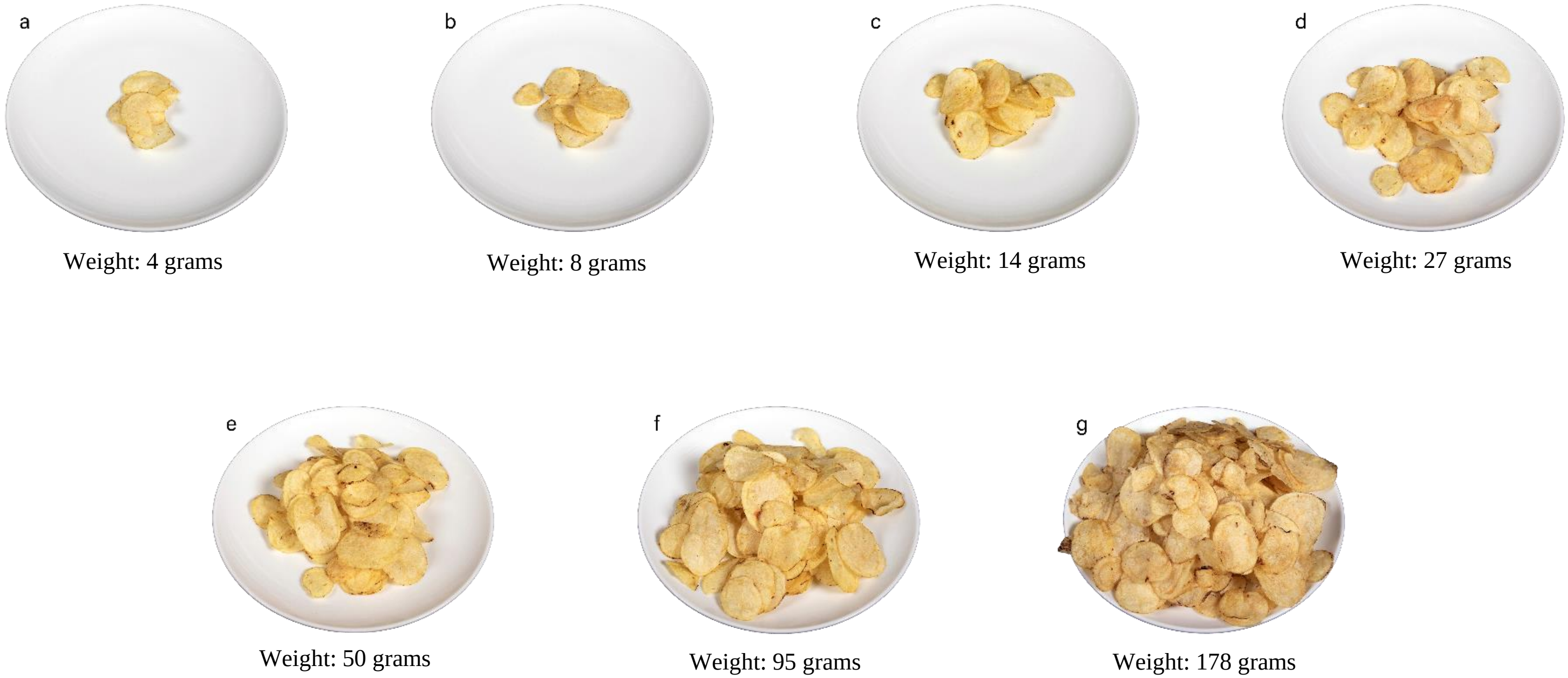


Fig. S17. Image-series for potato chips

a

Weight: 15 grams

b

Weight: 26 grams

c

Weight: 45 grams

d

Weight: 78 grams

e

Weight: 135 grams

f

Weight: 234 grams

g

Weight: 406 grams

Fig. S18. Image-series for candy with chocolate

Paper III and supplementary files

Salvesen, L., Wills, A. K., Øverby, N. C., Engeset, D., & Medin, A. C., *Relative validity of a non-quantitative 33-item dietary screener with a semi-quantitative food frequency questionnaire among young adults*. Journal of Nutritional Science, 2023. 12: p. e72.

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RESEARCH ARTICLE

Relative validity of a non-quantitative 33-item dietary screener with a semi-quantitative food frequency questionnaire among young adults

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Abstract

The objective of the study was to assess the concordance and ranking ability of a non-quantitative 33-item dietary screener developed to assess the diet of young adults in Norway, 'MyFoodMonth 1.1', compared to a semi-quantitative food frequency questionnaire (FFQ). Data were collected in a cross-sectional dietary survey evaluating the diets of students at the University of Agder, in southern Norway. The students were asked to complete both a dietary screener and an FFQ. Data collection was carried out from September to December 2020. Participants were first-year university students aged ≥18 years familiar with Scandinavian language. Almost half of the eligible sample (*n* 344) was excluded due to not completing the FFQ, compared to 1·7 % not completing the dietary screener, resulting in 172 (66 % female) participants with a median age of 21 years. For most items of the dietary screener (*n* 27/33, 82 %), all aspects of diet quality and components of the Diet Quality Score showed moderate-to-strong concordance with the FFQ evaluated using Kendall's tau-b analyses ($t > 0{\cdot}31$), supported by visual inspection of box and whisker plots and descriptive ranking ability in a cross-tabulation. There was little evidence to suggest that concordance was dependent on sex. The concordance and ranking ability of 'MyFoodMonth 1.1' is considered satisfactory compared to a semi-quantitative FFQ. This rapid dietary assessment instrument presents a valuable addition to traditional instruments and a possible solution to recruit hard-to-reach parts of the population.

Key words: Aspects of diet quality: Diet quality score: Frequency of intake: Self-report: Relative validity

Introduction

The requirement to complete long dietary questionnaires in nutritional studies is a threat to recruitment, representativeness and retention. Such studies are often overrepresented by women and motivated individuals from higher socio-economic groups[1], while men, adolescents, young adults and individuals from lower socio-economic groups are often underrepresented and difficult to recruit[2,3]. Compared to food frequency questionnaires (FFQs) and other comprehensive dietary assessment methods, non-quantitative dietary screeners offer a way to reduce participant burden and potentially increase participation rate and reach into populations that are challenging to recruit.

Dietary screeners compromise detailed dietary information in favour of a simplified dietary assessment. They are short FFQs, often without portion sizes, designed to quickly (<15 min) assess the usual (long-term) intake of selected foods or food groups and aspects of diet quality in a population[4]. The overall trend in dietary assessment is shifting towards digital methods[5,6], but there is limited information on whether dietary screeners are primarily digital or paper-based. Non-quantitative dietary screeners alone can be used to describe dietary intake, examine associations between diet and other variables and examine the effects of an intervention[7].

Validation of dietary assessment instruments is important to assess whether the instrument measures what it purports to measure. Full-length FFQs[8,9] and shorter FFQs[10,11] have been developed, validated, and used in a Norwegian setting. The shorter FFQs, designed as semi-quantitative questionnaires assessing both frequency of intake and quantity of

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>60 food items, may not be considered as dietary screeners due to their length and complexity. To our knowledge, presently there is no validated non-quantitative dietary screener used for dietary assessment in Norway.

The overall aim of the study was to assess the relative validity of the non-quantitative dietary screener 'MyFoodMonth 1.1' using a semi-quantitative FFQ as the comparison. Specifically, our objective was to assess the concordance and ranking ability of 'MyFoodMonth 1.1' for all single food items in the dietary screener; aspects of diet quality (in the form of selected food group categories, and iodine and calcium intake); a Diet Quality Score (DQS); and to assess whether there was a difference in ranking abilities in those above by sex.

Methods

Study design and sample

Data are from StudentKost2 – a dietary survey of students at the University of Adger (UiA), Southern Norway (unpublished work). The purpose of StudentKost2 was to assess students' diets in 2020, and to enable comparison between methods (dietary screener, 24 h dietary recall (24HR) and FFQ). Participants were recruited from August to October 2020. The recruitment strategies used were email, posters, flyers, videos in communal areas on campus, social media and in-person recruitment in classrooms. The target population was the 5003 first-year students aged ≥18 years at UiA familiar with Scandinavian language. A lottery of two iPhone 11s was used as an incentive to recruit participants.

Participants could choose to participate in study arm A: complete a dietary screener and 2 × 24HR, or arm B: complete a dietary screener, 2 × 24HR and an FFQ. Participants in study arm B were randomly assigned to receive either the FFQ or the 24HR within 48 h after completing the dietary screener. Participants who were assigned to receive the 24HR first, were sent the FFQ at the earliest 5 weeks after completing the dietary screener. The FFQ used in study arm B was the same instrument as used in a previous dietary survey among students, StudentKost1[12]. Informed consent was collected electronically by individuals who actively choose to sign up for study arm A or B. The background information form (age, height, weight, body mass index (BMI) and parental education), the dietary screener and the FFQ were all electronically self-reported using a smartphone or a computer at a time of the participants' choosing. Data used in the present study are from participants in study arm B. Fig. 1 presents the recruitment flowchart for study arm B, resulting in a total of 172 participants recruited (114 female, 58 male).

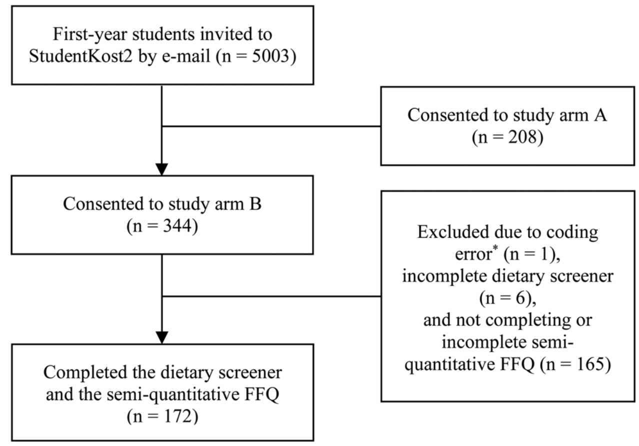

Fig. 1. Flowchart for StudentKost2, study arm B. *Participant lost due to incorrect ID-number.

'MyFoodMonth 1.1' dietary screener

The dietary screener 'MyFoodMonth 1.1' was developed by the Lifecourse Nutrition research group at UiA. It assesses the intake of thirty-three food items for the previous month (30 d) using ten frequencies of intake ranging from 'never' to '6+ times per day' (see Supplementary file 1). The dietary screener was based on the 2015 Dietary Screener Questionnaire from the National Cancer Institute's National Health Interview Survey Cancer Control Supplement[13]. The food list was altered to fit the Norwegian food culture, capturing intakes of fruit and vegetables, dairy, calcium, added sugars, whole grains/fibre, red meat and processed meat. All food items included were evaluated relative to data collected in a national dietary survey conducted among adults in Norway, the Norkost 2011 study[14].

The dietary screener does not assess portion sizes and does not aim to assess diet in its entirety, nor to estimate energy intake or absolutes of macro- or micronutrients of foods. It is designed to assess frequency of intake of selected food groups and hence assess aspects of diet quality. Furthermore, the dietary screener is designed to rank individuals according to their intake of food items, food groups reflecting aspects of diet quality, and calcium and iodine intake. Consequently, the dietary screener is designed to discriminate between low and high intakes based on the ten frequency of intake categories.

Following the thirty-three food items, the dietary screener includes questions on dietary patterns and preferences: use of dietary supplements (if yes, then which and how often), frequency of meals per week (breakfast, lunch, dinner, supper and snack) and abstaining from certain foods and beverages (seven predefined options and two open-ended options). Finally, an open-ended question with the option to leave a comment related to the diet.

Semi-quantitative FFQ

The FFQ[15] used in the present study was also developed by the Lifecourse Nutrition group at UiA and aims to assess the diet of preconception young adults. The FFQ is based on a questionnaire used among adolescents in the Norwegian Mother, Father and Child Cohort Study[9]. It consists of 121 food items, assessing an estimate of habitual dietary intake 4 weeks in retrospect. The nutritional calculation and estimation of gram intakes are based on standard portion sizes and nutritional values from the Norwegian Food Composition Table[16].

Data cleaning

Dietary screener data were checked for coding errors in ID-number, incomplete data and suspicious registrations (defined *a priori* as individuals reporting the same frequency of intake for twenty-two or more and seventeen or more food items (66 and 50 % of food items, respectively)). The calculation of the nutrient and food intake from the FFQ is described elsewhere[15]. Individuals with incomplete FFQ recordings were excluded, as complete dietary data was required to calculate nutrient and food intake.

Variables

Three data processing approaches were used to assess the relative validity of the dietary screener: first, keeping frequency categories as measured, i.e. raw measures; second, pooling food items and collapsing frequency categories to reflect aspects of diet quality; and third, as a DQS.

Harmonisation of dietary items between dietary screener and FFQ. Ninety-eight FFQ food items were aggregated into thirty-one groups corresponding to the food items in the dietary screener. Dietary screener food items 'Plant-based meat substitutes' and 'Nuts and seeds, unsalted' were not assessed by the FFQ and therefore not included in the comparison (Table 1). Food items in the FFQ that the author (LS) was unsure of whether to include in an aggregated group were discussed with a dietary expert (ACM) and solved by author consensus (LS, ACM) (Supplementary file 2).

Aspects of diet quality and nutrient intake. Single food items from the dietary screener were pooled to reflect aspects of diet quality (Table 2). The same pooling was used for the aggregated groups of the FFQ to sum up the intakes in grams. Dietary screener food items pooled to reflect the iodine and calcium intakes were compared with the total calculated nutrient intake of iodine and calcium from the FFQ. Simplified sets of pooled ordinal variables were derived to capture these aspects of diet quality components. The categories were chosen to (a) reflect typical intake and dietary guidelines in the Norwegian population[14,17] and (b) ensure that certain categories did not have low cell counts (Table 2). For example, to reflect intake relative to guidelines, food items were recoded into categories from '<1 a day' to '≥5 a day' for fruit and vegetable intake, '<3·5 a week' to '>2 a day' for whole grain, 'never' to '≥2·5 a week' for fish intake and '<1 a day' to '≥5 a day' for iodine-rich and calcium-rich foods. Red and processed meat, sugary foods, sugar-sweetened beverages, and beans, lentils, chickpeas, peas were recorded to present an even distribution of participants in categories ranging from 'never' to '≥1 a day'. For alcohol intake, the following categories were used: 'never' to '≥3·5 a week'.

Diet Quality Score

A DQS was devised that closely resembles the WELL Diet Score[18]. Nutritional professionals in the WELL Diet Score project distributed 0–10 points weighted relative to the health benefits associated with the ten frequencies of intake for the individual DQS components. The same scoring system was used in the present study for all frequencies of intake except two categories. That is, in our study '1/week' was equivalent to '1–2/week', and '2–4/week' was equivalent to '3–4/week', e.g. the score of two points in the WELL Diet score for Vegetables '1–2/week' was used for '1/week' in our study (detailed scoring system of the DQS components is available in Supplementary file 3).

The ten DQS components 'vegetables', 'fruits', 'whole grain (products)', 'beans and lentils', 'fish', 'nuts and seeds (unsalted)', 'sugar-sweetened beverages', 'sugary foods', 'meat (processed and red)' and 'salty foods' were derived from nineteen dietary screener food items as described in Table 2. The latter four DQS components above were inversely scored. All DQS components but 'nuts and seeds (unsalted)' were available for comparison with the FFQ. As previously described, the dietary screener food item 'nuts and seeds, unsalted' was not assessed by the FFQ, hence not available for comparison in the DQS.

Statistical analyses

Descriptive data for age, height, weight, BMI and parental education level were presented for the total sample and split by sex.

The dietary screener frequencies of intake were compared to FFQ data, both as intakes in grams, and nutrients. This was done to evaluate the non-quantitative dietary screener ability to reflect dietary intake without assigning portion sizes that would have correlated errors with the portion sizes in the FFQ.

Kendall's tau-b correlation analysis with bootstrap 95 % confidence intervals was used to estimate the concordance between raw measures from the dietary screener and the FFQ. A similar analysis was performed for the aspects of diet quality and DQS. Kendall's tau-b correlation coefficients were interpreted as follows: <0·30 = weak, 0·31–0·60 = moderate and >0·61 = strong[19–21]. We also cross-tabulated aspects of diet quality as ascertained from the dietary screener and FFQ to visually evaluate the ranking ability by comparing frequency of intake (assessed by the dietary screener) with median (IQR) (grams/nutrients per day) intake from the FFQ.

Box and whisker plots with participants as individual data points were produced to visualise the ranking ability using the raw measures from the thirty-one dietary screener food items available for comparison with the FFQ (grams per day). Participants were presented pooled, the box indicating median and IQR (25th and 75th percentiles), and whiskers using the quartile ±1·5*IQR convention.

Kendall's tau was repeated using *a priori* cut-offs as sensitivity analyses after removing individuals who reported the same frequency of intake for twenty-two or more and seventeen or more food items in the dietary screener. We suspected that these individuals were only interested in receiving the incentive and likely gave the same easy click response to each question to save time.

Kendall's tau analyses were performed using SPSS 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.), plots were produced in STATA (v17.0) and R (v 2022.2.0.443).

Table 1. Description of the semi-quantitative food frequency questionnaire food items aggregated into the corresponding dietary screener food items

Dietary screener items	Semi-quantitative FFQ items
Cereal and porridge, sweetened (e.g. Special K, corn flakes with honey)	Cornflakes, All-Bran, Special K, Cheerios Oat Crunch or the like
Cereal and porridge, unsweetened (e.g. 4-Korn muesli, oatmeal, Go'dag muesli, and Weetabix)	Oatmeal/oat porridge
	Muesli
Whole-grain bread, crispbread, rolls (>50% whole grain)	Whole wheat bread/wheat bread, bread with a medium fibre content
	Crispbread, high fibre content
Fish spread (e.g. mackerel in tomato sauce)	Roe
	Fish spread or cold cuts
White cheese (all types)	White/yellow cheese
Whey cheese	Brown cheese
Yoghurt, skyr (all types)	Natural yoghurt
	Fruit yoghurt/drinking yoghurt, ordinary
	Fruit yoghurt/drinking yoghurt, sugar free/reduced sugar content
Cow's milk (all types)	Whole milk (sweet/sour, e.g. Kefir)
	Low-fat milk
	Extra skimmed milk
	Skimmed milk
	Cultured milk products (e.g. Biola)
	Chocolate milk
	Activia/Actimel drinking yoghurt
Plant-based milk (all types)	Soy milk, rice milk or other type of milk
Juice/smoothie (not nectar)	Orange juice
	Apple juice
Fruit and berries, including fresh, frozen and canned (not juice or smoothie)	Apple
	Pear
	Banana
	Orange, mandarin, clementine, grapefruit
	Nectarine, peach or plum
	Melon
	Kiwi
	Pineapple, fresh
	Berries, fresh or frozen
	Grapes
	Raisins
	Dried fruit
Unsalted nuts and seeds	N/A
Vegetables, including salad, cabbage, carrot, green beans, etc. (not potatoes or sweet potatoes)	Broccoli
	Cauliflower
	Onion, garlic or leek
	Avocado
	Maize
	Mushrooms
	Peas
	Mixed salad
	Spinach
	Green, yellow, orange or red pepper
	Carrots
	Cucumber
	Tomato
Beans, lentils, chickpeas, peas (not green beans)	Dishes with beans, lentils or peas
Fried potatoes/sweet potatoes (e.g. fries, roast potatoes)	French fries
Potatoes/sweet potatoes, other (e.g. baked, boiled, mashed)	Potatoes, cooked or mashed
Whole-grain dinner products (e.g. barley, pasta, couscous)	Rice, whole grain
	Pasta/spaghetti, whole grain
	Noodles, whole grain
Pizza (all types)	Pizza
Tomato sauce, including sauce/salsa for tacos, ketchup, pasta, etc. (not pizza)	Ketchup
Plant-based substitutes (all types of meat substitutes)	N/A
Red meat, minced or cuts (beef, lamb/mutton, pork, kid)	Pork
	Beef, lamb
Processed meat (e.g. bacon, spread, sausage)	Liver pâté
	Ham, roast beef or the like
	Salami, boiled sausage slices, cured meats or the like
	Chicken or turkey cold cuts
	Meatballs/patties
	Sausages (of pork and/or beef)
	Taco (tacos or mince wraps)
	Hamburger
	Casserole dish
	Pasta dish with meat
	Processed chicken products

Continued

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Table 1. Continued

Dietary screener items	Semi-quantitative FFQ items
Fatty fish and fish products (e.g. salmon, mackerel)	Oily fish
Lean fish and fish products (e.g. cod, pollock)	White fish
	Processed fish meat
Salty snacks (e.g. popcorn, chips, salty nuts)	Potato chips, tortilla chips
	Popcorn
	Nuts
Candy, including chocolate	Candy
	Vanilla and/or milk chocolate
	Dark chocolate
	Chocolate bar
Waffles, buns, cake, biscuits, etc.	Pie
	Pastries
	Cake
	Cookies
Ice cream, panna cotta, pudding, mousse, etc.	Ice cream
	Ice pop
	Pudding, mousse, jelly
	Rice pudding and rice cream dessert
	Canned fruit
	Custard
Sugar-sweetened beverages	Squash, sugar-sweetened (e.g. lemonade, Ribena)
	Other juice or nectar (e.g. tropical juice, breakfast juice)
	Soft drinks (e.g. Coca Cola, Fanta, Sprite)
Sugar-sweetened energy drinks (e.g. Gatorade, Red Bull)	Energy drinks (e.g. Red Bull, Battery, Pure Rush, Cult, Burn)
Coffee/tea/iced coffee/iced tea with sugar/syrup/honey	Frappuccino, mocaccino, ice coffee or the like
Alcoholic beverages	Beer
	Cider
	Wine
	Liquor, liqueur
Water	Tap water, bottled water or mineral water

Semi-quantitative FFQ, semi-quantitative food frequency questionnaire; N/A, not applicable.

Ethical standards

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Norwegian Centre for Research Data (ref.nr: 848472) and the ethical committee for the Faculty of Health and Sport Science at the University of Agder (ref.nr: RITM0070447). Informed consent by action was obtained electronically from all subjects.

Results

Sample description

Fig. 1 shows that of the 344 participants eligible for inclusion, 1·7 % were excluded due to incomplete dietary screener submission, and 48 % due to incomplete or non-completion of the FFQ. Table 3 describes the characteristics of the 172 participants who completed both the dietary screener and FFQ. The median age was 21 years and 66 % were females. The median BMI was within the healthy weight range (18·5–24·9 kg/m^2)[22], and most of the participants had one or two parents who had completed higher education.

Concordance between the dietary screener and the semi-quantitative FFQ food items

The concordance quantified using Kendall's tau between the raw measures from the dietary screener and the thirty-one food items available for comparison with the FFQ (grams per week) are plotted in Fig. 2. These ranged from 0·20 (95 % CI 0·07–0·31) (weak concordance) for tomato sauce (including sauce/salsa for tacos, ketchup, pasta, etc., but not pizza) to 0·79 (95 % CI 0·71–0·86) (strong concordance) for whey cheese. Twenty food items (65 %) had concordance between 0·31 and 0·60 (moderate) and seven food items (23 %) greater than 0·61 (strong). The raw measures from the dietary screener and grams per day from the FFQ are also visually presented as box and whisker plots (available in Supplementary file 4, Figs. S1–S31).

The concordance of the food items in the dietary screener split by sex is available in Supplementary file 5, Fig. S32. The concordance was generally similar between the sexes – only five out of thirty-one food items showed any suggestion of difference. For female participants, the concordance varied from 0·13 (95 % CI −0·03 to 0·031) for cereal and porridge, sweetened (e.g. Special K) to 0·78 (95 % CI 0·69–86) for whey cheese. For male participants, the concordance varied from 0·18 (95 % CI 0·00–0·36) for coffee/tea/iced coffee/iced tea with sugar/syrup/honey to 0·84 (95 % CI 0·65–0·99) for whey cheese. The greatest differences in concordance between female and male participants were observed for plant-based milk (all types) (0·74 (95 % CI 0·62–0·85) and 0·45 (95 % CI 0·14–0·72), respectively), red meat, minced or cuts (beef, lamb, pork, goat) (0·51 (95 % CI 0·40–0·62) and 0·22 (95 % CI 0·02–0·42)), and cereal and porridge, sweetened (e.g. Special K) (0·13 (95 % CI −0·03 to 0·31) and 0·43 (95 % CI 0·17–0·67)).

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Table 2. Description of the dietary screener food items derived into aspects of diet quality with collapsed frequency of intake and the Diet Quality Score with scoring valence

		Aspects of diet quality		Diet Quality Score	
		Dietary aspects	Frequencies of intake	Components	Scoring valence*
Dietary screener	Cereal and porridge (unsweetened) Whole-grain bread Whole grain (barley/pasta/couscous)	Whole grain	<3·5 a week 3·5 a week to <1 a day 1–2 a day >2 a day	Whole grain (products)	Positive
	Beans/lentils/chickpeas/peas	Beans, lentils, chickpeas, peas (not green beans)	Never >0 to <weekly Weekly to <3·5 a week 3·5 a week to <1 a day ≥1 a day	Beans and lentils	Positive
	Red meat (beef/lamb/pig/goat) Processed meat	Red and processed meat	Never >0 to <weekly Weekly to <3·5 a week 3·5 a week to <1 a day ≥1 a day	Meat (processed and red)	Negative
	Cereal and porridge (sweetened) Candy/chocolate Waffles/buns/cake/biscuits Ice cream/panna cotta/pudding, etc.	Sugary foods	Never >0 to <weekly Weekly to <3·5 a week 3·5 a week to <1 a day ≥1 a day	Sugary foods	Negative
	Sugar-sweetened beverages Energy drinks with sugar	Sugar-sweetened beverages	Never >0 to <weekly Weekly to <3·5 a week 3·5 a week to <1 a day ≥1 a day	Sugar-sweetened beverages	Negative
	Fruit/berries (not juice/smoothie) Vegetables (not potatoes)	Fruit and vegetable	<1 a day 1–2·5 a day>2·5 to <5 a day ≥5 a day	Fruit Vegetables	Positive Positive
	Alcoholic beverages	Alcoholic beverages	Never >0 to <2 a month 2 a month to <weekly Weekly to <3·5 a week ≥3·5 a week	N/A	
	Nuts/seeds (unsalted)[†]	N/A		Nuts and seeds (unsalted)	Positive
	Salty snacks	Single ordinal variable	Never >0 to <2 a month 2 a month to <weekly Weekly to <3·5 a week 3·5 a week or more	Salty foods	Negative
	Fish spread Fatty fish (salmon/mackerel) Lean fish (cod, pollock)	Fish	Never >0 to <1 a week 1 to <2·5 a week ≥2·5 a week	Fish	Positive
	White cheese Whey cheese Yoghurt Cow's milk	Calcium-rich foods[§] Iodine-rich foods[‡]	<1 a day 1–2·5 a day>2·5 to <5 a day ≥5 a day	N/A	
	Plant-based milk	Single ordinal variable	Never >0 to <weekly Weekly to <3·5 a week 3·5 a week to <1 a day ≥1 a day	N/A	

Juice/smoothie	Single ordinal variable	Never	N/A
Coffee/tea with sugar/syrup/honey	Single ordinal variable	>0 to <2 a month	N/A
Fried potatoes/sweet potatoes	Single ordinal variable	2 a month to <weekly	N/A
Potatoes/sweet potatoes (other)	Single ordinal variable	Weekly to <3·5 a week	N/A
Pizza	Single ordinal variable	3·5 a week or more	N/A
Tomato sauce	Single ordinal variable		N/A
Plant-based meat substitutes†	N/A		N/A
Water	Single ordinal variable	<1 a day	N/A
		1–2·5 a day	
		>2·5 to <5 a day	
		≥5 a day	

N/A, not applicable.
* Scoring valence: positive, scored 0–10 points from the lowest to the highest diet quality; negative, scored 10–0 points from the lowest to the highest diet quality.
† Not available for comparison with the semi-quantitative food frequency questionnaire (FFQ).
‡ Compared to total iodine intake (µg) per day calculated from the semi-quantitative FFQ.
§ Compared to total calcium intake (mg) per day calculated from the semi-quantitative FFQ.

There were no individuals who reported a suspicious sequence of the same frequency of intake for twenty-two or more food items in the dietary screener. Only four individuals reported a suspicious sequence of the same frequency of intake for seventeen or more food items. In a sensitivity analysis removing these individuals, results were unaltered.

Aspects of diet quality and DQS

Table 4 reports the distribution of values and ranking of the FFQ and the DQS according to the aspects of diet quality defined using the dietary screener. A visual inspection of the median and IQR (25th and 75th percentiles) shows that the dietary screener distinguished between high and low intake for most variables. An unbalanced distribution of participants (mainly among males) for the aspects 'fruit and vegetable', 'red and processed meat' and 'beans, lentils and chickpeas' presented in Table 4 affect the credibility of the estimates.

Fig. 3 formally quantifies the concordance between the aspects of diet quality derived from the dietary screener (frequency of intake) and the FFQ (grams per day), ranging from 0·37 (95 % CI 0·28–0·47) for sugary foods to 0·70 (95 % CI 0·62–0·76) for fish. The ability of the dietary screener to capture intake of iodine and calcium (based on foods rich in these nutrients) compared to nutrient values in the FFQ showed moderate concordance of 0·34 (95 % CI 0·24–0·45) and 0·42 (95 % CI 0·32–0·53), respectively. Concordance for the nine single food items (ordinal variables) derived from the dietary screener, and that are not included as aspects of diet quality, ranged from 0·19 (95 % CI 0·06–0·30) for tomato sauce to 0·69 (95 % CI 0·59–0·79) for plant-based milk (available in Supplementary file 5, Fig. S33).

Concordance of the aspects of diet quality, iodine-rich foods and calcium-rich foods split by sex are available in Supplementary file 5, Fig. S34, and single food item ordinal variables that are not included as aspects of diet quality in Supplementary file 5, Fig. S35. The concordance was generally similar between the sexes – only two out of nineteen variables showed any suggestion of difference. The greatest differences in concordance between female and male participants for aspects of diet quality were observed for fruit and vegetable (0·37 (95 % CI 0·25–0·49) and 0·51 (95 % CI 0·36–0·64)) and alcoholic beverages (0·52 (95 % CI 0·40–0·63) and 0·65 (95 % CI 0·48–0·77)), and for the single food items (ordinal variables), the greatest differences were observed for plant-based milk (0·75 (95 % CI 0·62–0·85) and 0·45 (95 % CI 0·11–0·73)) and coffee/tea with sugar/syrup/honey (0·37 (95 % CI 0·25–0·49) and 0·18 (95 % CI −0·01 and 0·37)), respectively.

Fig. 4 presents Kendall's tau for the nine DQS components with available comparators in the FFQ. The concordance ranged from 0·33 (95 % CI 0·22–0·42) for sugary foods to 0·64 (95 % CI 0·55–0·72) for beans, lentils and chickpeas. The concordance split by sex is available in Supplementary file 5, Fig. S36. The concordance was generally similar between the sexes. The largest difference in concordance between female and male participants was observed for the DQS component

Table 3. Descriptive statistics for participants completing both the dietary screener and the semi-quantitative food frequency questionnaire, presented as median with interquartile range and frequency with proportion, unless stated otherwise

	Total		Female		Male	
	(*n* 172)		(*n* 114)		(*n* 58)	
	Median	IQR	Median	IQR	Median	IQR
Age, years	21	(19, 25)	21	(19, 24)	22	(20, 25)
Height, cm*	173	(9)	168	(6)	181	(8)
Weight, kg	68†	(60, 79)	65‡	(58, 73)	78§	(69, 90)
BMI	23†	(20·9, 25·7)	22·8‡	(20·5, 25·6)	23·4§	(21·6, 26·2)
Parental education level, *n* (%)						
Lower education	37	(22%)	28	(25%)	9	(16%)
Vocational secondary school	39·5	(23%)	26·5	(23%)	13	(22%)
Higher education	85	(49%)	53·5	(47%)	31·5	(54%)
Other	10·5	(6%)	6	(5%)	4·5	(8%)

IQR, interquartile range; SD, standard deviation; BMI, body mass index.
* Presented as mean (SD). Reporting weight was optional, resulting in sample variation for weight and BMI.
† *n* 157.
‡ *n* 101.
§ *n* 56. BMI calculated as kg/m^2. Parental education level: Lower education (primary school and secondary school), Higher education (university, less than 4 years and university, more than 4 years), and Other (other education and not sure/not applicable).

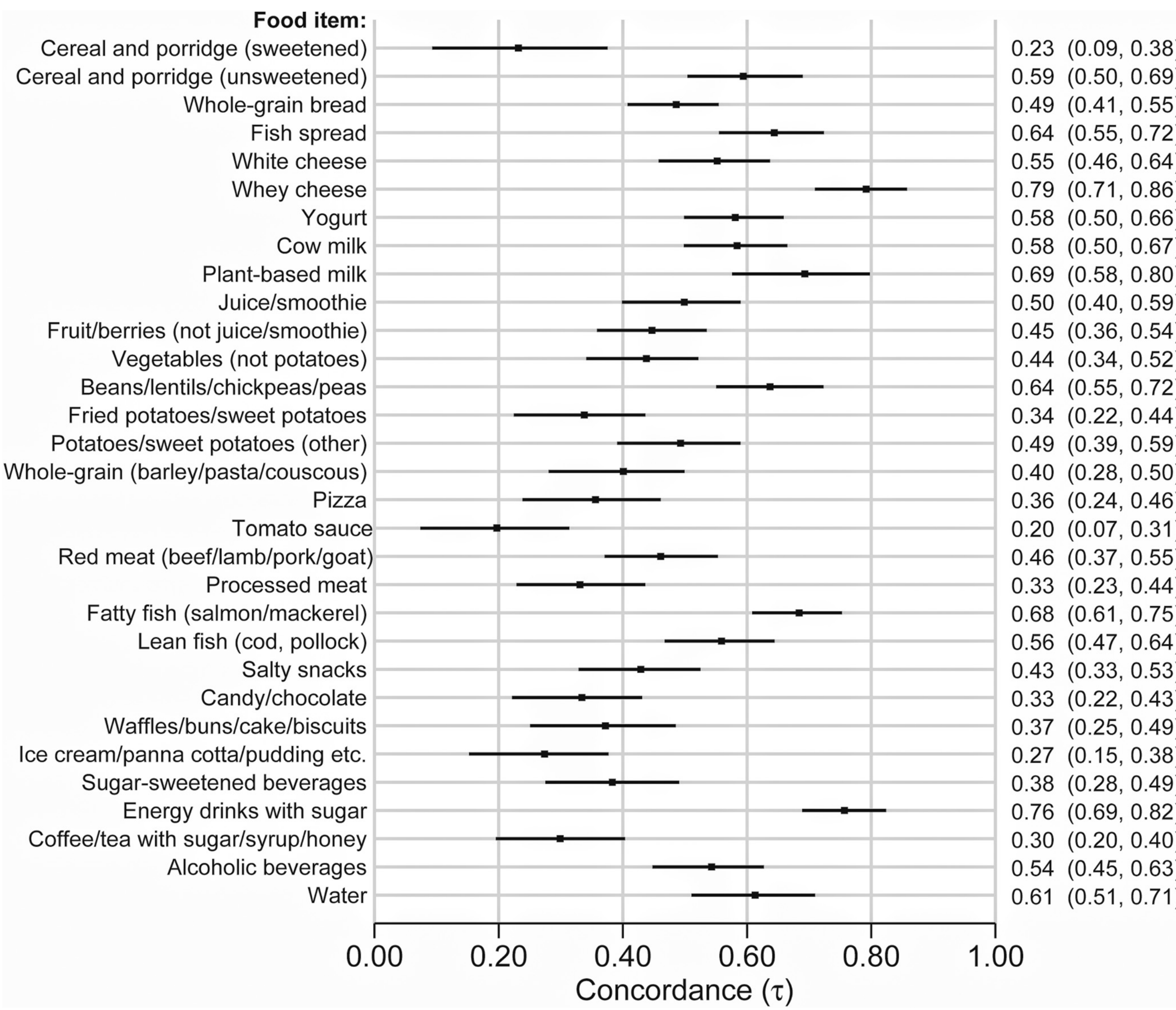

Fig. 2. Forest plot of Kendall's tau-b concordance with 95 % confidence intervals for thirty-one food items in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire.

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Table 4. Cross-table of aspects of diet quality, including iodine and calcium intake, derived from the dietary screener 'MyFoodMonth 1.1' and the distribution of intakes from the semi-quantitative food frequency questionnaire, and the Diet Quality Score

			Female					Male				
			FFQ (g)			DQS (0–10)		FFQ (g)			DQS (0–10)	
	Aspects of diet quality	Frequency of intake	*N*	Median	(IQR)	Median	(IQR)	*n*	Median	(IQR)	Median	(IQR)
Dietary screener	Fruit and vegetable*	<1 a day	29	121	(71, 180)	6	(5, 8)	26	109	(49, 158)	4·5	(3, 8)
		1–2·5 a day	54	217	(140, 368)	12	(10, 14)	25	202	(166, 270)	10	(9, 12)
		>2·5 to <5 a day	19	193	(159, 295)	15	(12, 18)	6	236	(163, 347)	11	(10, 15)
		≥5 a day	12	447	(365, 568)	19	(19, 19)	1	568	(568, 568)	19	(19, 19)
	Whole grain	<3·5 a week	19	35	(9, 71)	1	(0, 4)	9	62	(15, 127)	2	(0, 4)
		3·5 a week to <1 a day	19	73	(30, 101)	4	(4, 6)	10	69	(36, 90)	6	(4, 6)
		1–2 a day	38	129	(73, 183)	8	(8, 8)	17	134	(66, 186)	8	(8, 8)
		>2 a day	38	174	(133, 221)	10	(10, 10)	22	173	(113, 218)	10	(10, 10)
	Fish	Never	14	0	(0, 0)	0	(0, 0)	15	0	(0, 0)	0	(0, 0)
		>0 to <1 a week	28	21	(11, 30)	7	(4·75, 7)	7	16	(13, 45)	10	(4, 10)
		1 to <2·5 a week	27	36	(27, 46)	10	(10, 10)	23	40	(31, 50)	10	(10, 10)
		≥2·5 a week	45	77	(51, 116)	10	(10, 10)	13	64	(36, 83)	10	(10, 10)
	Red and processed meat†	Never	11	0	(0, 7)	10	(10, 10)	2	53	(14, -)	10	(10, 10)
		>0 to<weekly	10	86	(34, 130)	9	(8, 10)	2	22	(11, -)	10	(10, 10)
		Weekly to <3·5 a week	26	78	(56, 101)	6	(6, 6)	12	138	(74, 214)	6	(4·5, 6)
		3·5 a week to <1 a day	45	127	(86, 178)	2	(2, 4)	27	162	(126, 258)	4	(2, 4)
		≥1 a day	22	130	(93, 251)	1	(0, 1)	15	233	(171, 283)	1	(0, 1)
	Sugary foods†	Never	1	12	(12, 12)	10	(10, 10)	1	8	(8, 8)	10	(10, 10)
		>0 to <weekly	14	11	(6, 29)	6	(6, 8)	9	16	(10, 28)	8	(6, 8)
		Weekly to <3·5 a week	40	32	(23, 39)	6	(6, 6)	24	35	(20, 53)	6	(6, 6)
		3·5 a week to <1 a day	34	43	(23, 61)	4	(1, 4)	18	38	(24, 55)	4	(4, 4)
		≥1 a day	25	45	(34, 75)	0	(0, 0)	6	56	(38, 78)	0	(0, 0)
	Sugar-sweetened beverages†	Never	21	0	(0, 36)	10	(10, 10)	9	36	(18, 143)	10	(10, 10)
		>0 to <weekly	47	50	(36, 71)	8	(8, 9)	11	50	(36, 114)	9	(6, 9)
		Weekly to <3·5 a week	13	100	(64, 243)	4	(4, 6)	12	79	(55, 184)	4	(4, 6)
		3·5 a week to <1 a day	21	143	(79, 357)	4	(1, 4)	14	179	(143, 314)	2·5	(1, 4)
		≥1 a day	12	175	(20, 461)	0	(0, 0)	12	386	(179, 712)	0	(0, 0)
	Beans, lentils, chickpeas, peas (not green beans)	Never	40	0	(0, 0)	0	(0, 0)	19	0	(0, 0)	0	(0, 0)
		>0 to <weekly	44	21	(0, 21)	2	(1·25, 3·5)	24	21	(21, 43)	2	(1, 4)
		Weekly to <3·5 a week	14	86	(37, 129)	6	(6, 6)	8	43	(21, 129)	6	(6, 6)
		3·5 a week to <1 a day	8	129	(27, 129)	8	(8, 8)	2	32	(21, –)	8	(8, 8)
		≥1 a day	8	129	(43, 193)	9	(9, 9)	5	43	(43, 161)	9	(9, 9)
	Alcoholic beverages	Never	27	0	(0, 0)	N/A		11	0	(0, 36)	N/A	
		>0 to <2 a month	21	79	(41, 138)			8	68	(36, 113)		
		2 a month to <weekly	53	95	(49, 206)			26	150	(76, 306)		
		Weekly to <3·5 a week	11	191	(60, 372)			12	477	(298, 676)		
		≥3·5 a week	2	514	(290, –)			1	1335	(1335, 1335)		
	Iodine-rich foods	<1 a day	31	86‡	(60, 119)	N/A		13	66‡	(55, 107)	N/A	
		1 to 2·5 a day	48	113‡	(69, 150)			27	106‡	(88, 142)		
		>2·5 to <5 a day	29	132‡	(93, 214)			14	160‡	(58, 205)		
		≥5 a day	6	311‡	(212, 460)			4	157‡	(150, 185)		
	Calcium-rich foods	<1 a day	35	535§	(324, 679)	N/A		14	616§	(410, 801)	N/A	
		1 to 2·5 a day	47	751§	(571, 905)			28	814§	(652, 971)		
		>2·5 to <5 a day	27	891§	(673, 1353)			12	1107§	(888, 1302)		
		≥5 a day	5	1828§	(1396, 2045)			4	1130§	(921, 1416)		

FFQ, semi-quantitative food frequency questionnaire; DQS, Diet Quality Score; IQR, interquartile range; N/A, not applicable.
* Diet quality score components 'Vegetable' and 'Fruit' combined, ranging from 0 to 20.
† Diet Quality Score component inversely scored.
‡ Compared to total iodine intake (µg).
§ Compared to total calcium intake (mg).

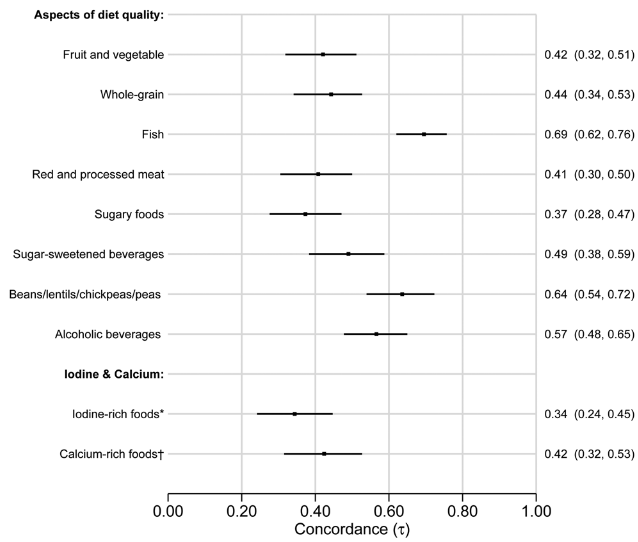

Fig. 3. Forest plot of Kendall's tau-b concordance with 95 % confidence intervals for aspects of diet quality, iodine-rich foods and calcium-rich foods derived from the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire. *Compared to iodine intake (μg) per day. †Compared to calcium intake (mg) per day.

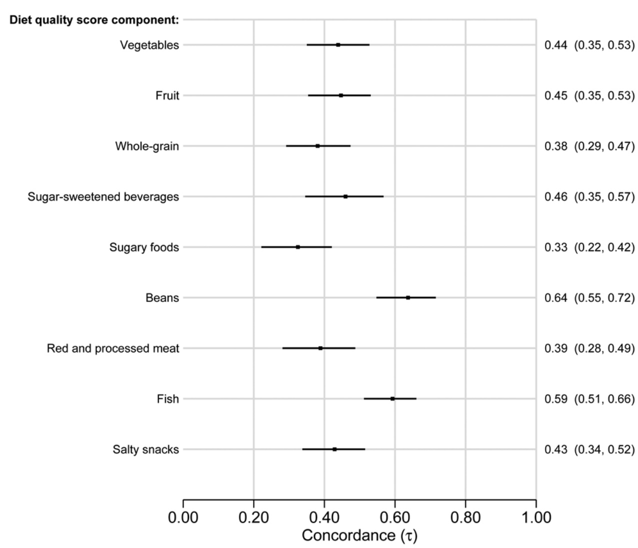

Fig. 4. Forest plot of Kendall's tau-b concordance with 95 % confidence intervals for the Diet Quality Score components derived from the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire.

vegetables (0·37 (95 % CI 0·24–0·49) and 0·50 (95 % CI 0·35–0·64)), respectively.

Discussion

Summary of findings

As far as we are aware, this is the first validation study of a non-quantitative dietary screener to assess dietary intake among young adults in a Norwegian population. The 33-item dietary screener was compared to a 121-food item FFQ. Kendall's tau-b analyses showed that twenty-seven of the thirty-one dietary screener variables available for comparison with the FFQ had a moderate or strong concordance (>0·31). The aspects of diet quality, and DQS, derived from the dietary screener, were all considered satisfactory. That is, they showed moderate-to-strong concordance with the FFQ. This was corroborated by the ranking ability visualised in a cross-table showing aspects of diet quality with DQS components and intakes from the FFQ. There was little evidence to suggest that concordance between the dietary screener and FFQ was dependent on sex.

Comparison with other studies

Many validation studies on dietary assessment methods exist, but there are a limited number of validation studies on dietary screeners. Studies available for comparison have used a variety of validation approaches that are not directly comparable to ours.

Fruit and vegetable intakes assessed with a dietary screener compared to an FFQ

The previously reported concordance for the intakes of fruit (0·42[23], 0·61[24], 0·63[25], 0·54[26]) and vegetable (0·30[23], 0·49[24], 0·41[25], 0·39[26]), separately, are comparable to our findings. Furthermore, our pooled fruit and vegetable variable as an aspect of diet quality is comparable to Dehghan *et al.*[27] at 0·49, while Block *et al.*[28] report a higher concordance at 0·71. The discrepancy between our results and those of Block *et al.* may be due to their use of seven questions to assess the intake of fruits and vegetables in the dietary screener compared to our use of two questions. This makes the dietary screener of Block *et al.* much more detailed and more like the FFQ they used in their comparison. Furthermore, in contrast to our study, Block *et al.* used defined portion sizes (small/medium/large) in their FFQ in addition to software to generate age- and gender-specific portion sizes, which may have yielded more accurate portion size estimations for comparison with their dietary screener.

Fish and/or other seafood intakes assessed with a dietary screener compared to an FFQ

Our results for fish and seafood are also comparable to others (0·56 (oily fish)[24], 0·68[27], 0·46[26]), and substantially stronger compared to the concordance of Hebestreit *et al.*[23] at 0·25. We speculate whether parts of the discrepancy between our results and those of Hebestreit *et al.* may be due to our dietary screener using three questions to assess fish intake, covering intake of different types of fish, compared to the single question (servings of fish/seafood per week) used in the study of Hebestreit *et al.*

Red and processed meat intakes assessed with a dietary screener compared to an FFQ

Comparing our results with those of de Rijk *et al.*[25] we found a similar concordance for red meat (0·30) and somewhat lower for processed meat (0·55). Our pooled variable for red and processed meat is comparable to Dehghan *et al.*[27] (0·40), whereas Hebestreit *et al.*[23] report a higher concordance of 0·58. Our non-quantitative dietary screener variables assessing red and processed meat intake is not designed to discriminate between portion sizes. Splitting these into more variables, enabling us to distinguish between intake of meat as cuts or meat for dinner (typically having very different portion sizes), could have contributed to a better concordance with the current FFQ.

Sugar-sweetened beverages and sugary food intakes assessed with a dietary screener compared to an FFQ

Other studies report concordance for sugar-sweetened beverages between −0·04[23] and 0·74[27], indicating that it may be difficult to accurately assess. We found concordance in the area of 0·40 for sugar-sweetened beverages, indicating moderate concordance compared to the FFQ. For sugary foods, our results are comparable to other studies (0·44[23], 0·39[25]). It should be noted that the single food item 'cereal and porridge, sweetened' included in the pooled variables defined as 'sugary foods' performed poorly compared to the FFQ, both in raking of participants intake (Supplementary file 4, Fig. S1) and for the concordance for female participants (Supplementary file 5, Fig. S36). We speculate that there are more women than men eating this kind of food and that the high concordance for men reflects the non-consumers. For females, it could be that they find it difficult to know if the cereal should be defined as sweetened or not – perhaps leading to misclassifications between the dietary screener and the FFQ. We suggest refining the variable 'cereal and porridge, sweetened' for future use of the dietary screener.

Alcohol intake assessed with a dietary screener compared to an FFQ

We found somewhat stronger concordance for our total alcohol intake variable compared to other studies, showing concordance at 0·35 for wine[23] and 0·41[25] for pooled alcohol consumption. The concordance of individuals' alcohol intake was assessed by comparing a single question in the dietary screener with the total alcohol intake reported for the week and weekend in the FFQ in the present study. This is similar to de Rijk *et al.*[25], although they assessed intake split into week and weekend in the dietary screener, but used a single question in the FFQ. Our dietary screener shows surprisingly good concordance of participants' intake of alcohol compared to de Rijk *et al.* We speculate that this may be due to the proportion of non-consumers in our study.

Whole grain and legume intakes assessed with a dietary screener compared to an FFQ

The strength of the concordance for our pooled whole grain variable ('cereal and porridge, unsweetened', 'whole-grain bread' and 'whole-grain dinner products') is consistent with what has been reported in other studies for fairly comparable variables (0·35 (starches)[27], 0·22[25] (whole-grain products)). On the other hand, our findings for beans, lentils and chickpeas showed a considerably stronger concordance (0·64) than those found for legumes by de Rijk *et al.*[25] at 0·43. We speculate that this discrepancy may be explained by the high number of non-consumers of beans, lentils and chickpeas observed in our study, because it is more difficult to report the correct intake of a food you eat sometimes or often than foods you never eat[29]. Nevertheless, the results show that there is a high concordance between (zero or higher) intakes of legumes in both the dietary screener and FFQ in our study.

Calcium-rich foods and iodine-rich foods intakes assessed with a dietary screener compared to an FFQ

The only study that is comparable in some measure to ours, in regard to the calcium and iodine concordance, is by van Lee *et al.*[26], who found an inverse association between their crude dietary screener index and estimated calcium intake from a full-length FFQ. However, this association disappeared when adjusted for energy intake estimates. In stark contrast, we found moderate concordance between the dietary screener intakes of calcium-rich and iodine-rich foods and the estimated total nutrient intake of calcium or iodine calculated from the FFQ. This shows that our non-quantitative dietary screener may provide a rough estimate of the level of calcium and iodine intake, despite not assessing the total diet or calculating nutrient intakes.

Strengths and limitations

A strength of our study is the sample size, which enabled us to estimate the concordance with adequate precision[30,31]. We were also able to stratify our analysis by sex to check whether the dietary screener performs differently for males and females.

We also display the individual data points, which allows the concordance to be given a visual context and may be of use for future researchers who are interested in components of the dietary screener.

'MyFoodMonth 1.1' is purposively designed as a non-quantitative dietary screener. To estimate the quantities of foods from the dietary screener, we could have assigned standardised age- and gender appropriate portion sizes after data collection, as others have done previously, e.g. Block *et al.*[28]. We did not adopt this approach, because we wanted to avoid introducing additional estimation error, and a false impression of instrument resolution – using a 'one-size-fits-all' portion size (even adjusted for age- and gender, or body size, etc.) will not capture the between-person variation in portion sizes[30]. Moreover, by avoiding portion sizes, we strengthen the applicability of the instrument by reducing the time and resources necessary for data processing.

The sample population consists entirely of first-year students, limiting the generalisability. The student population with a 33 % proportion of men in our study is comparable to the student population at UiA[32] and nationwide in Norway[33] per 2021 (41 and 40 % men, respectively). However, the median BMI in our study sample is comparable to the mean BMI (24·2 for female, 23·8 for male) for young adults (18–24 years) reported in the Norwegian National Public Health Survey 2020[34]. Furthermore, the variation in parental education level in this study strengthens its generalisability to a general population of young adults in Norway.

Implications

The non-quantitative dietary screener validated in this study is a rapid instrument assessing diet in a simple and effective way, with the potential to reach populations difficult to recruit using traditional dietary assessment instruments (e.g. FFQ and 24HR). As shown in Fig. 1, 48 % of participants eligible for inclusion did not complete the FFQ, whereas <2 % did not complete the dietary screener, illustrating this point.

This dietary screener may have utility as a main dietary assessment instrument, as a supplement to other dietary assessment instruments, or for studies with diet as a secondary outcome to reduce the total burden of the data collection.

The food items ‘cereal and porridge, sweetened’, ‘tomato sauce’ and ‘coffee/tea/iced coffee/iced tea with sugar/syrup/honey’ showed poor concordance with the FFQ. We suggest altering all three in future versions of the dietary screener.

‘Cereal and porridge, sweetened’ was included in both the aspect of diet quality component ‘sugary foods’, and the DQS component ‘sugary foods’, and should therefore ideally be kept in the dietary screener. To improve the ‘cereal and porridge, sweetened’ item in the dietary screener, we believe we need to clarify the difference between the sweetened and unsweetened cereal and porridge by altering the explanation texts for these food items. A suggestion would be to instruct participants to categorise cereals and porridge according to the ‘Keyhole’ scheme, a well-known[35] label used in the Nordic Region based on the Nordic Nutrition Recommendations[36], intended to make it easier for shoppers to choose better and healthier products. This could be done by simply adding the Keyhole label besides the unsweetened cereal and porridge food item. For cereals or breakfast cereals to carry the ‘Keyhole’ label, they must satisfy certain requirements: fat at most 8/100 g; sugars at most 13/100 g, of which added sugars at most 9/100 g; dietary fibre at least 6/100 g and salt at most 1/100 g[37], which fits well with the ‘cereal and porridge, unsweetened’.

‘Coffee/tea/iced coffee/iced tea with sugar/syrup/honey’ may have performed poorly because it was too heterogeneous, comprising beverages with varying sugar content. Moreover, it was never included in either aspects of diet quality or a DQS component. This was because it comprises beverages with lower sugar content compared to other typical SSBs, e.g. two sugar cubes (4 g) in a small cup of coffee (100 g) compared to 10/100 g sugar content in regular soda. However, this food item category also includes iced tea, which often has sugar content similar to regular soda. Due to this, we suggest that in future versions of the dietary screener, we should include iced tea in the SSB-variable, and omit the lower sugar containing coffees and teas.

‘Tomato sauce’ comprising different kinds of tomato-based sauces, spanning from ketchup to e.g. a Bolognese sauce, was not included in either aspects of diet quality or a DQS component from the start, hence excluding this poor performing variable will not impact these. We speculate whether the food item category is too broad, and in future versions of MyFoodMonth, we suggest, specifying that tomato should be reported in the vegetable food item, and that the tomato sauce food item should be excluded.

Conclusions

The relative validity of the non-quantitative 33-item dietary screener ‘MyFoodMonth 1.1’ showed moderate-to-strong concordance and performed satisfactorily in ranking intake for most raw measures, aspects of diet quality, including calcium and iodine, and DQS components compared to a semi-quantitative FFQ, both for men and women in a young student population. This dietary screener presents a promising alternative as a rapid dietary assessment instrument with the potential to reach populations difficult to recruit using traditional instruments.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/jns.2023.57.

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Supporting information

Supplementary file 1: MyFoodMonth 1.1 dietary screener

Supplementary file 2: Aggregated food-frequency questionnaire food items – rationale for inclusion/exclusion of food items

Supplementary file 3: 'MyFoodMonth 1.1' Diet Quality Score scorings

Supplementary Figure S1-S31: Figure S1-S31. Box and whisker plots of 31 items in the dietary screener 'MyFoodMonth 1.1'compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

Supplementary Figure S32-S36: Forest-plots of Kendall's tau-b concordance with 95% confidence intervals for the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire, pooled or split by gender.

Short questionnaire about your diet (MyFoodMonth 1.1)

The questions apply to selected food and beverage items consumed during the last month, that is, the last 30 days. Enter how often you ate or drank the foods and beverages listed below either at meals or as a snack (in-between-meal), at home, on the go, in a café, or anywhere.

Enter (X) to indicate your answer. Thanks for your help!

1. How often did you eat/drink the following items the last month? (Enter once per row)

	Times per day				Times per week			Times per month		Never
	6+	4-5	2-3	1	5-6	2-4	1	2-3	1	
Cereal and porridge										
Sweetened (e.g., Special K, Corn Flakes with honey)										
Unsweetened (e.g., 4-Korn muesli, oatmeal, Go'dag muesli, and Weetabix)										
Whole grain bread, crispbread, rolls (>50% whole grain)										
Fish spread (e.g., mackerel in tomato sauce)										
White cheese (all types)										
Whey cheese										
Yoghurt, skyr (all types)										
Cow's milk (all types)										
Plant-based milk (all types)										
Juice/smoothie (not nectar)										
Fruit and berries, including fresh, frozen, and canned (not juice or smoothie)										
Unsalted nuts and seeds										
Vegetables, including salad, cabbage, carrot, green beans, etc. (not potatoes or sweet potatoes)										
Beans, lentils, chickpeas, peas (not green beans)										
Fried potatoes / sweet potatoes (e.g., fries, roast potatoes)										
Potatoes / sweet potatoes, other (e.g., baked, boiled, mashed)										
Whole grain dinner products (e.g., barley, pasta, couscous)										
Pizza (all types)										
Tomato sauce, including sauce/salsa for tacos, ketchup, pasta, etc. (not pizza)										
Plant-based substitutes (all types of meat substitutes)										
Red meat, minced or cuts (beef, lamb/mutton, pork, kid)										
Processed meat (e.g., bacon, spread, sausage)										
Fatty fish and fish products (e.g., salmon, mackerel)										
Lean fish and fish products (e.g., cod, pollock)										
Salty snacks (e.g., popcorn, chips, salty nuts)										
Candy, including chocolate										
Waffles, buns, cake, biscuits etc.										
Ice cream, panna cotta, pudding, mousse, etc.										
Sugar-sweetened beverages										
Sugar-sweetened energy drinks (e.g., Gatorade, Red Bull)										
Coffee / tea / iced coffee / iced tea with sugar/syrup/honey										
Alcoholic beverages										
Water										

2. Have you taken any supplements such as vitamins, protein supplement etc.?
No ☐ Yes ☐
If yes; what and how often?

3. How often do you usually eat the following meals per week? (Enter <u>once</u> per row)								
	Times per week							Rarely/ never
	7	6	5	4	3	2	1	
Breakfast								
Lunch								
Dinner								
Supper								
	Times per day				Times per week			Rarely/ never
	6+	4-5	2-3	1	5-6	2-4	1	
Snack (in-between-meals)								

4. I avoid consuming certain foods and beverages because of …: (Enter <u>once</u> per row)			
	No, never	Sometimes	Yes, always
… allergies or intolerance(s)			
… my health			
… my religion			
… my weight			
… climate considerations			
… animal welfare			
… veganism			
***… other reasons than those above** (describe below)*			
Describe the foods and beverages you avoid (if applicable):			
Other reasons why you avoid consuming certain foods and beverages (if applicable):			

Comments related to my diet (if applicable):

Supplementary file 2. Aggregated food-frequency questionnaire food items – rationale for inclusion/exclusion of food items

- "Sports drinks" excluded from the aggregated food item corresponding to the dietary screener food item "Energy drinks with sugar"
    - Sports drinks are not available in the Norwegian food composition table. The food item "Sports drink" was previously coded as "Coconut water" in the FFQ, due to it having the closest resembling nutritional content.
- "Sugar, refined, tea-spoon to coffee/tea" excluded from the aggregated food item corresponding to the dietary screener food item "Coffee / tea / iced tea with sugar/sirup/honey" due to difference in quantity between teaspoon(s) of sugar and beverages containing sugar
- "Sour milk, strawberry, Biola" included in the aggregated food item corresponding to the dietary screener food item "Cow's milk" as it is categorised as cow's milk in the Norwegian food composition table
- "Grain mixture with fruit, nuts, sweetened" included in the aggregated food item corresponding to the dietary screener food item "Cereal or porridge, unsweetened".
    - Food item listed as an example of unsweetened cereal alternatives in the FFQ.
    - Compared to another the example "Go'dag" in the dietary screener food item there is only a 5.2-gram difference in added sugar, while a sweetened cereal, e.g., "Corn flakes, sweetened, Frosties", has 11 grams more added sugar.

Supplementary file 3. 'MyFoodMonth 1.1' Diet Quality Score scorings

Diet Quality Score components Screener variable(s)	Scoring Valence	Criteria for min score (0)	Criteria for max score (10)	'MyFoodMonth 1.1' Diet Quality Score scorings									
				Never	1 a month	2-3 a month	1 a week	2-4 a week	5-6 a week	1 a day	2-3 a day	4-5 a day	≥6 a day
Vegetables Vegetables, including salad, cabbage, carrot, green beans, etc. (not potatoes or sweet potatoes)	positive	≤1 x month	≥4 x day	0	0	1	2	4	6	8	9	10	10
Fruits Fruit and berries, including fresh, frozen, and canned (not juice or smoothie)	positive	≤1 x month	≥2 x day	0	0	1	2	4	6	8	10	10	10
Whole grain (products) Cereal and porridge, Unsweetened (e.g., 4-Korn muesli, oatmeal, Go'dag muesli, and Weetabix) Whole grain bread, crispbread, rolls (>50% whole grain) Whole grain dinner products (e.g., barley, pasta, couscous)	positive	≤1 x month	2-5 x day	0	0	1	2	4	6	8	10	10	8
Sugar-sweetened beverages Sugar-sweetened beverages Sugar-sweetened energy drinks (e.g., Gatorade, Red Bull)	negative	≥1 x day	0	10	9	8	6	4	1	0	0	0	0
Sugary foods Cereal and porridge, Sweetened (e.g., Special K, Corn Flakes with honey) Candy, including chocolate Waffles, buns, cake, biscuits etc. Ice cream, panna cotta, pudding, mousse, etc.	negative	≥1 x day	0	10	9	8	6	4	1	0	0	0	0
Beans and lentils Beans, lentils, chickpeas, peas (not green beans)	positive	0	≥2 x day	0	1	2	4	6	8	9	10	10	10
Nuts and seeds (unsalted) Unsalted nuts and seeds	positive	0	1-3 x day	0	1	2	4	6	8	10	10	8	6
Meat (processed and red) Red meat, minced or cuts (beef, lamb, pork, goat) Processed meat (e.g., bacon, spread, sausage)	negative	≥2 x day	≤1 x month	10	10	8	6	4	2	1	0	0	0
Fish Fatty fish and fish products (e.g., salmon, mackerel) Lean fish and fish products (e.g., cod, pollock) Fish spread (e.g., mackerel in tomato sauce)	Positive	0	≥1 x week	0	4	7	10	10	10	10	10	10	10
Salty foods Salty snacks (e.g., popcorn, chips, salty nuts)	negative	≥2 x day	0	10	9	8	6	4	2	1	0	0	0

Total Possible Points: 100

Supplementary file 4.

Figure S1-S31. Box and whisker plots of 31 items in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

Figure S1. Box and whisker plot for “Cereal & porridge (sweetened)” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

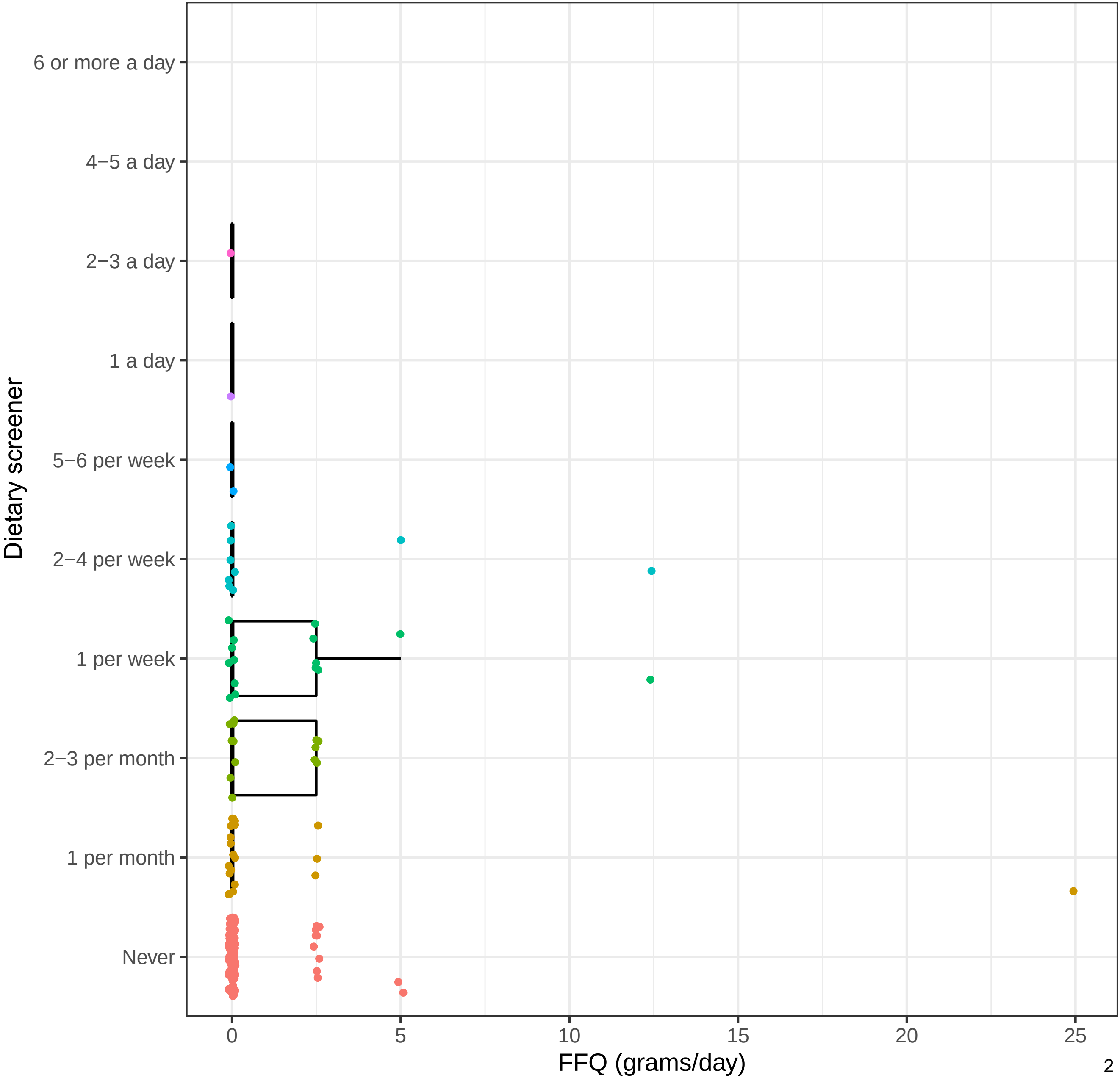


Figure S2. Box and whisker plot for “Cereal & porridge (unsweetened)” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

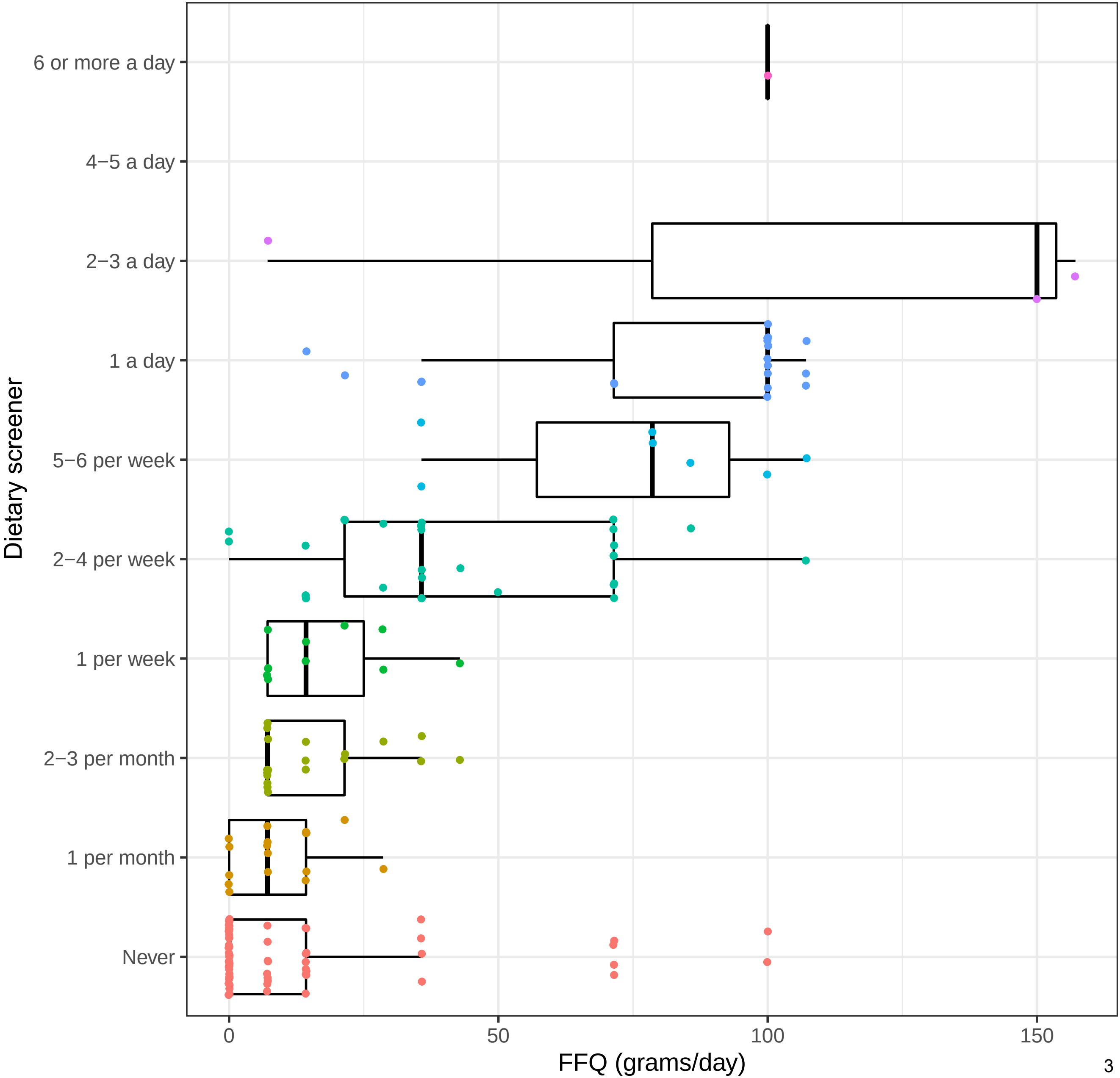


Figure S3. Box and whisker plot for “Whole−grain bread” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

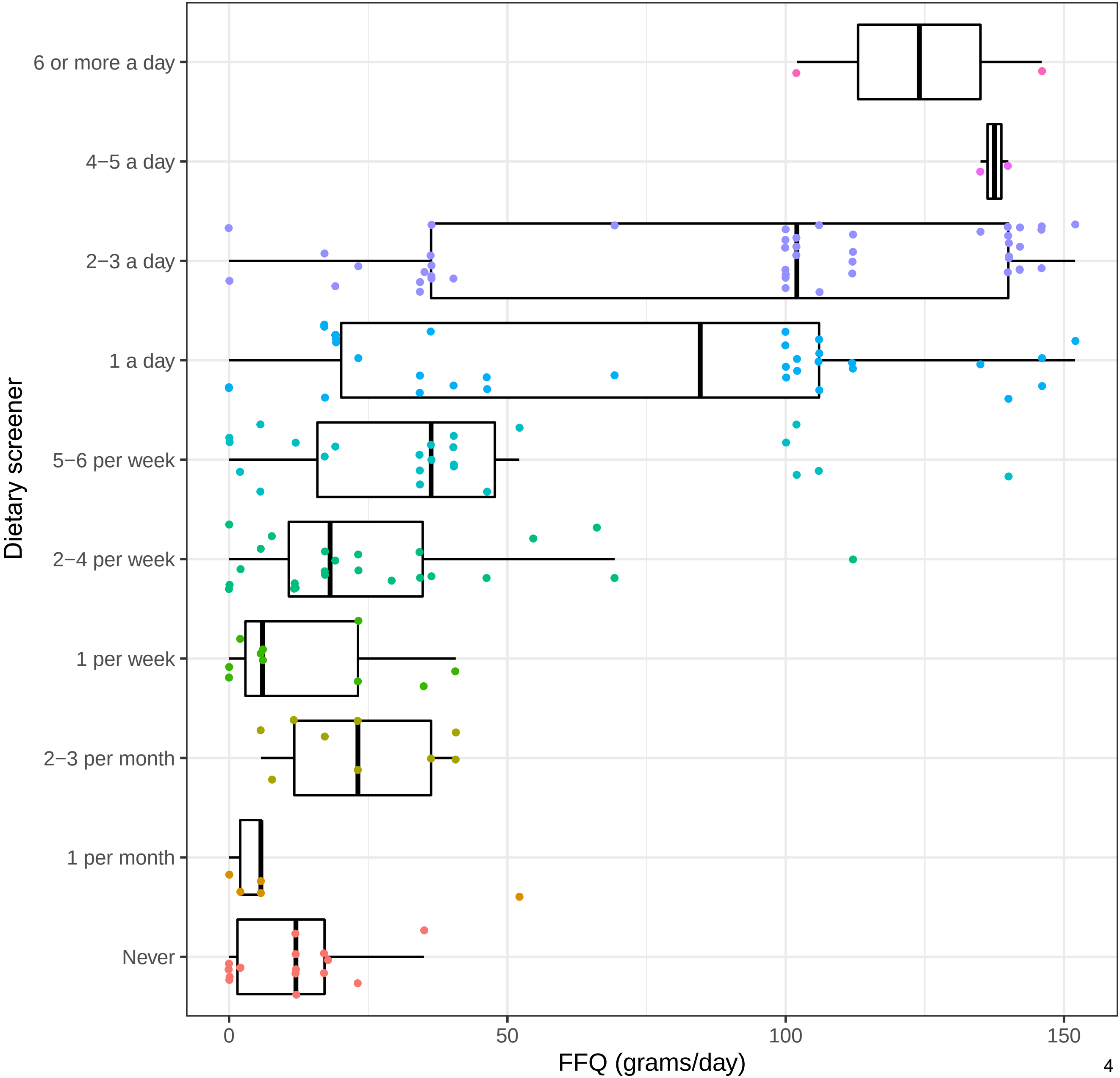


Figure S4. Box and whisker plot for "Fish spread" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

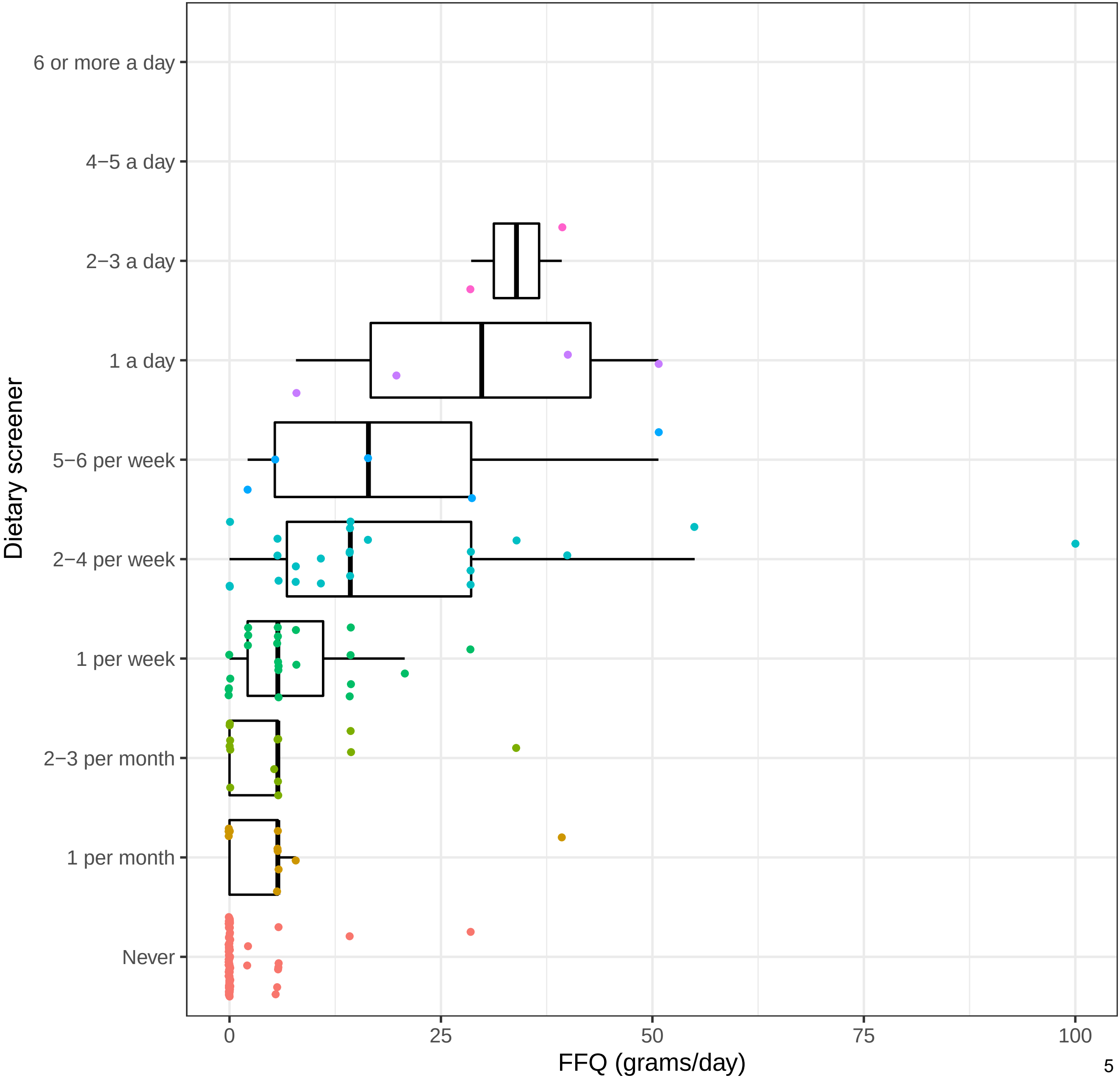


Figure S5. Box and whisker plot for “White cheese” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile 1.5*interquartile range convention.

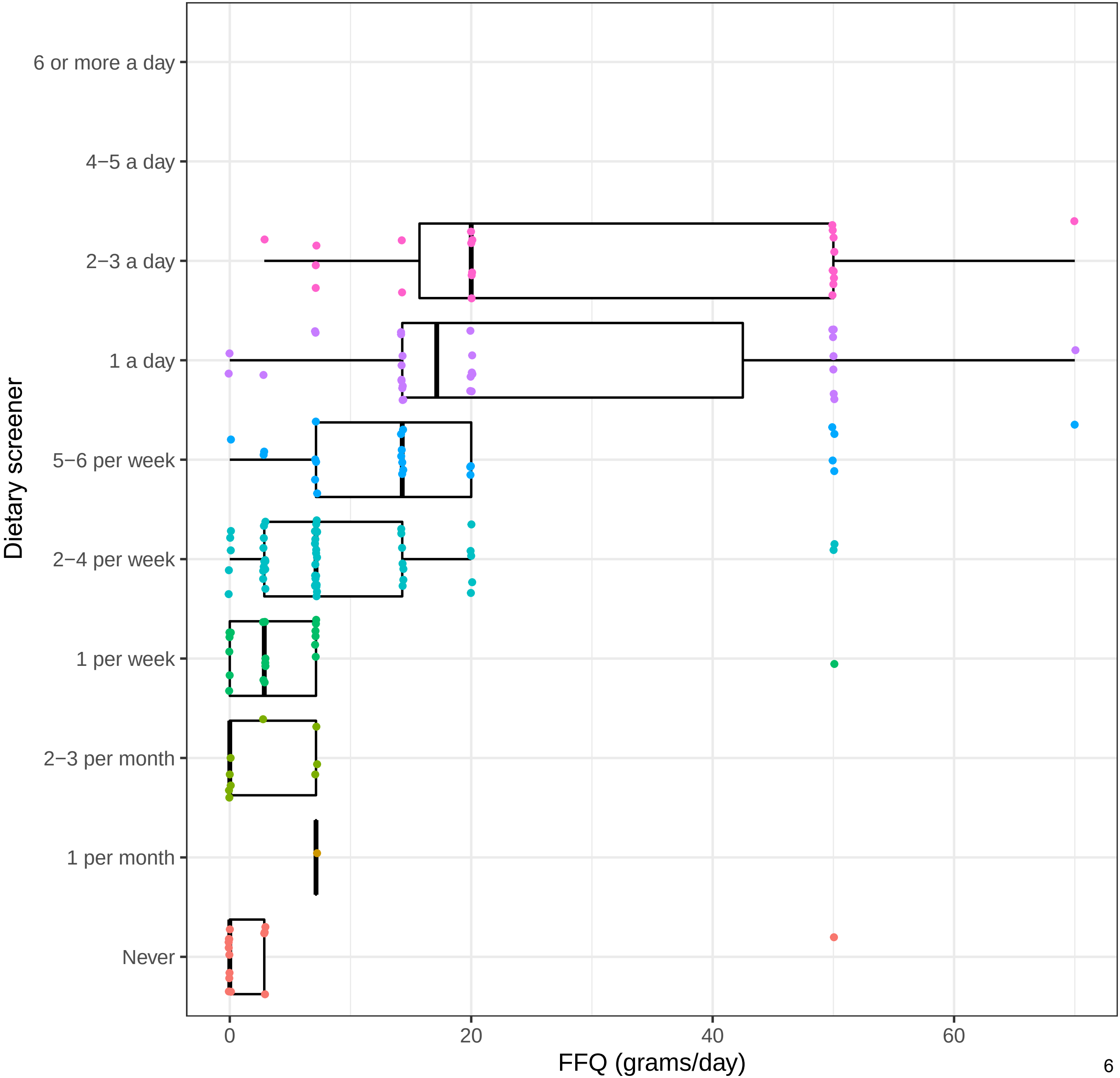


Figure S6. Box and whisker plot for “Whey cheese” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

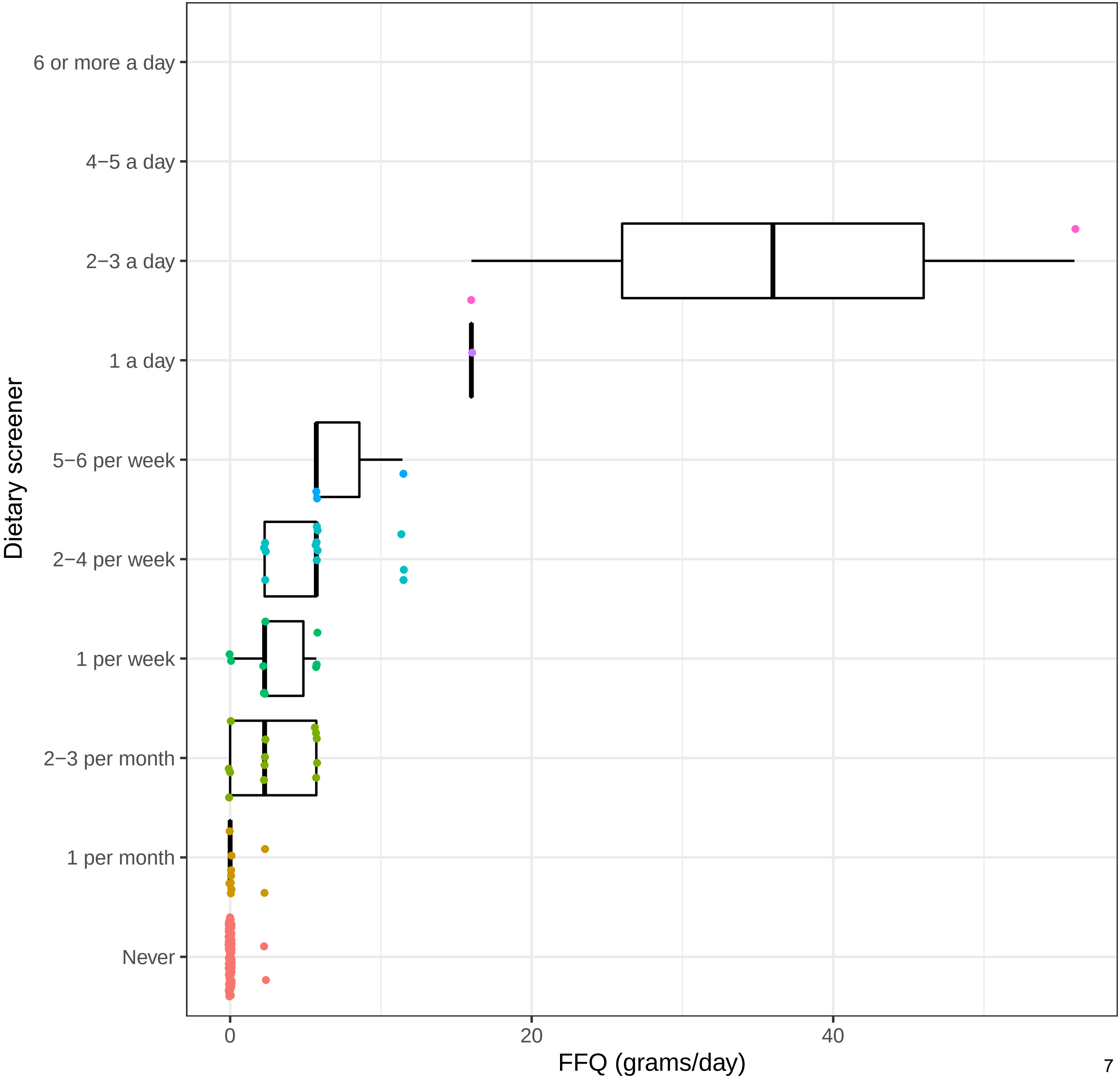


Figure S7. Box and whisker plot for “Yoghurt” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

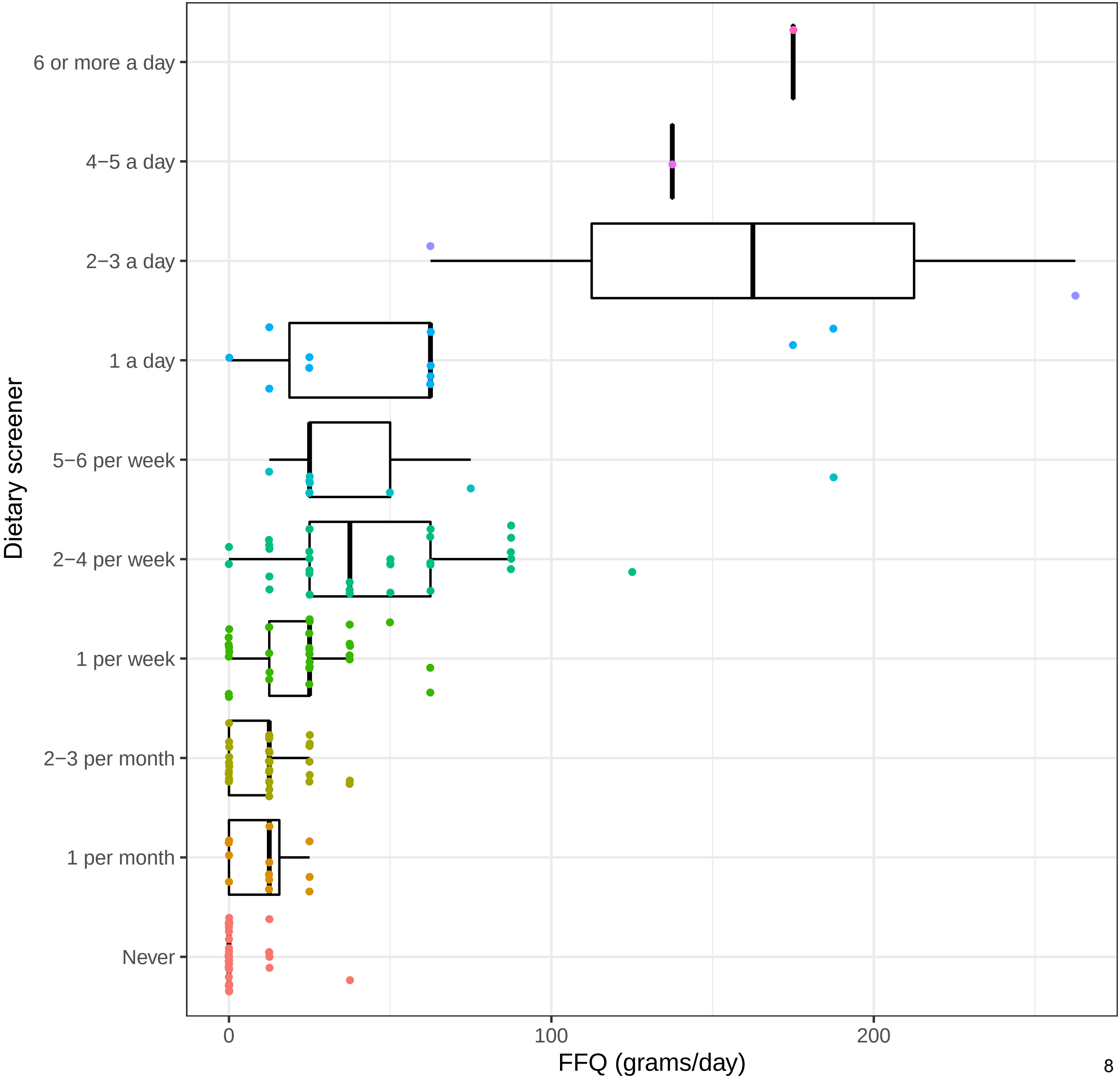


Figure S8. Box and whisker plot for “Cow milk” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

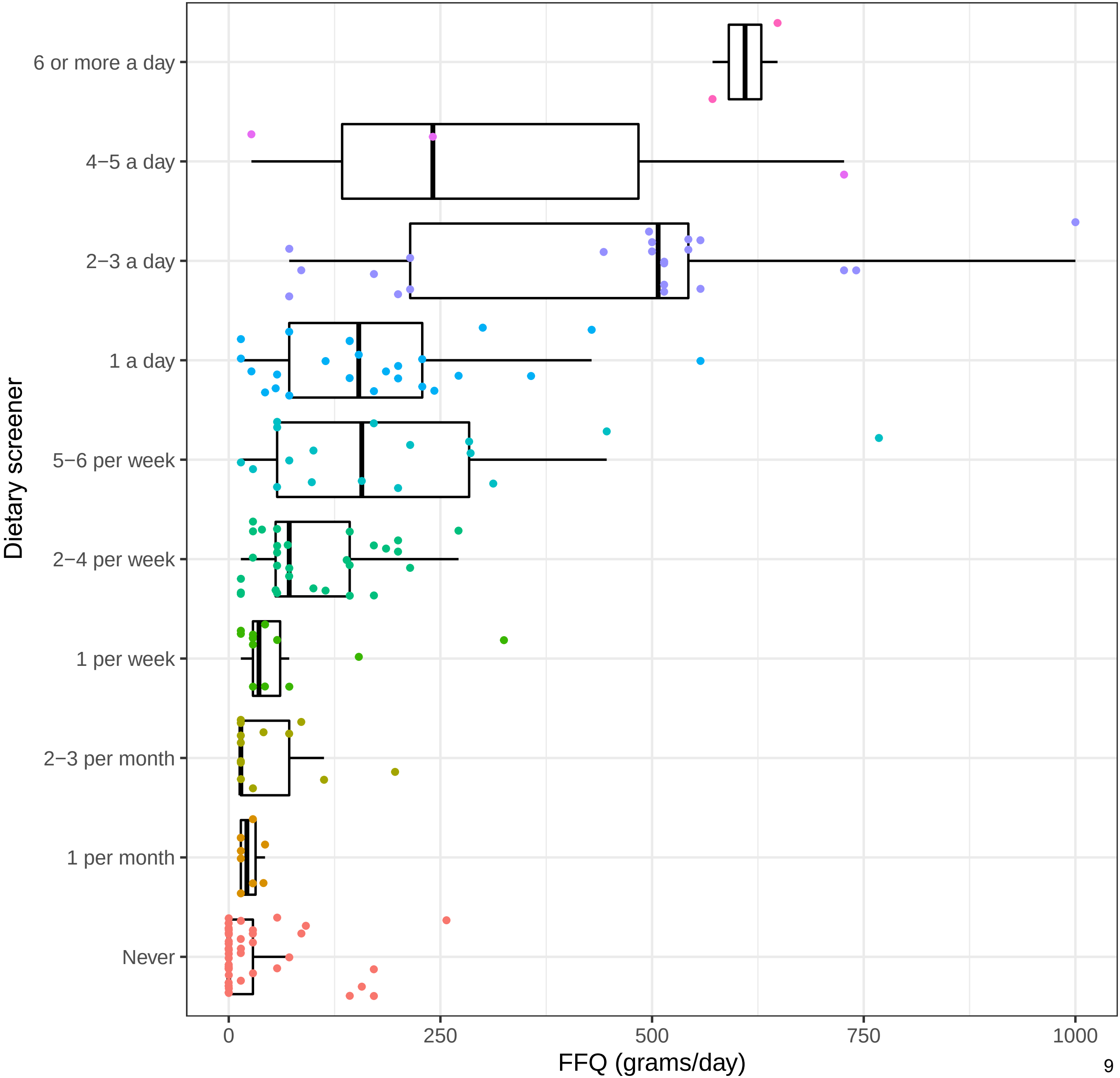


Figure S9. Box and whisker plot for “Plant−based milk” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

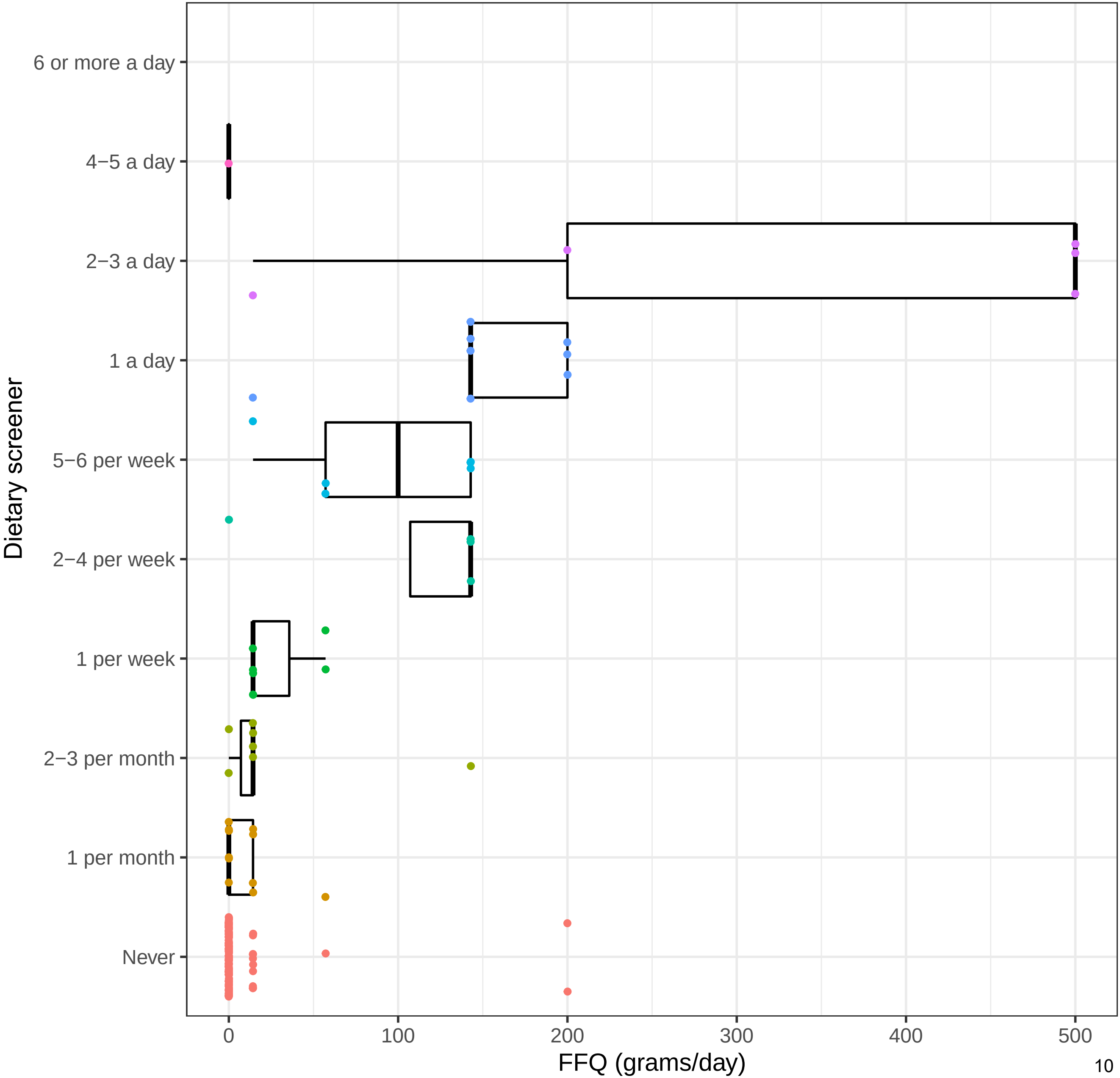


Figure S10. Box and whisker plot for “Juice/Smoothie” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

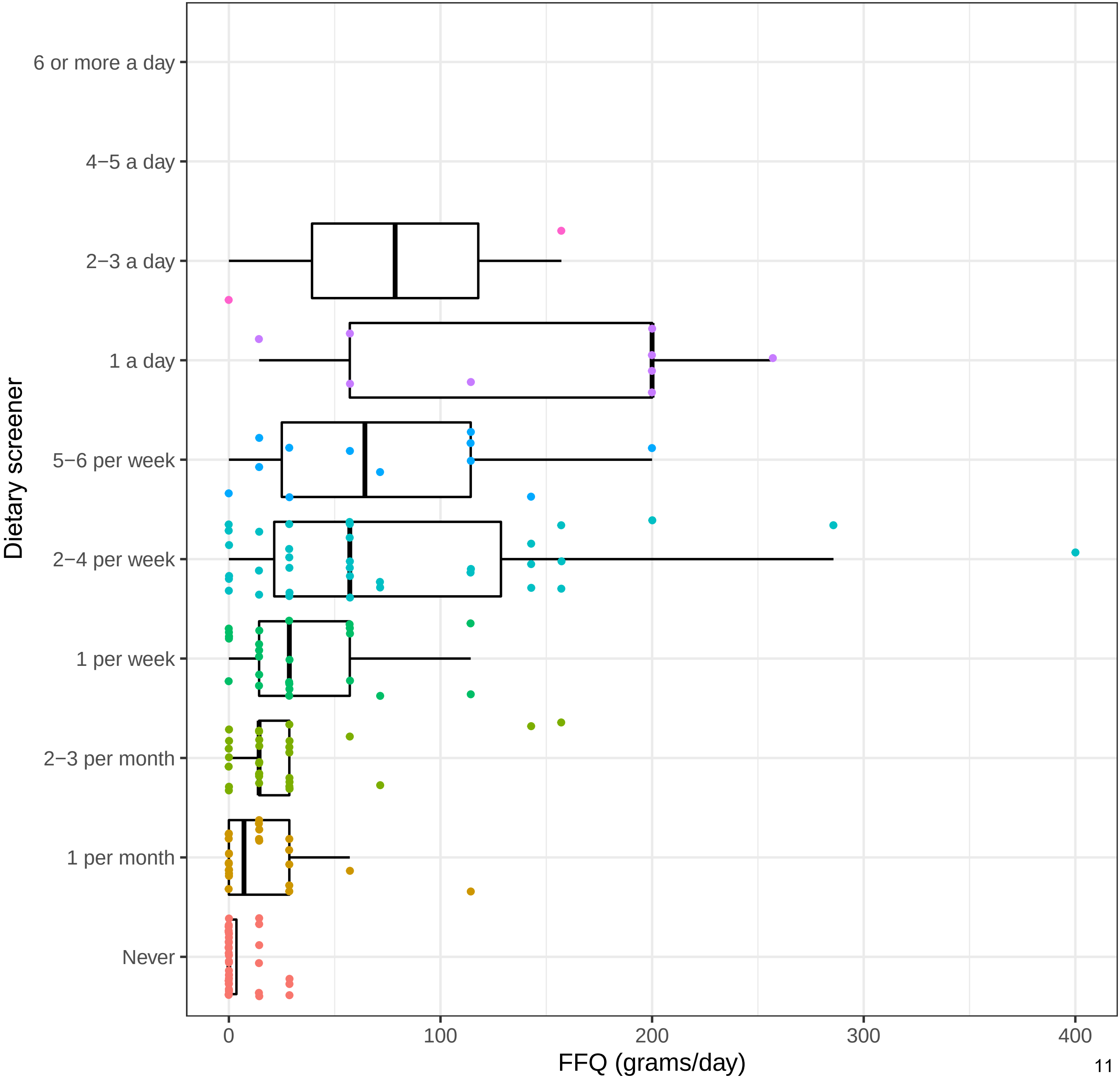


Figure S11. Box and whisker plot for "Fruit/berries (not juice/smoothie)" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

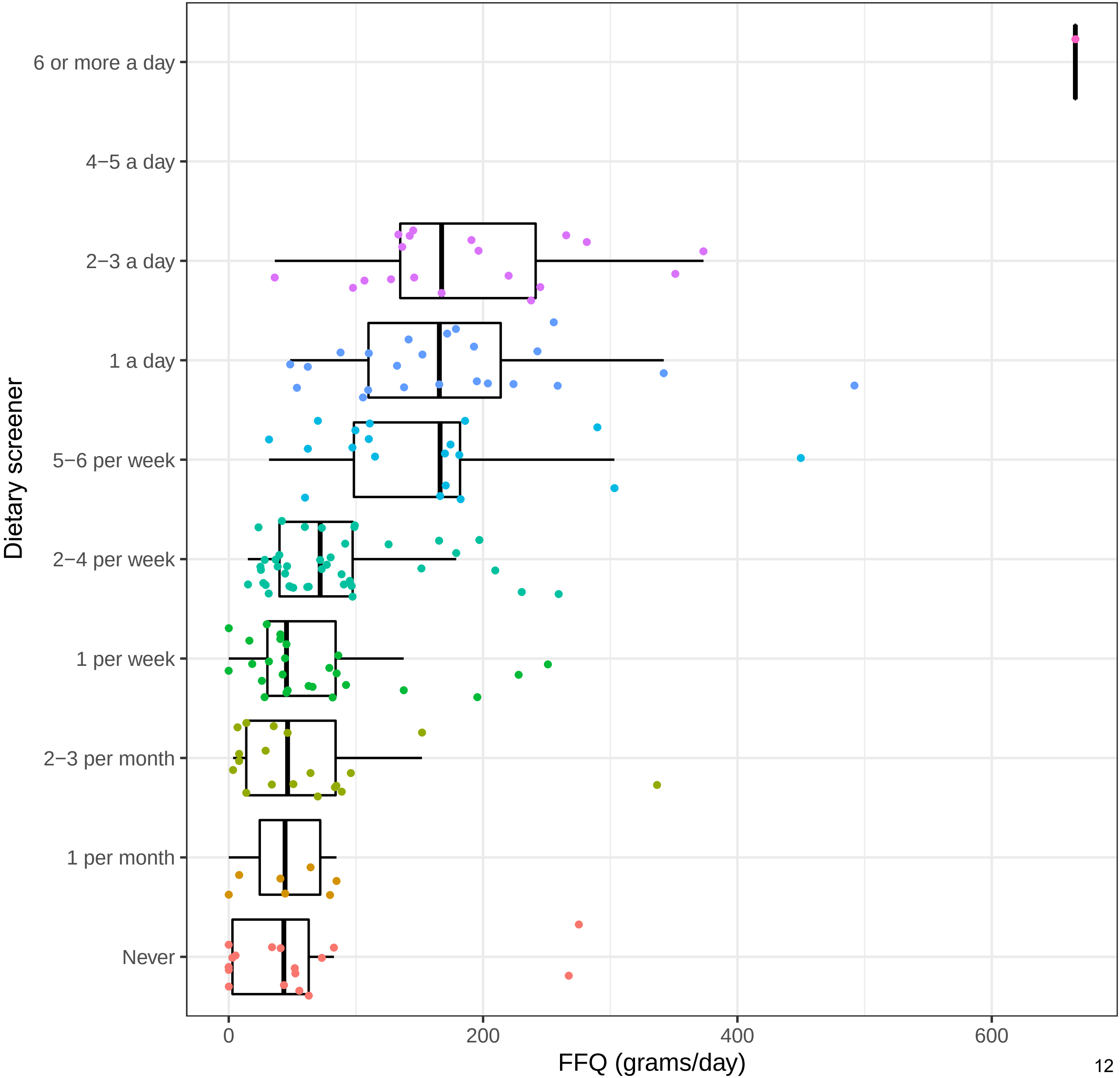


Figure S12. Box and whisker plot for “Vegetables (not potatoes)” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

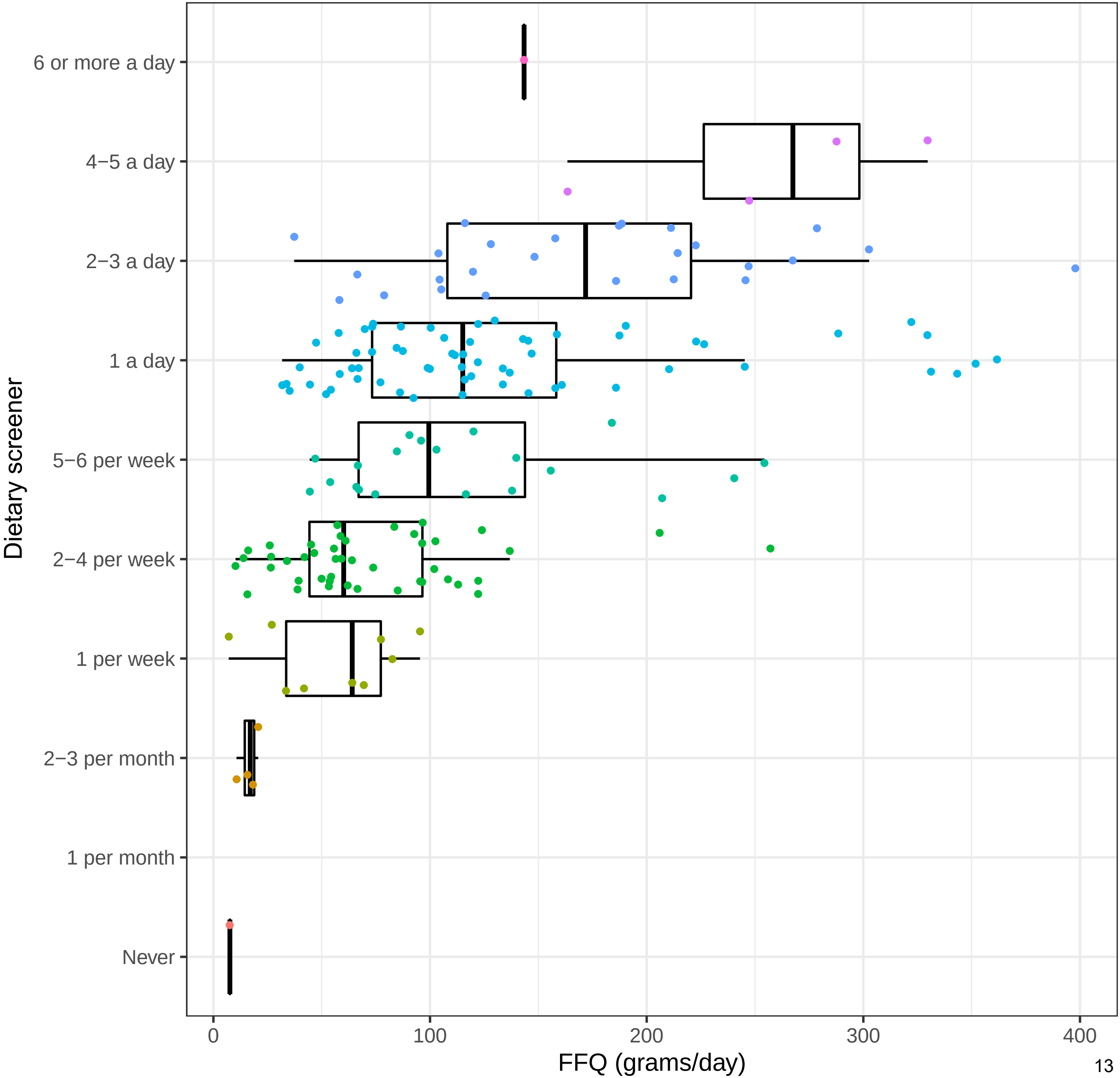


Figure S13. Box and whisker plot for “Beans/lentils/chickpeas/peas” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

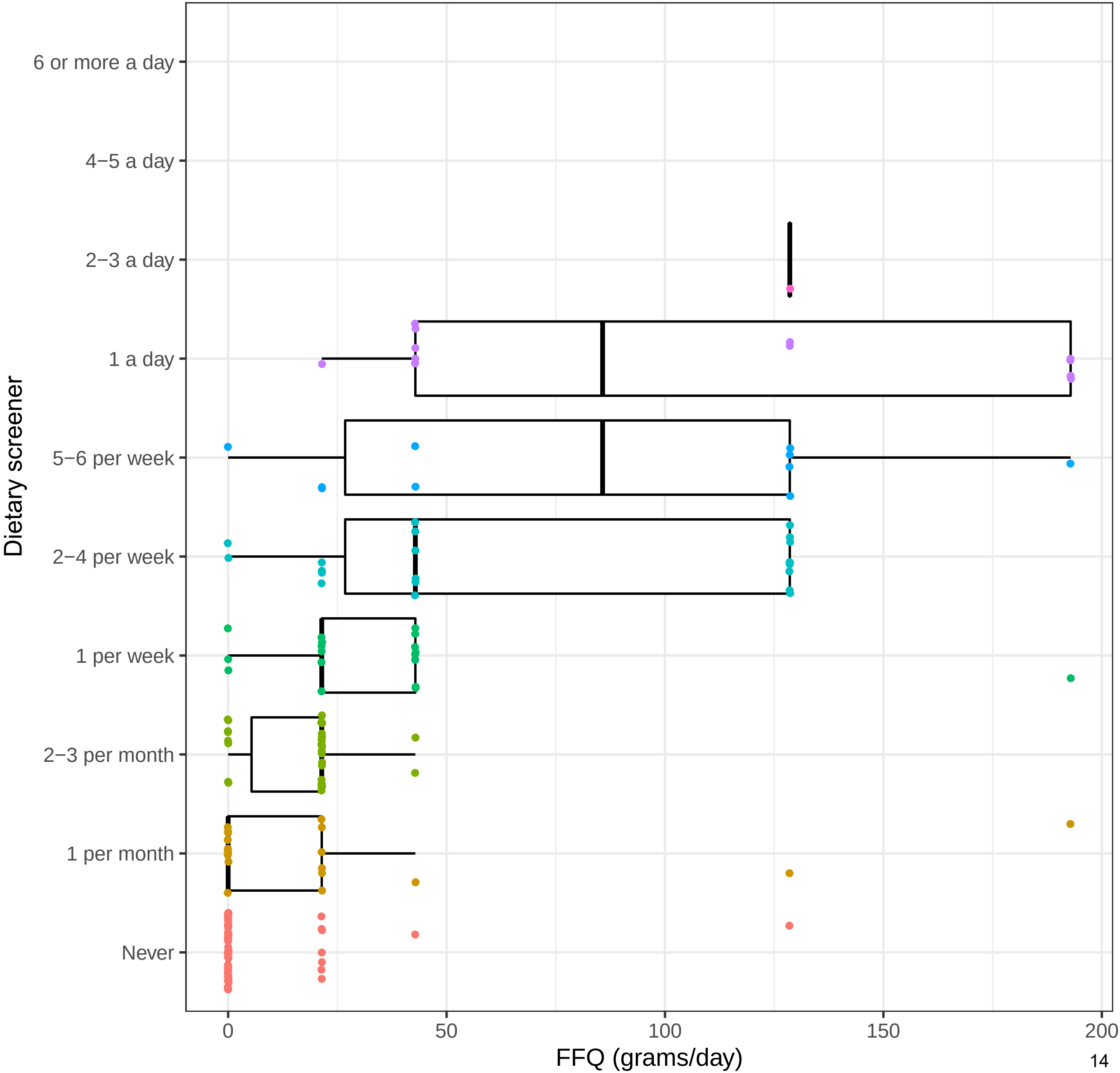


Figure S14. Box and whisker plot for “Fried potatoes/sweet potatoes” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

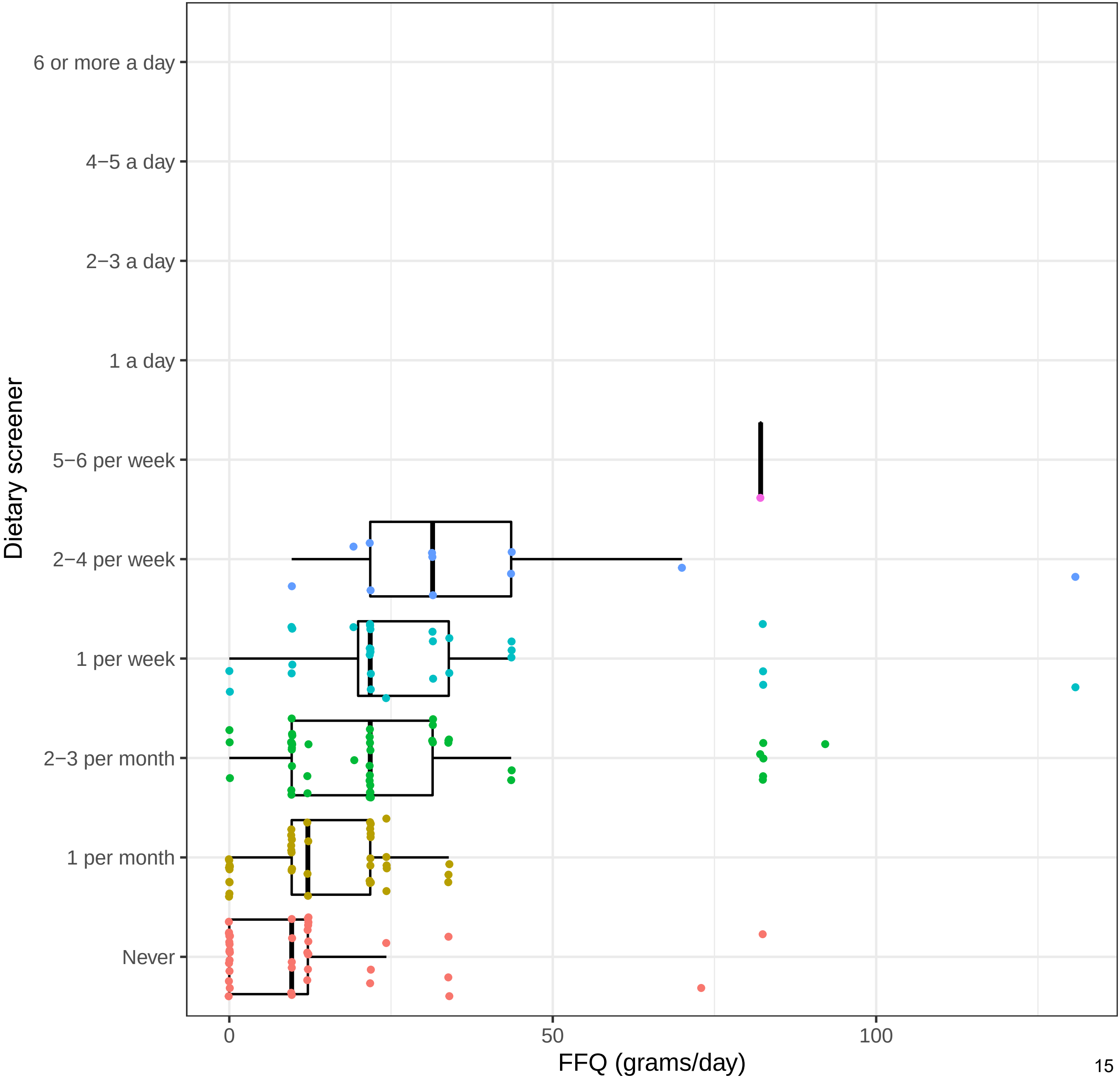


Figure S15. Box and whisker plot for “Potatoes/sweet potatoes” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

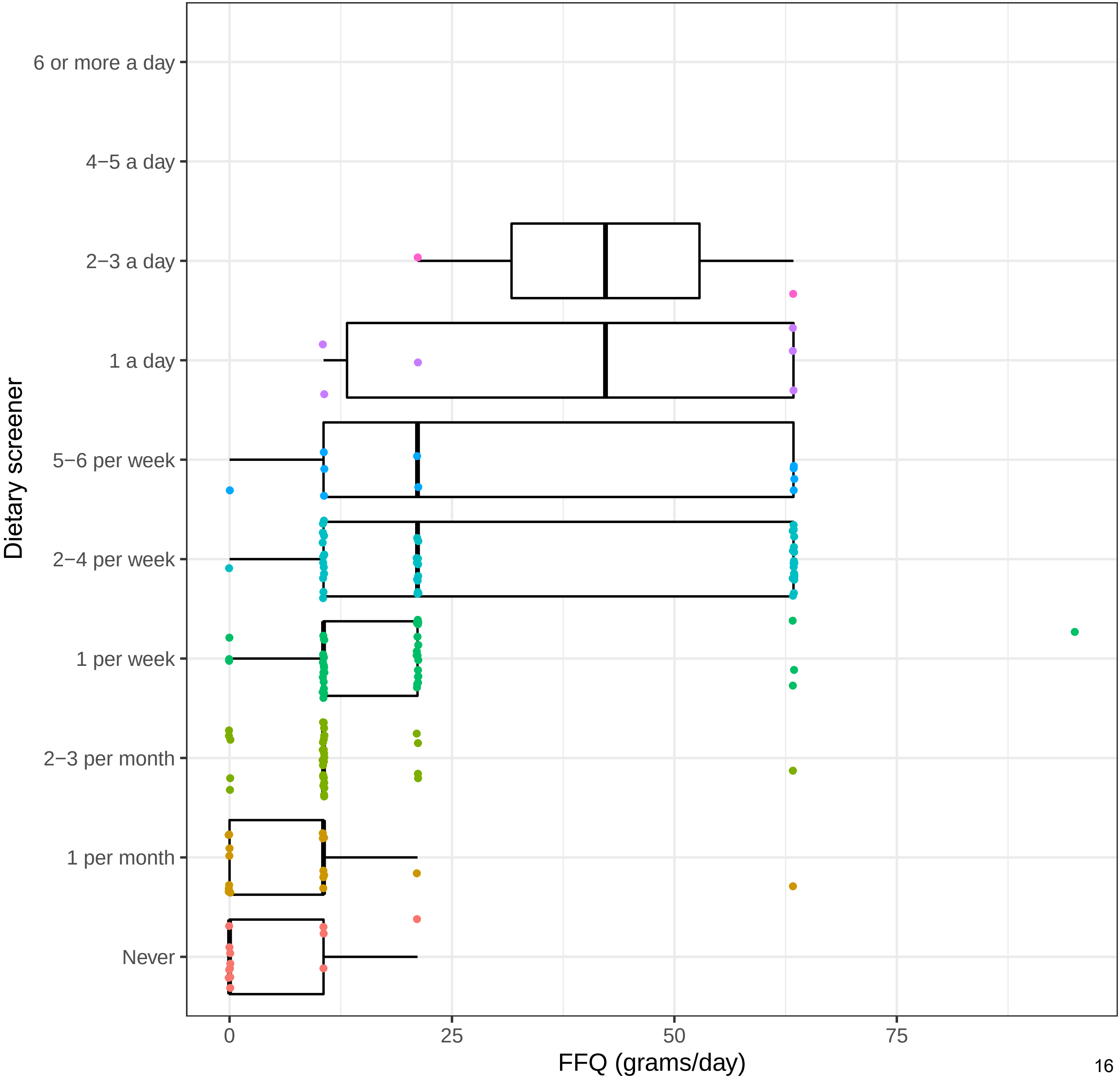


Figure S16. Box and whisker plot for "Whole grain (barley/pasta/couscous)" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

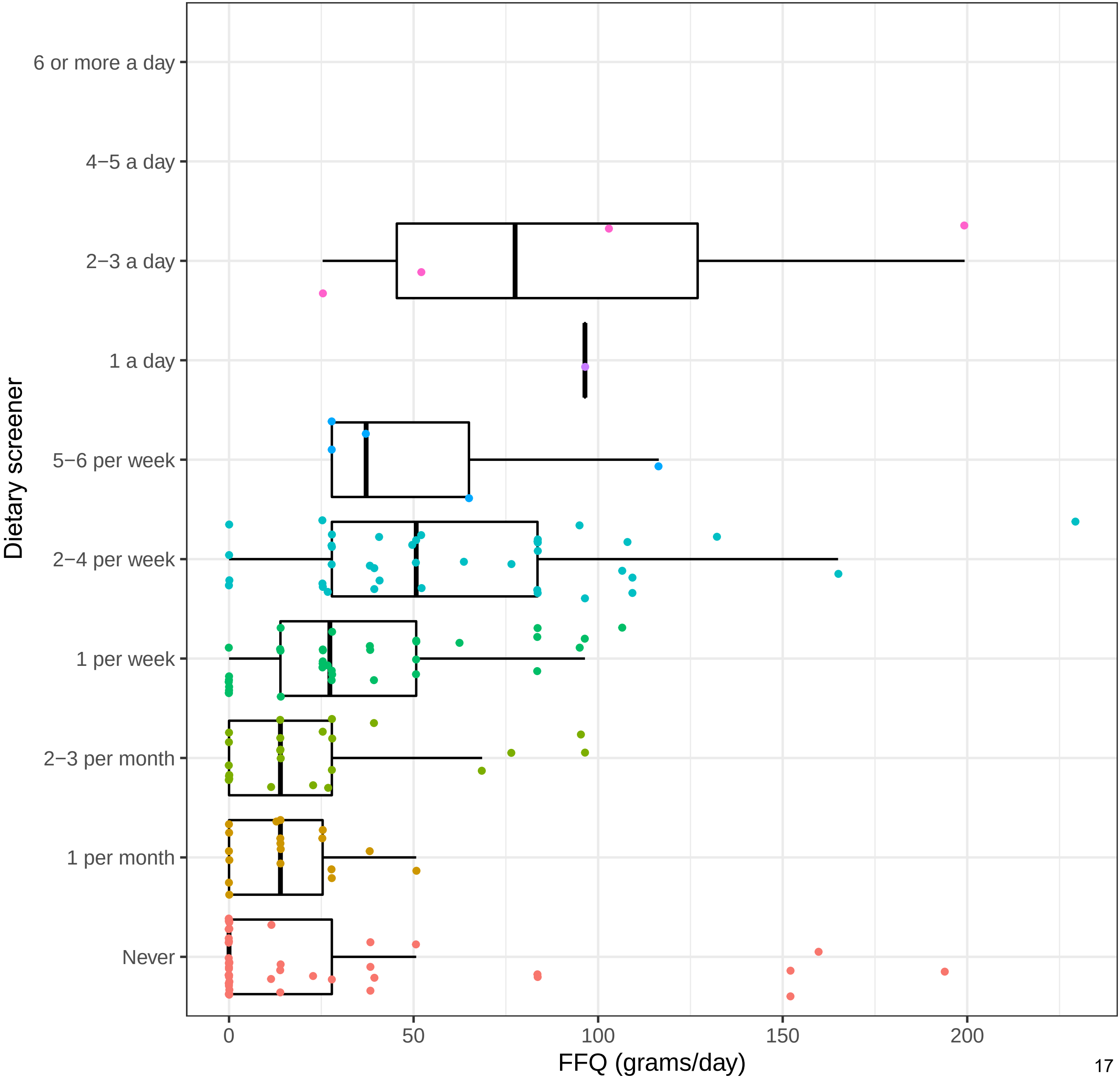


Figure S17. Box and whisker plot for "Pizza" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

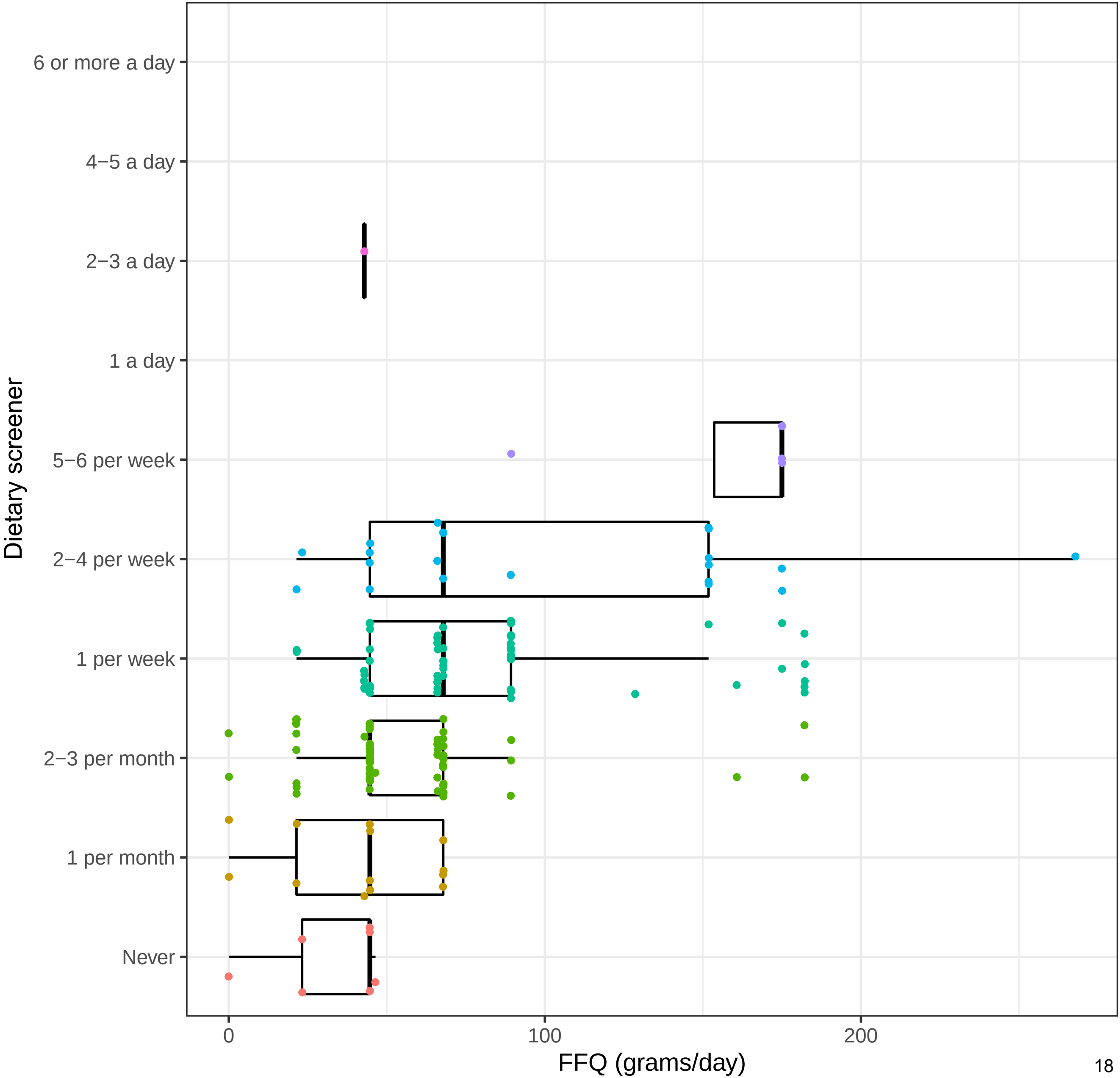


Figure S18. Box and whisker plot for “Tomato sauce” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

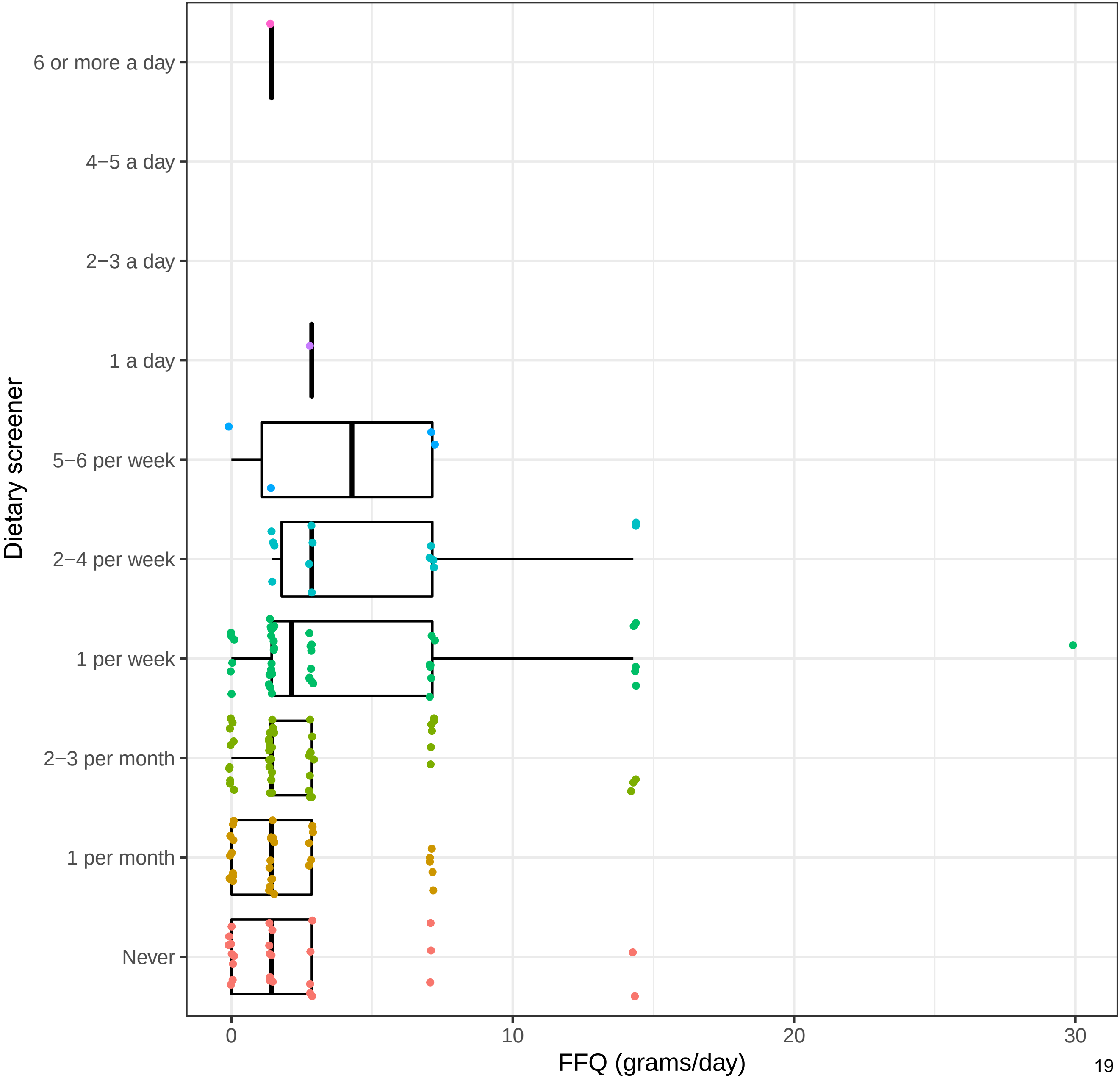


Figure S19. Box and whisker plot for "Red meat (beef/lamb/pork/goat)" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

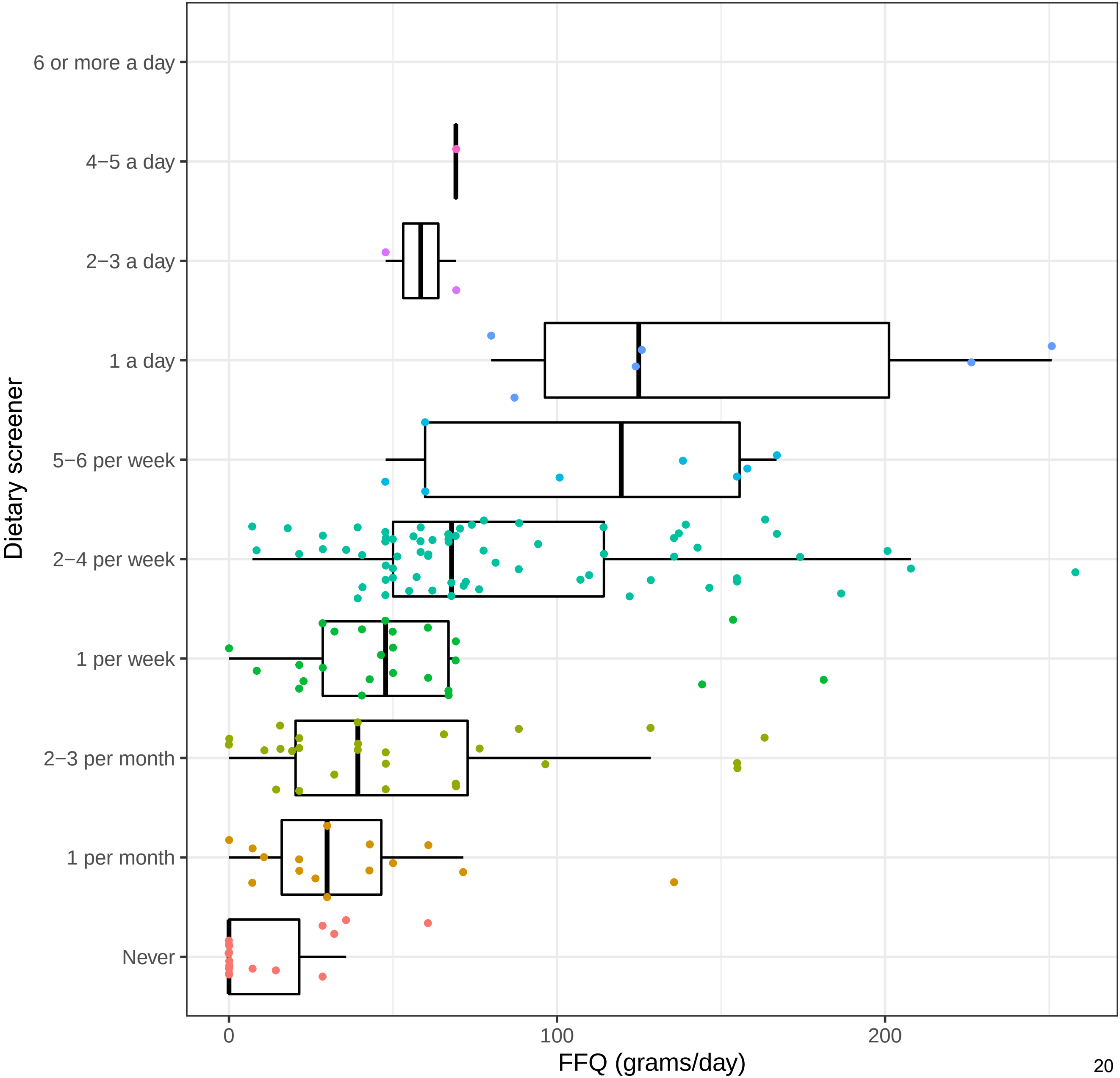


Figure S20. Box and whisker plot for “Processed meat” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

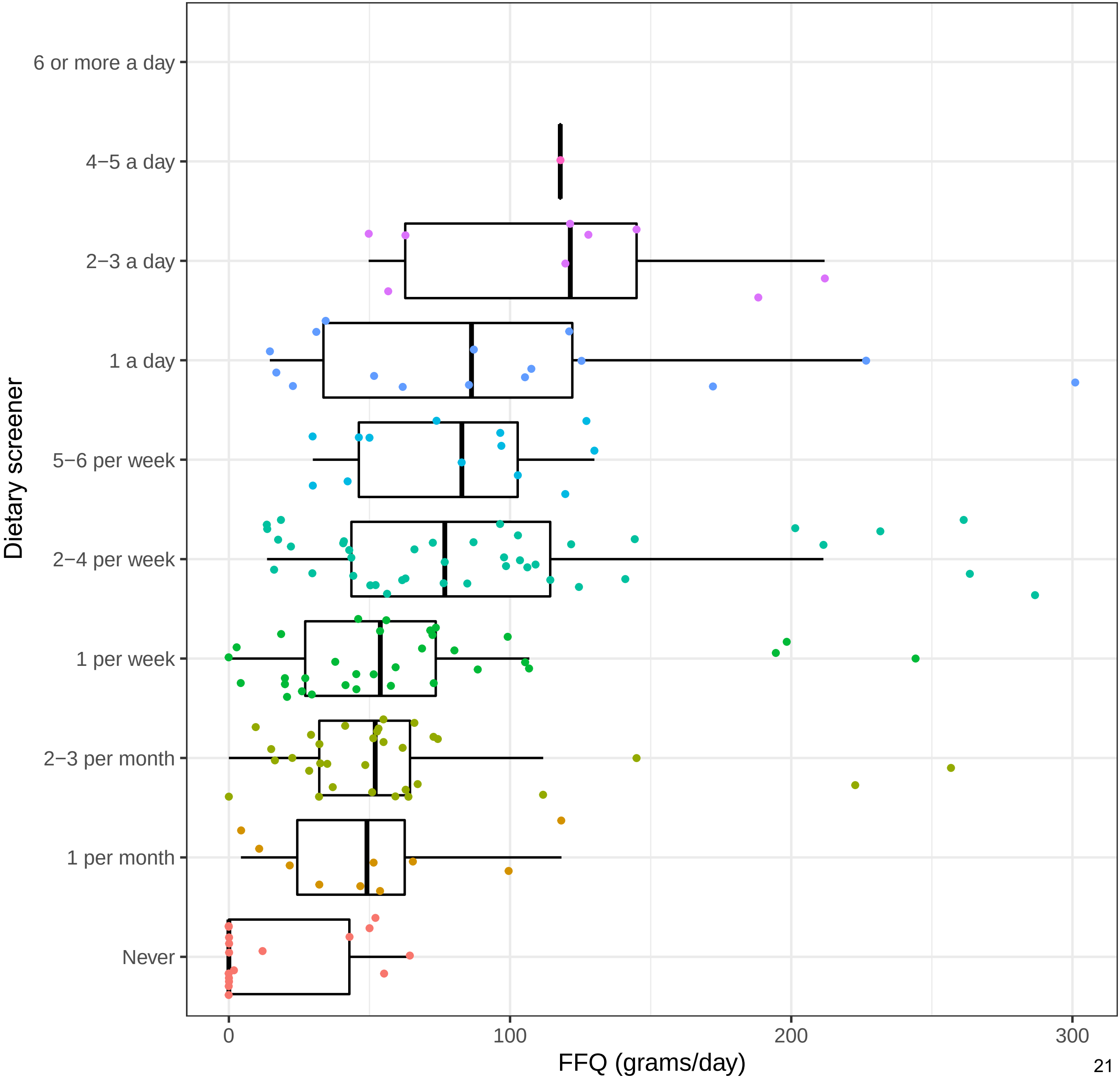


Figure S21. Box and whisker plot for "Fatty fish (salmon/mackerel)" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

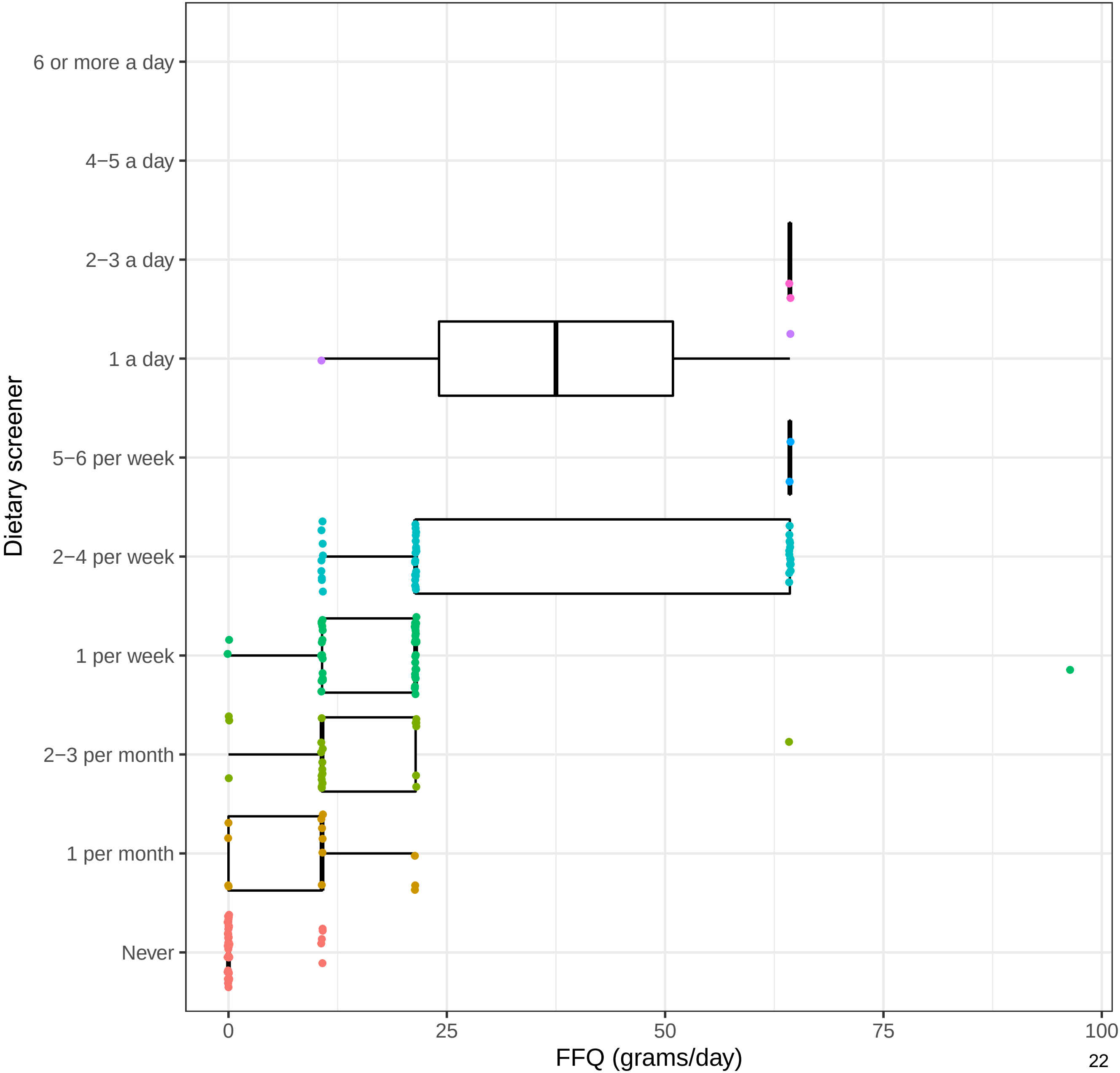


Figure S22. Box and whisker plot for “Lean fish (cod/pollock)” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

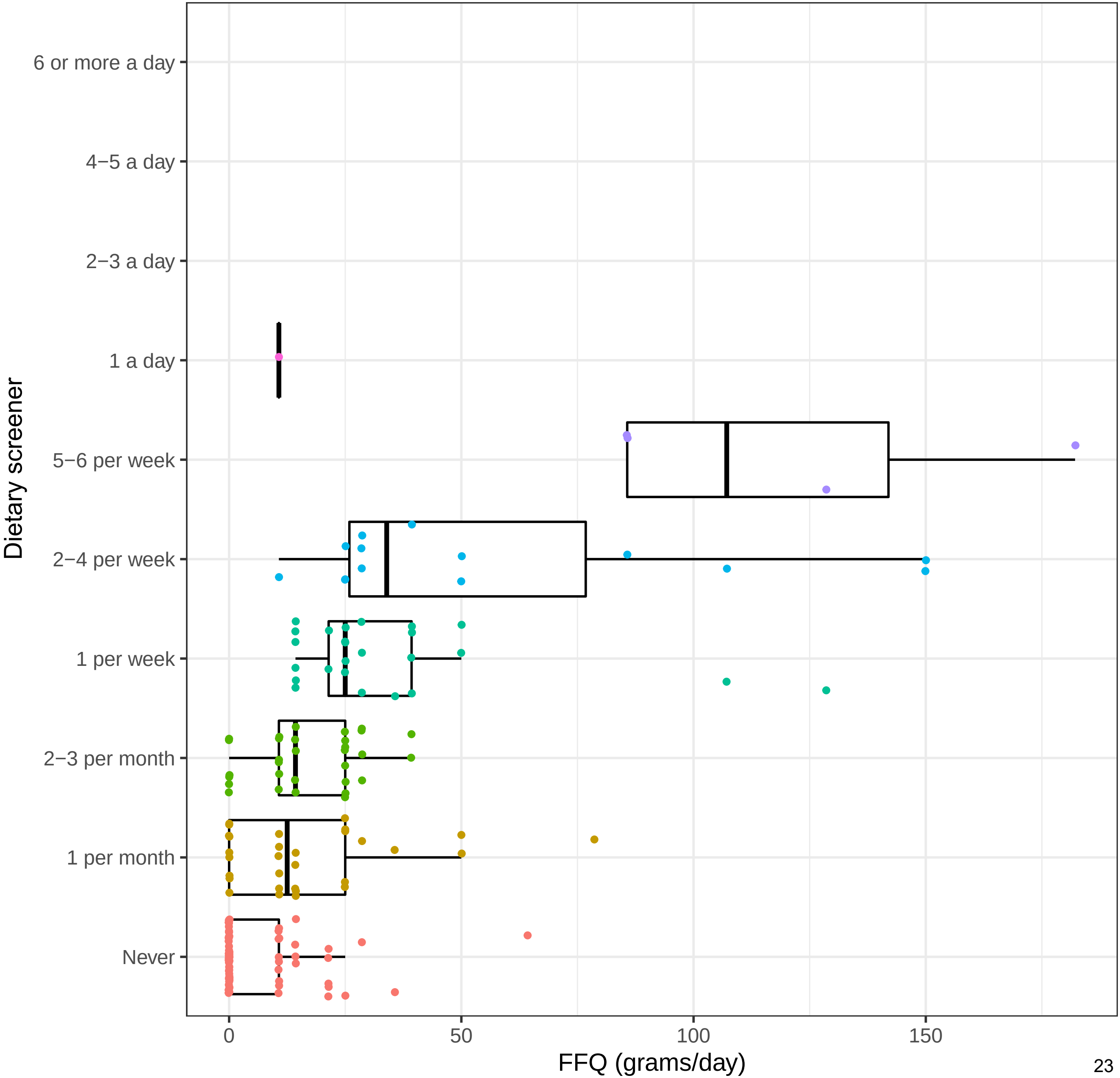


Figure S23. Box and whisker plot for "Salty snacks" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

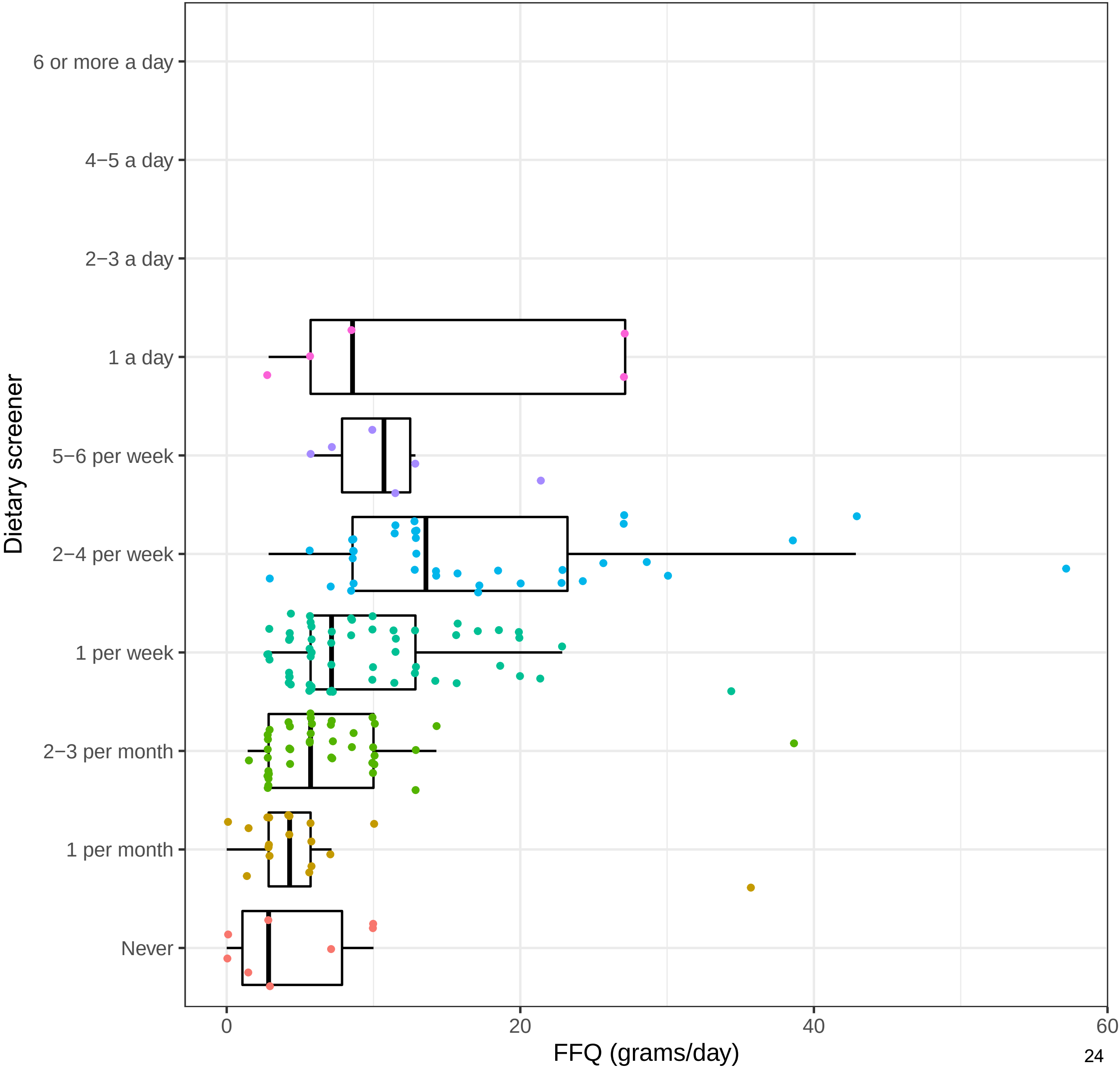


Figure S24. Box and whisker plot for “Candy/chocolate” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

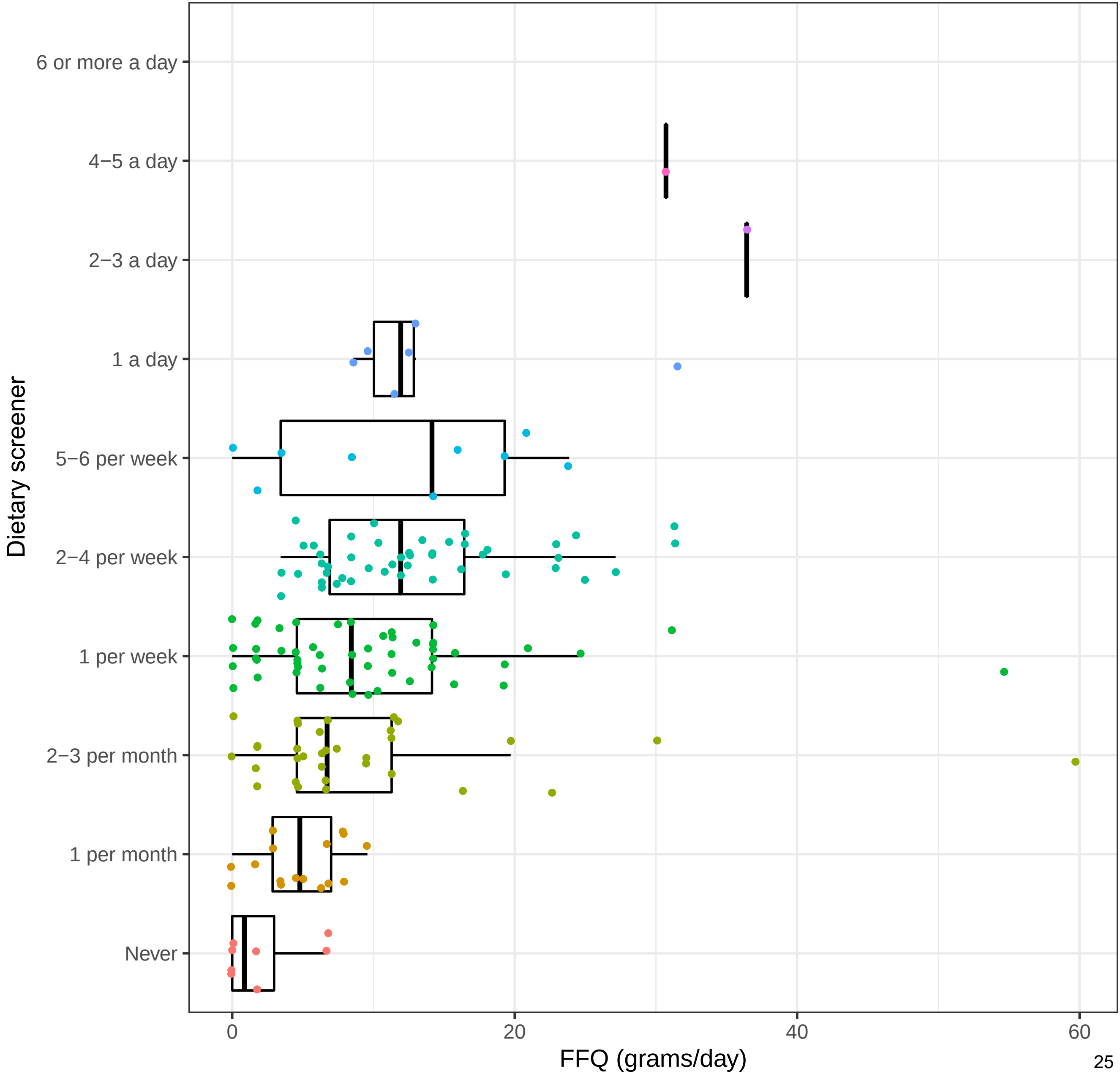


Figure S25. Box and whisker plot for “Waffles/buns/cake/biscuits” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

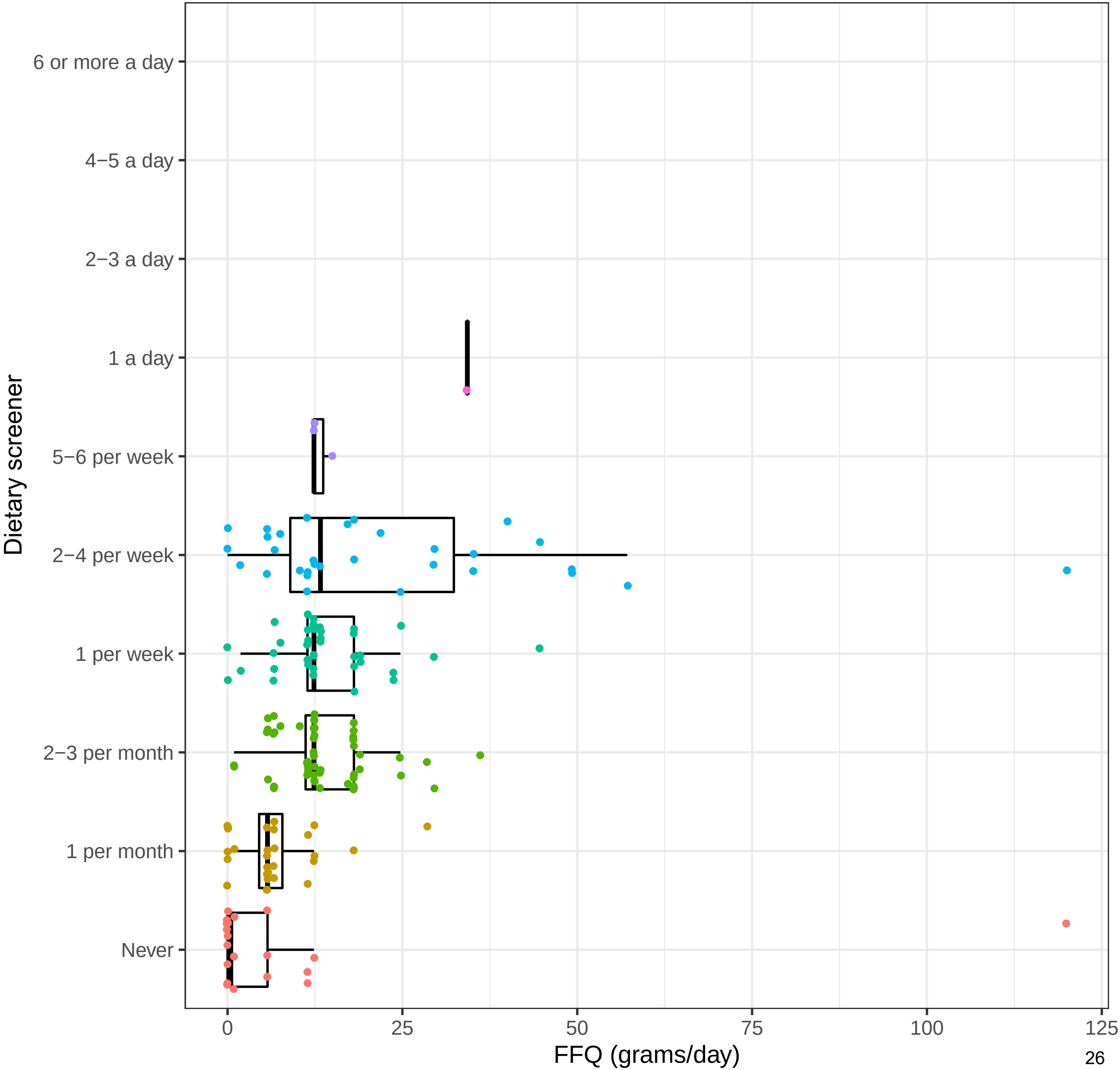


Figure S26. Box and whisker plot for “Ice cream/panna cotta/pudding etc” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

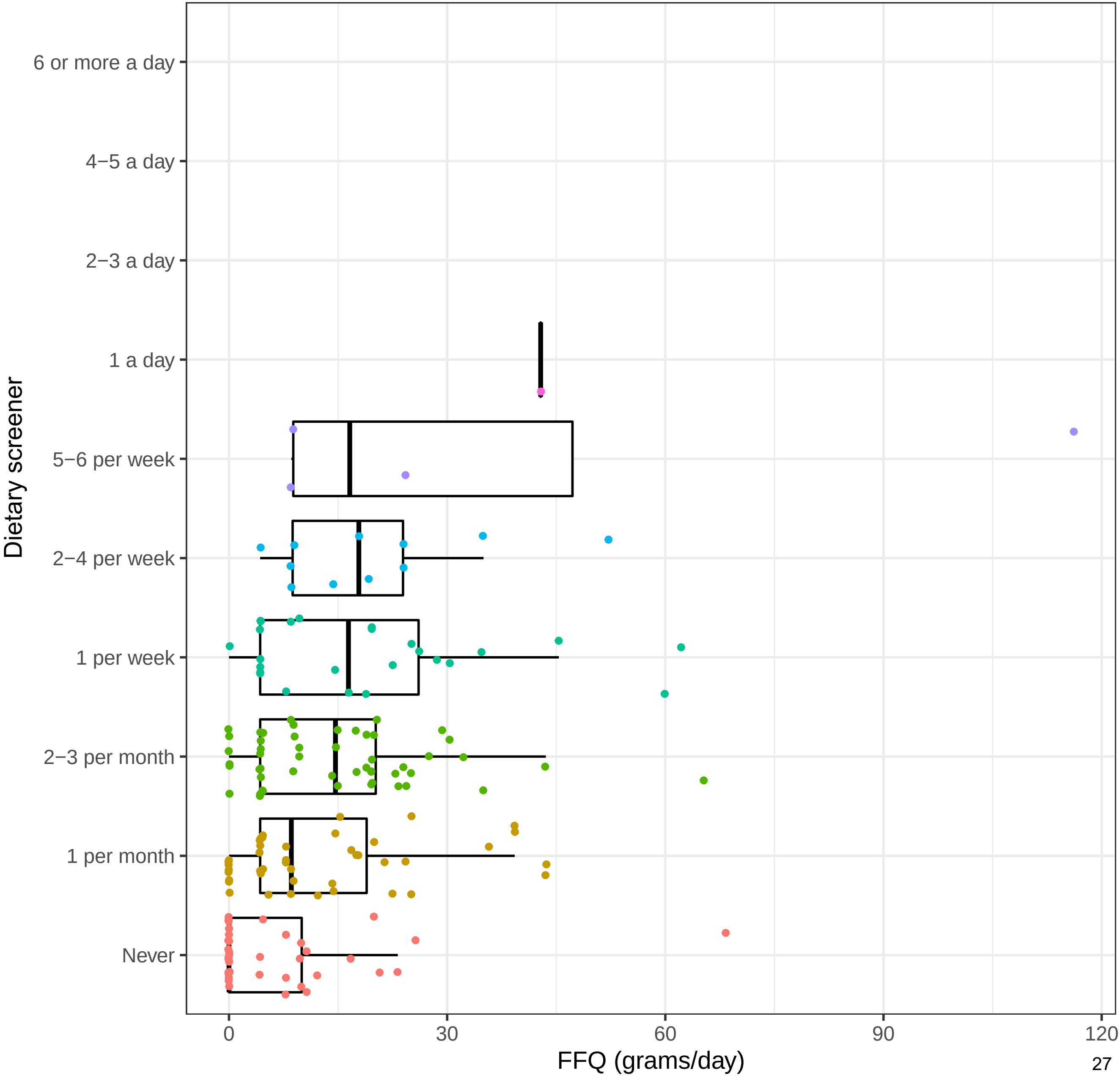


Figure S27. Box and whisker plot for “Sugar-sweetened beverages” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartil ±1.5*interquartile range convention.

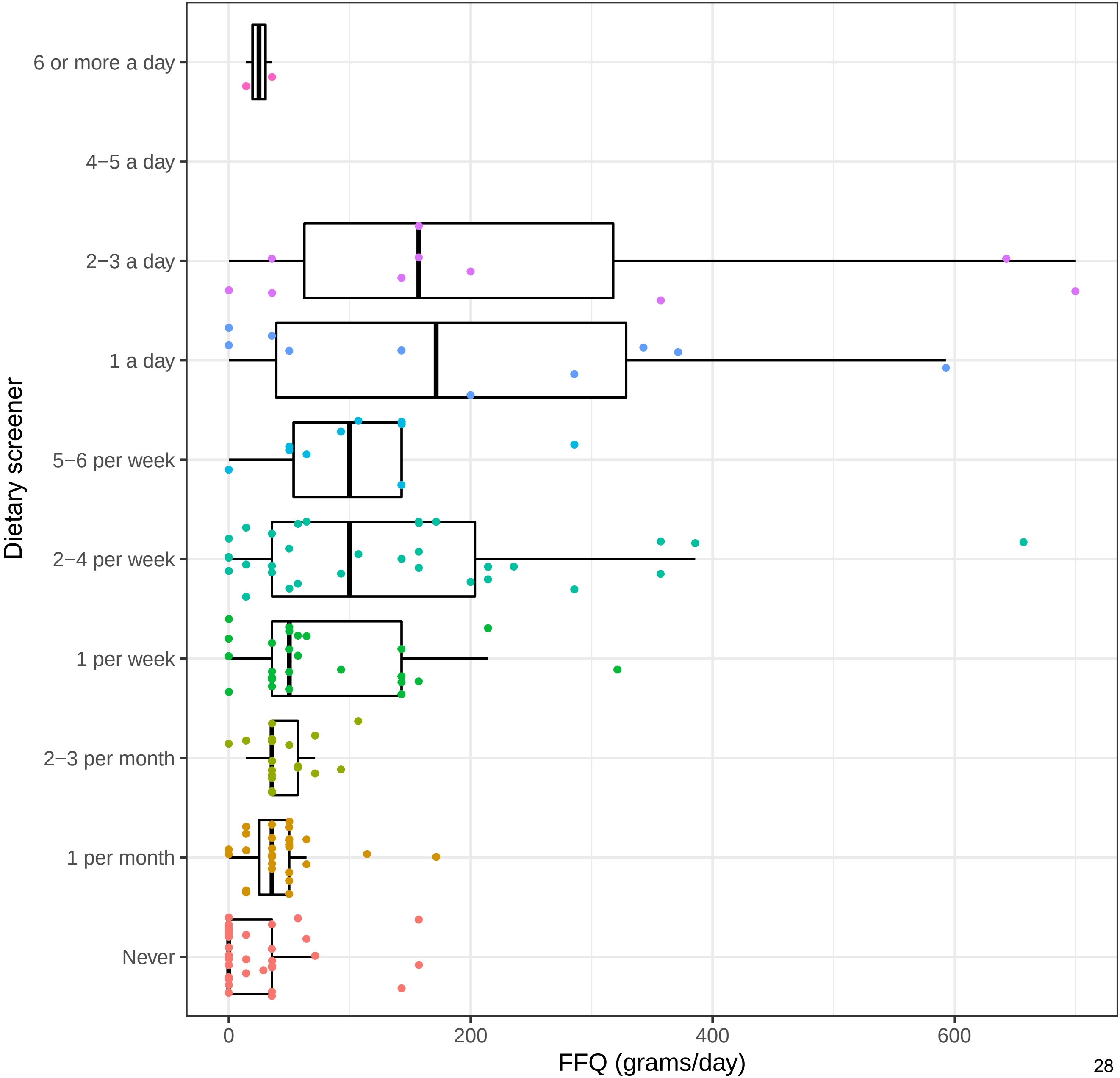


Figure S28. Box and whisker plot for “Energy drinks with sugar” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

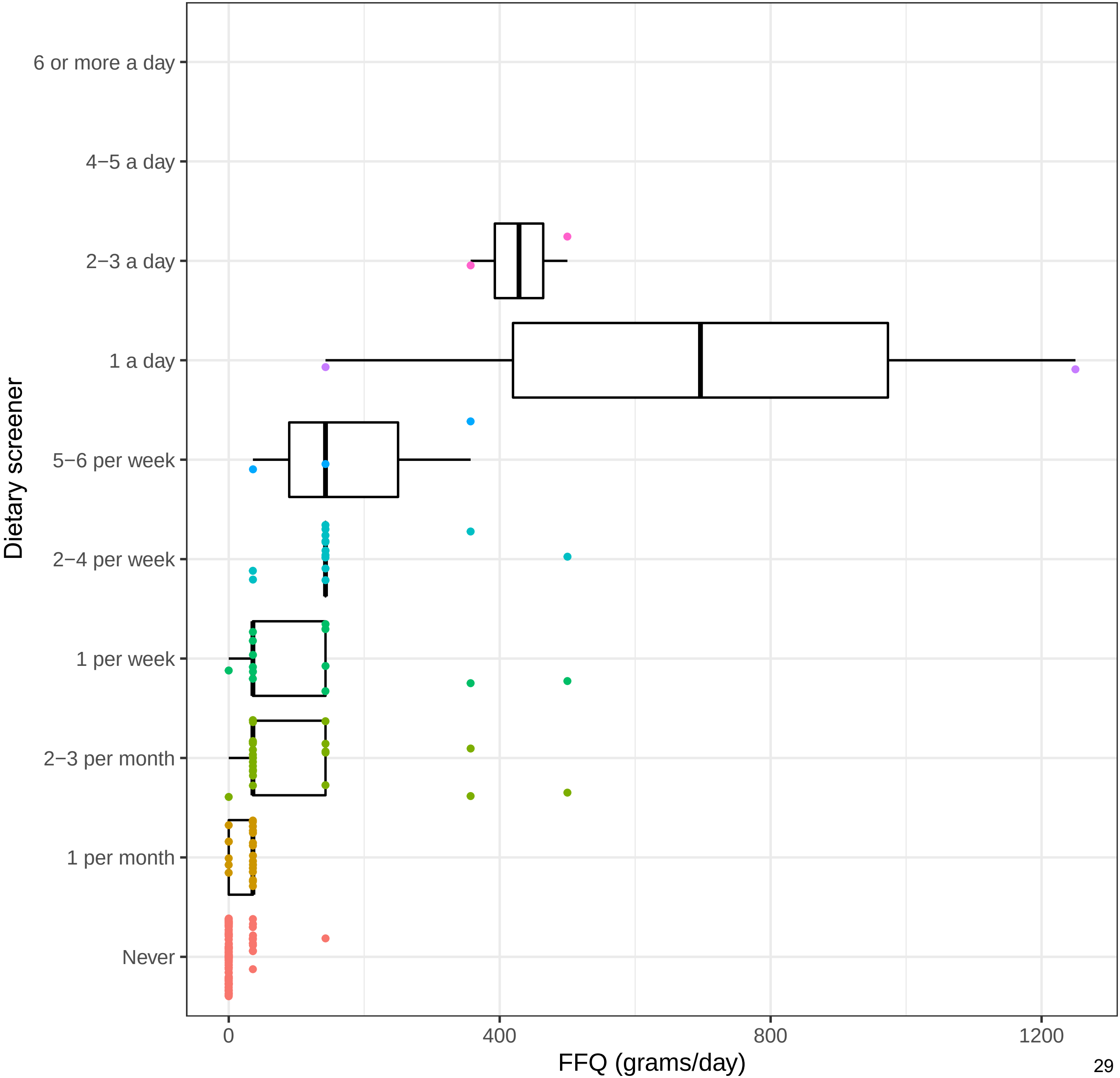


Figure S29. Box and whisker plot for "Coffee/tea with sugar/syrup/honey" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.

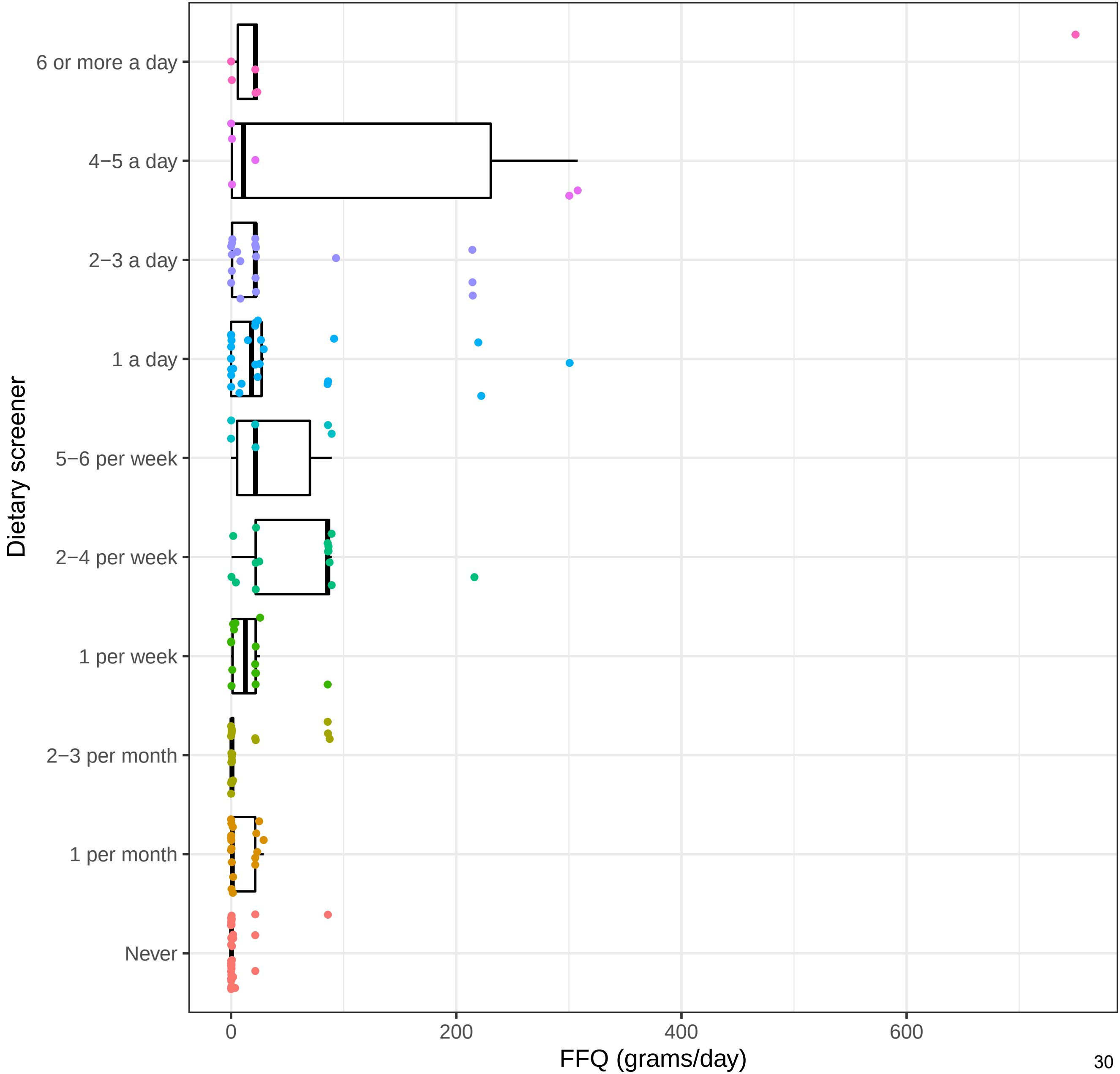


Figure S30. Box and whisker plot for “Alcoholic beverages” in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile±1.5*interquartile range convention.

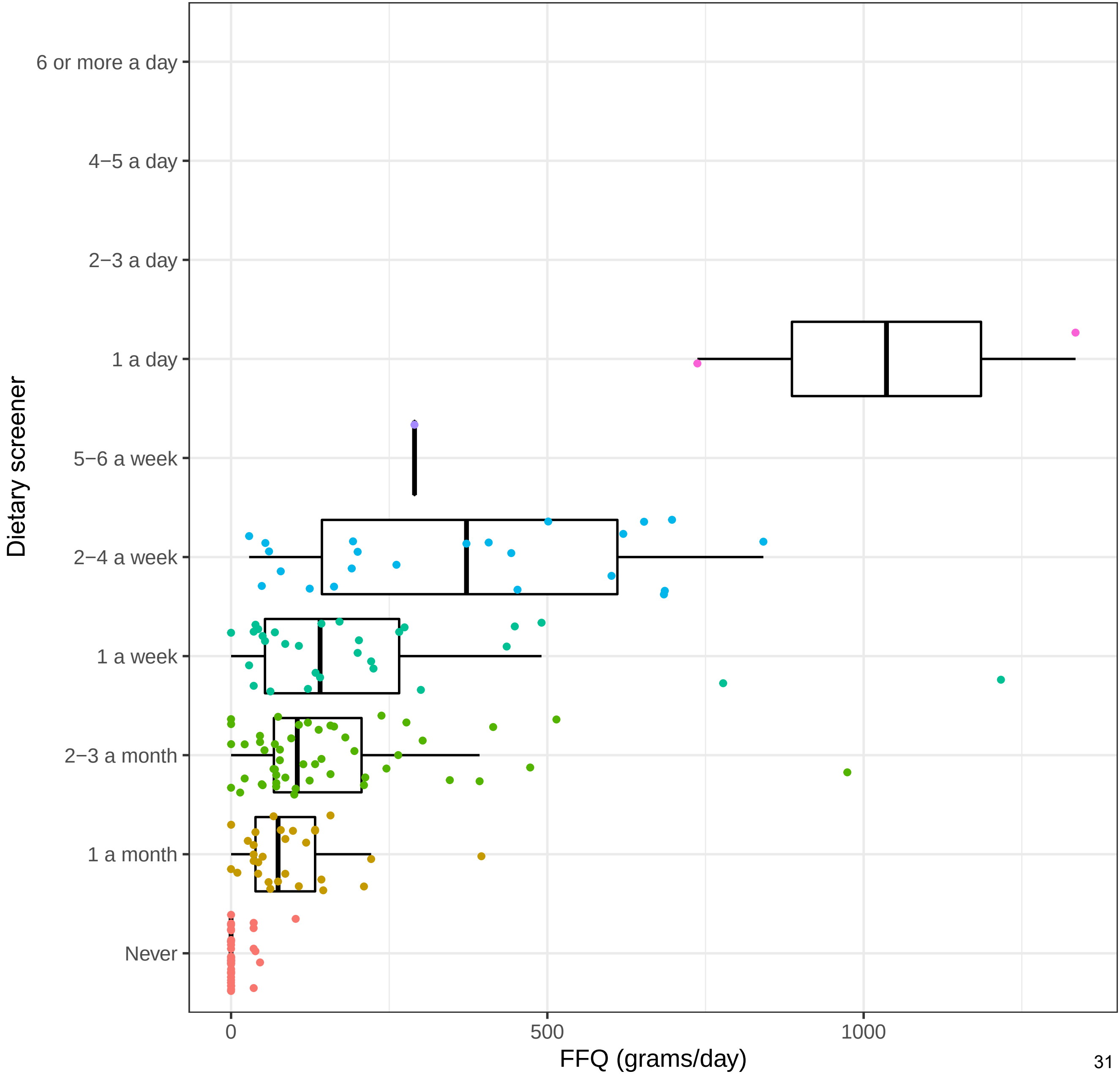
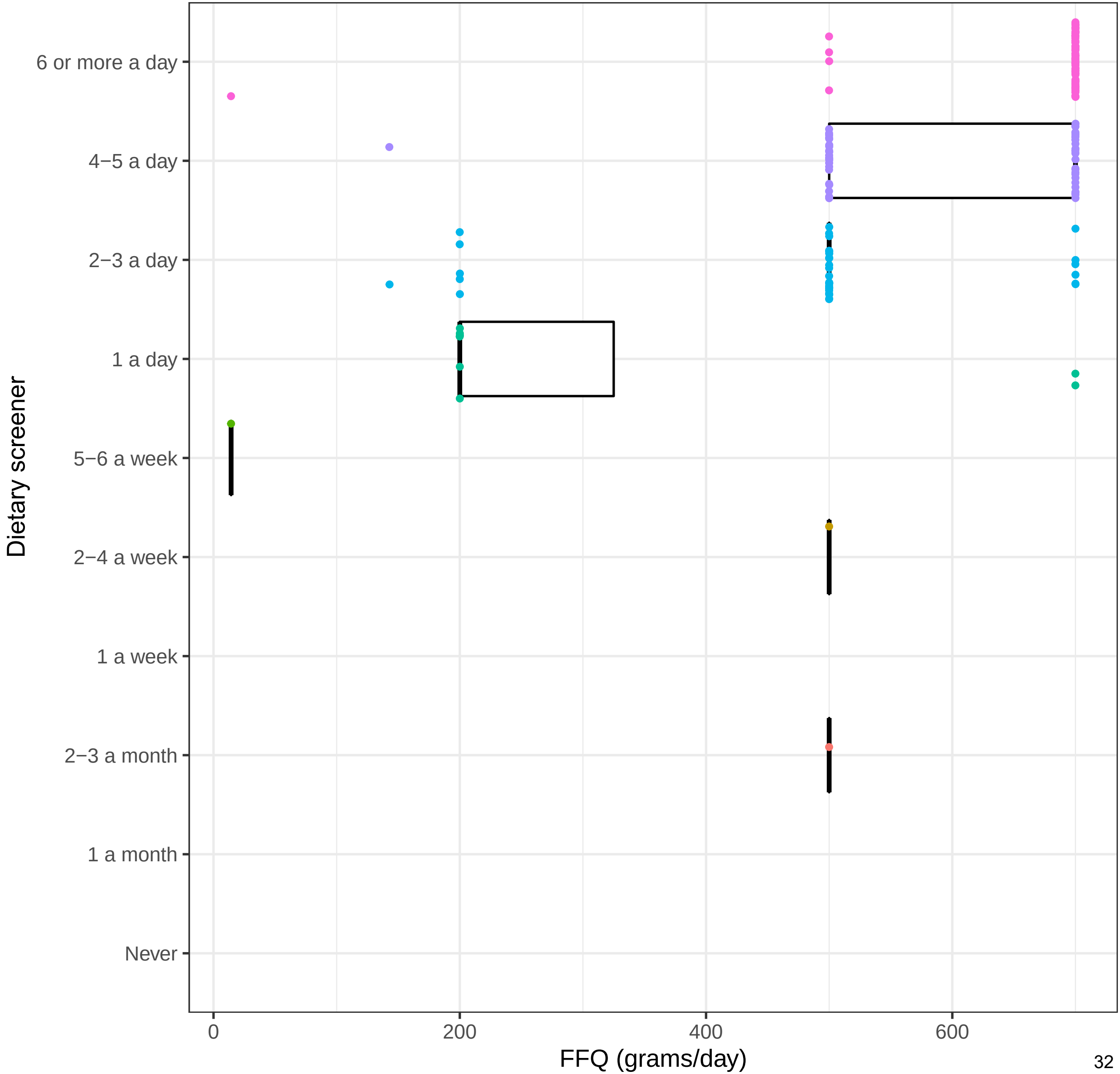


Figure S31. Box and whisker plot for "Water" in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food-frequency questionnaire. Participants presented pooled, the box indicating median and interquartile range (25th and 75th percentiles), and whiskers as quartile ±1.5*interquartile range convention.



Supplementary file 5.

Forest-plots of Kendall's tau-b concordance with 95% confidence intervals for the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire, pooled or split by gender.

Figure S32. Forest-plot of Kendall’s tau-b correlation coefficient with 95% confidence intervals for 31 food items in the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire split by gender.

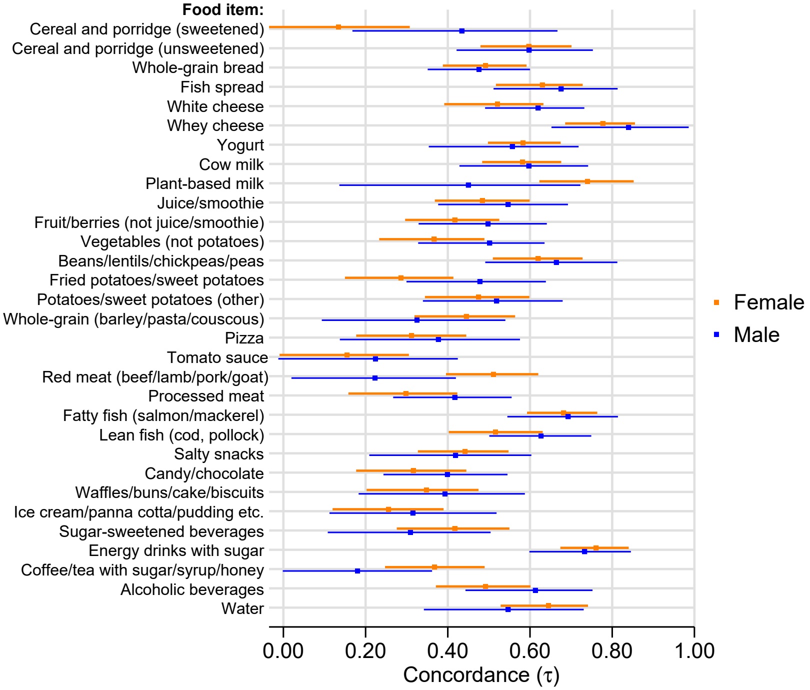


Figure S33. Forest-plot of Kendall’s tau-b correlation coefficient with 95% confidence intervals for single food item ordinal variables not included as aspects of diet quality derived from the dietary screene 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire.

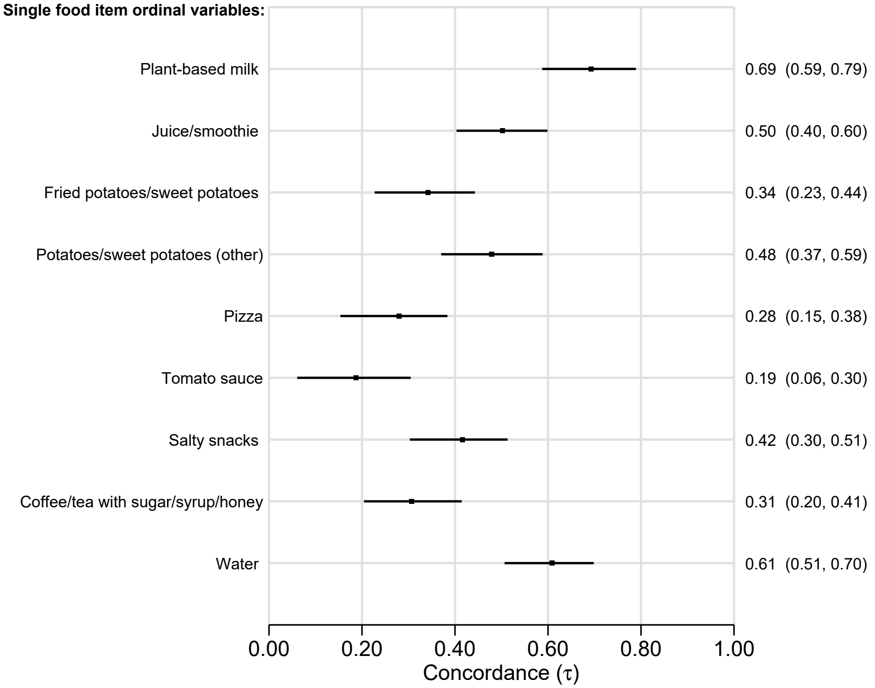
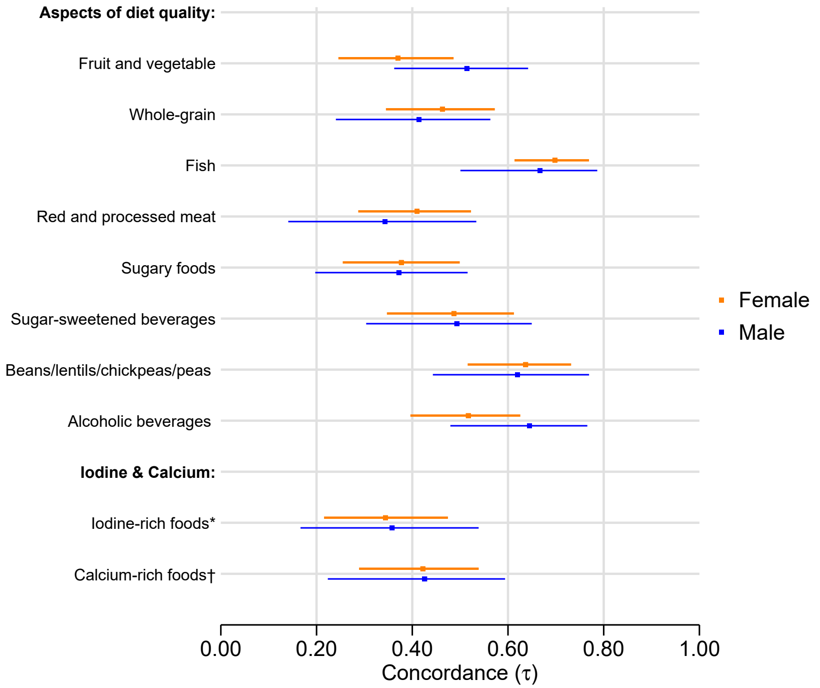


Figure S34. Forest-plot of Kendall's tau-b correlation coefficient with 95% confidence intervals for aspects of diet quality, iodine-rich foods, and calcium-rich foods derived from the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire split by gender.



*Compared to iodine intake (µg) per day. †Compared to calcium intake (mg) per day.

Figure S35. Forest-plot of Kendall's tau-b correlation coefficient with 95% confidence intervals for single food item ordinal variables not included as aspects of diet quality derived from the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire split by gender.

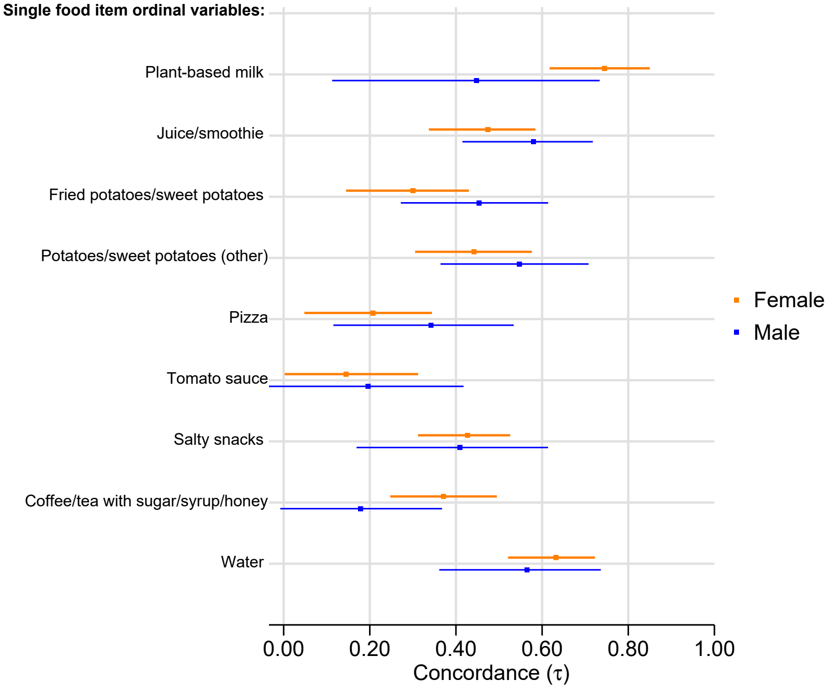
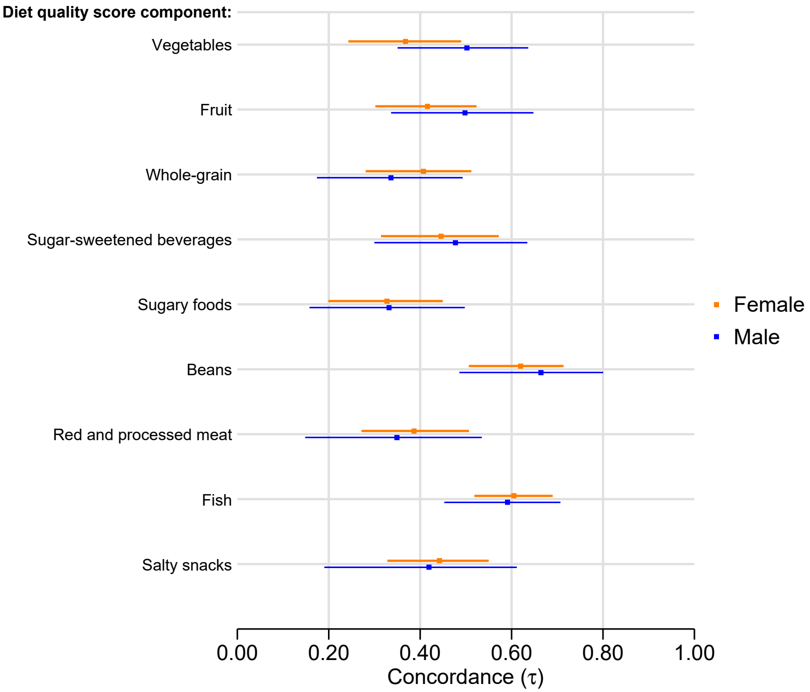


Figure S36. Forest-plot of Kendall’s tau-b correlation coefficient with 95% confidence intervals for the diet quality score components derived from the dietary screener 'MyFoodMonth 1.1' compared to a semi-quantitative food frequency questionnaire split by gender.



Paper IV, figures, and supplementary files

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Developmental Origins of Health and Disease knowledge is associated with diet quality in preconception young adult men and women

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Short title: Preconception DOHaD knowledge and diet quality

Abstract

The Developmental Origins of Health and Disease (DOHaD) approach supports that nutritional exposures in early life affect an individual's later health and risk of disease. Dietary exposure during the preconception period may also influence individual, and inter- and transgenerational health and disease risk, in both men and women. This study aimed to describe knowledge of the DOHaD approach (DOHaD$_{KNOWLEDGE}$) and diet quality in preconception young adults in Norway; to assess associations between DOHaD$_{KNOWLEDGE}$ and a Diet Quality Score (DQS); and to assess gender differences in those above. Data from 1362 preconception young adults was obtained from the PREPARED study baseline dataset. The sample had 88% women participants, a mean age of 27 years, 36% had overweight or obesity, and 77% had higher level of education. DOHaD$_{KNOWLEDGE}$ was assessed by the participants' agreement to five statements using a Likert scale. Diet quality was assessed using aspects of diet quality and a DQS derived from a dietary screener. We found moderate level of both DOHaD$_{KNOWLEDGE}$ (12/20 points) and diet quality (DQS: 60/100 points), indicating potential for improvements. Specifically, the greatest potential for diet quality improvements were observed for sugary foods, red and processed meats, legumes, and unsalted nuts and seeds. Gender differences were observed for both DOHaD$_{KNOWLEDGE}$ and diet quality. DOHaD$_{KNOWLEDGE}$ was positively associated with DQS, adjusted for sociodemographic factors, with little evidence of an interaction effect by gender. This study indicates that knowledge of the DOHaD approach is positively associated with diet quality in preconception young men and women. Future studies should consider incorporating pregnancy intentions, relationship status, and health literacy.

Keywords

DOHaD knowledge; preconception nutrition; diet quality; young adults

Introduction

The Developmental Origins of Health and Disease (DOHaD) approach highlights the role of environmental exposures in early life, including nutrition, especially during the utero-period, that can permanently affect health outcomes and risk of disease later in life [1]. The body of evidence supporting the DOHaD approach is based on epidemiological and animal studies [2, 3], the former providing knowledge on the role of nutrition in the development of disease, and the latter proposing mechanisms causing the alterations that may influence both individual, inter- and transgenerational effects.

Recently, the DOHaD approach has also emphasised the importance of health behaviours during the reproductive years for parents-to-be – before life starts – namely in the preconception period [4-6]. Stephenson et al. [5] have proposed three definitions of the preconception period spanning from the biological perspective, covering days to weeks before embryo development and maturation; the individual perspective, covering weeks to months before pregnancy; and finally, the public health perspective, covering months to years prior to pregnancy. The duration of the preconception period, defined from the public health perspective, is characterized by large individual variation, as some reproduce as early as in adolescence, whereas others have children in midlife or even as older adults.

Utilizing the preconception perspectives faces a challenge since not all pregnancies are planned. Globally, the incidence of unintended pregnancies among all pregnancies was estimated at 48% (46-51%) in 2015-2019 [7]. In Norway between 2008-2010, more than one in five pregnancies (21%) was reported to be unintended [8]. At an average of 6 months of pregnancy, the distribution of age groups were as follows: 24% were under 25 years old, 34% were aged 25-30, 27% were aged 31-35, and 14% were aged over 35 years old (non-country specific, including Belgium, Iceland, Denmark, Estonia, Norway, and Sweden) [8].

The Global Burden of Disease study has quantified the impact of dietary risks on health, based on data from adults aged 25 years or older [9]. Data show that an unhealthy diet is a major risk factor for non-communicable diseases, and that there is a large potential to improve diet quality, as it is a modifiable behaviour. Globally, Afshin et al. [9] found that the consumption of nearly all healthy foods and nutrients were suboptimal among adults ages 25 years or older in 2017. The largest discrepancies between current and optimal daily intake were observed for nuts and seeds, milk, and whole grains. At the same time, global daily intake of unhealthy foods and nutrients all exceeded optimal levels, particularly for sugar-sweetened beverages (SSB), processed meat, and sodium. These dietary trends are also reflected in Western Europe [9]. The consumption of healthy foods show that the intake of milk and calcium is higher in Western Europe compared to global intakes in 2017, but that the consumption of legumes and whole grain is lower. For the unhealthy foods, Western Europe show close to double the intake of both red meat, processed meat, and SSB compared to the global intake in 2017.

For young people in the preconception period, diet quality may be even less optimal. This is because the transition into emerging adulthood, namely from the end of adolescence to being a younger adult, is observed to be associated with deteriorating eating habits [10] and weight gain [11]. The negative changes in diet in this period of life are associated with two key life transition phases; leaving the parental home and leaving education[12], and may be important periods to target in improving preconception diets.

Public awareness of the critical preconception period in which diet may influence the risk of future disease in future children is an important starting point to improve preconception diet. Although the DOHaD approach is well recognized in the scientific society, little is known about the general populations' knowledge about it. Only a few studies have reported results of the public's understanding of the DOHaD approach [13-16], and very little is published on

$DOHaD_{KNOWLEDGE}$ and diet quality. However, knowledge of the DOHaD approach was observed to be positively associated with diet quality in a sample of pregnant Canadian women in a study from 2020 [17]. So far, these studies on the DOHaD approach have focused on women only, even though preconception nutrition and health behaviour are believed to be of importance to all individuals of reproductive age, regardless of gender [4, 18, 19]. Moreover, nutritional epidemiological studies that include paternal preconception in a wider sense are also scarce, despite the emerging evidence of its importance [20-22].

The aims of this paper were to describe knowledge of the DOHaD approach ($DOHaD_{KNOWLEDGE}$) and diet quality in a Norwegian preconception population; to assess if $DOHaD_{KNOWLEDGE}$ was associated with a Diet Quality Score (DQS); and to assess gender difference in those above.

Methods

Study design and study population

This study used baseline data from the PREPARED research project [23], a digital randomised controlled trial aimed at improving the diet of preconception young adults in Norway and the health outcomes of the participants' future offspring. The PREPARED research project adopts a public health perspective on preconception, in line with the definition by Stephenson et al. [5], targeting both men and women regardless of pregnancy planning [23]. Recruitment occurred from October 2021 to January 2023 using social media advertisement on Snapchat, Facebook, Instagram, and YouTube. Norwegian preconception men and women aged 20-35 years, without biological children, literate in Norwegian/Scandinavian language, with access to a smartphone or other digital device were eligible for participation. A lottery of ten gift cards worth 5000 NOK (approximately 500 €) was used as an incentive to recruit participants.

Baseline data were collected using a digital questionnaire tool created with nettskjema.no, a survey solution developed and hosted by the University of Oslo (nettskjema@usit.uio.no). Participants were asked to provide sociodemographic background information (55 questions) (the variables gender, age, mother tongue, height, weight, and level of education were used in the current study), followed by a DOHaD knowledge questionnaire (5 questions) and questions about their dietary habits, including a 33-items dietary screener (MyFoodMonth 1.1) (54 questions in total). All questions in the questionnaires were obligatory, except the question about their body weight. All data were stored, and analyses were performed on the Services for Sensitive Data (TSD) facilities, operated and developed by the TSD service group at University of Oslo, IT-Department (USIT) (tsd-drift@usit.uio.no).

Figure 1 presents a recruitment flowchart for the baseline data of the PREPARED study. Of the 1437 individuals who wanted to participate in the study, 75 were excluded due to ineligibility (did not meet the inclusion criteria and other reasons (duplicates and participants in the pilot study)). The descriptive statistics of the study sample included 1362 eligible participants. Six participants who identified themselves as having a non-binary gender (identifies as a gender not solely male or female) were excluded from data analyses, resulting in 1356 participants (1201 women and 155 men).

Insert fig 1 here

DOHaD$_{\text{KNOWLEDGE}}$

DOHaD$_{\text{KNOWLEDGE}}$ was evaluated using five statements about the long-term influences of parental and/or grandparental health and behaviour during periconception and the prenatal and perinatal period on children's health, with a focus on nutrition, developed by McKerracher et al. [17]. A 5-point Likert scale (0 = *strongly disagree,* 4 = *strongly agree*), was used for each of the statements, summarized into a $DOHaD_{KNOWLEDGE}$ scale. The $DOHaD_{KNOWLEDGE}$ scale ranged from 0 points, indicating no knowledge with the theory of the DOHaD approach, to 20 points, indicating very strong knowledge [17]. The statements were translated into Norwegian using a standard forward-backward translation process, ensuring that the meaning was maintained. Statements made in the first person were changed to the third person to better suit a preconception population including both men and women, e.g., phrases such as “what I eat during pregnancy” were changed to “what a woman eats during pregnancy”.

Aspects of diet quality and DQS

Aspects of diet quality and a DQS were derived from MyFoodMonth 1.1, a non-quantitative dietary screener [24]. The dietary screener assesses the intake of 33 food items during the previous month (30 days) using ten frequency categories ranging from “never” to “6 or more per day”. The dietary screener has previously been validated in a Norwegian sample of young adults, and showed satisfactorily ranking abilities, compared to a semi-quantitative food frequency questionnaire [24].

Aspects of diet quality is presented as ordinal ranked frequency of intake data for single food items (e.g., alcoholic beverages) and pooled food items (e.g., iodine-rich foods). The frequencies of intake from the dietary screener were recoded to four and five categories to simplify data presentation.

A DQS consisting of ten components was derived from 19 food items from the dietary screener. The DQS assign points using a weighted scoring from 0 to 10 points relative to health benefits associated with the frequency of intake for the respective food items, i.e., a higher score indicates a healthier diet, previously described in detail [24]. The total DQS ranged from 0 points, indicating low diet quality, to 100 points, indicating high diet quality.

Analysis

Descriptive data for age, body mass index (BMI), level of education, ethnicity, $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$, and DQS were presented for the total sample and split by gender. The continuous variable BMI was recoded into categories: underweight (<18.5), healthy weight (18.5 to <25), overweight (25 to <30), and obesity (≥30) [25]. The level of education was classified as: lower education (primary and secondary school), vocational secondary school, higher education (<4 years of university or college education), higher education (≥4 years of university or college education), and other. Participants who identified themselves as non-binary (*n*=6) were included in the descriptive table 1 but excluded from statistical analysis.

Differences between gender (women and men) were evaluated using the chi-squared test for independence for categorical variables, and independent samples t-tests and Mann-Whitney *U* tests for continuous variables, depending on the skewness of the data.

Linear regression analyses were used to assess the association between $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ and DQS in the preconception sample of young adults in this study. First, a standard linear regression analysis was performed to assess the crude association, followed by a multiple regression analysis to assess the association adjusted for the possible confounding variables: gender, BMI, and educational level. Further, as sensitivity analyses, the multiple regression analysis was repeated after removing four cases with standardized residuals >3, and subsequently removing fourteen cases with extreme BMI values in a separate analysis. The removal of cases did not materially alter the results. An assessment of a possible interaction effect of gender on the association between $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ and DQS was conducted by running an additional multiple regression analysis with the interaction term $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ X gender.

Data processing and analyses were performed using SPSS 25 (IMB Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IMB Corp.).

Results

Table 1 describes the characteristics of the participants included in the PREPARED study. The participants had a mean age of 27 years (ranging from 20 to 35 years), and most were women (88%). A majority had a BMI within the healthy weight range, and about a third of the women and half of the men had overweight, including obesity. Nine percent of the participants had a mother tongue other than Norwegian. Most participants had higher education (77% had studied at university or university college), but a higher proportion of lower educational level was observed for men.

Participant relationship status was distributed as follows: 42% single, 18% in a relationship (not cohabiting or married), 39% cohabiting or married, and 1% divorced or separated, widow or widower, or other. The proportion of singles were 15% higher among men compared to women.

Insert table 1 here

$\text{DOHaD}_{\text{KNOWLEDGE}}$

Figure 2 presents participants' agreement with the five $\text{DOHaD}_{\text{KNOWLEDGE}}$ statements, with the highest proportions of participants reporting 'Either or' or 'Agree' for all statements. This was corroborated by the mean total $\text{DOHaD}_{\text{KNOWLEDGE}}$ score of 12 (SD 3.7) points, indicating a moderate knowledge level (table S1). The highest proportion of disagreement (strongly disagree, 6%) was observed for the $\text{DOHaD}_{\text{KNOWLEDGE}}$ statement pertaining to the association between a woman's diet during pregnancy and the risk of her grandchildren becoming obese. The two DOHaD$_{KNOWLEDGE}$ statements most participants strongly agreed with were the one concerning maternal diet during pregnancy, and the one concerning maternal diet during breastfeeding, and the relation to her baby's risk of becoming obese as an adult.

The total DOHaD$_{KNOWLEDGE}$ score showed similar mean values for women and men (12 (SD 3.6) points and 12 (SD 4.1) points, respectively) (table S1). However, higher proportions of men reported extreme views (strongly disagree and strongly agree) for all the DOHaD$_{KNOWLEDGE}$ statements compared to women. Chi-squared tests for independence indicated evidence of associations between gender for the DOHaD$_{KNOWLEDGE}$ statements "Before pregnancy, both what the mother and the father eat affects the growth and health of their baby" (p=0.009) and "What a woman eats before pregnancy affects the child's risk of becoming obese as an adult" (p=0.006) (table S1). Little evidence of gender associations was found for the overall DOHaD$_{KNOWLEDGE}$ score or for the remaining statements.

Insert fig 2 here

Diet quality

Table 2 shows scores for the total DQS and for the ten individual DQS components. The mean (SD) total DQS was 60 (14), showing a moderate total DQS. Moderately high median DQS were observed for the components vegetables, 8; wholegrain, 8; SSB, 9; and fish, 10. Less-than-optimal DQS were observed for sugary foods, legumes, unsalted nuts and seeds, and red and processed meats (all with a median score of 4 points).

Women had a higher mean total DQS than men (mean difference: +5.45 points; 95% CI: 3.17, 7.72). Gender difference in diet quality favouring women was observed for the DQS components vegetables (*p*<0.001) and fruit (*p*<0.001), and for the inverted DQS components SSB (*p*<0.001) and red and processed meats (*p*<0.001). The only gender difference in diet quality favouring men was observed for the inverted DQS component sugary foods (*p*=0.003).

A detailed description of aspects of diet quality is available in table S2, which includes all variables from table 2 (except unsalted nuts and seeds), in addition to alcoholic beverage intake, iodine-rich foods, and calcium-rich foods. Table S2 corroborates the findings in table 2, showing gender difference for the variables fruits and vegetables (*p*<0.001), red and processed meats (*p*<0.001), sugary foods (*p*=0.004), and SSB (*p*<0.001). Moreover, table S2 shows that 14% of participants reported never drinking alcoholic beverages, and 22% reported drinking alcoholic beverages less often than twice a month. Most of the participants reported an intake of iodine-rich and calcium-rich foods ≤2.5 times a day (67% and 70%, respectively).

Insert table 2 here

Associations between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and DQS

The crude and adjusted associations between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and the total DQS are shown in table 3. On average, a one-unit higher score on the $\text{DOHaD}_{\text{KNOWLEDGE}}$ scale was associated with 0.71 point higher total DQS (95% CI: 0.52, 0.91). This was slightly attenuated after adjusting for gender, BMI, and education (0.60 (95% CI: 0.41, 0.79)). No interaction effect of gender on the association between $\text{DOHaD}_{\text{KNOWLEDGE}}$ and total DQS was found.

Insert table 3 here

Discussion

Most participants agreed, or strongly agreed, with the individual $DOHaD_{KNOWLEDGE}$ statements. Higher proportions of men reported extreme views (strongly disagree and strongly agree) than women for all $DOHaD_{KNOWLEDGE}$ statements. There was a gender difference in two $DOHaD_{KNOWLEDGE}$ statements. The total DQS showed a moderate diet quality among the participants. Women were observed to have a higher total DQS than men. There were gender differences for both the total DQS and the DQS components: vegetables, fruit, SSB, sugary foods, and red and processed meats. Lastly, a positive association was observed between $DOHaD_{KNOWLEDGE}$ and total DQS, with little evidence of an interaction effect of gender.

Knowledge of the DOHaD approach – Comparison with other studies

To our knowledge, this is one of four studies assessing knowledge of the DOHaD approach in a preconception sample that includes males [26-28]. Also, there is limited literature published on knowledge of the DOHaD approach in the general population. In a recent study from 2022, Lynch *et al.* [15] assessed public knowledge of epigenetics and epigenetic concepts, that is, how behavioural and environmental factors interact with and cause changes in gene expression, in an Australian adult population (94.6% female, mean age: 37.5 years). Approximately one-third of the sample had heard of DOHaD, but their understanding of the approach appeared low. Another study from 2018, which included first-year undergraduate nutritionist and nursing students in Japan and New Zealand, assessed whether the students had ever heard of DOHaD. The results showed that awareness in both samples was negligible [28]. In a study from 2019, a sample of pregnant Canadian women (mean age: 30.5 years) reported a mean $DOHaD_{KNOWLEDGE}$ score of 9.4 points (SE ±0.25) [17]. The present findings of a mean of 12 points (SD 3.7), using the same $DOHaD_{KNOWLEDGE}$ scale, indicate slightly more knowledge of the DOHaD approach in this sample.

The two $\text{DOHaD}_{\text{KNOWLEDGE}}$ statements concerning the effect of maternal diet during pregnancy and while breastfeeding on the child's risk of adult obesity received the highest support among the participants. One may speculate whether this is due to the fact that pregnant and breastfeeding women in Norway, like many other countries, receive advise from health care personnel regarding the importance of a healthy diet and how to eat healthy during this period of life [29, 30]. Although this advice does not necessarily include information regarding the potential risk of the child developing overweight or obesity in the future, the two $\text{DOHaD}_{\text{KNOWLEDGE}}$ statements may be perceived to be in line with the existing diet advice in pregnancy care, compared to the other statements.

Diet quality – Comparison with other studies

Substantially more is published on diet quality than on knowledge of the DOHaD approach. Using 2018 data from the Global Dietary Database (GDD), Miller et al. [31] estimated a worldwide mean Alternative Healthy Eating Index (HEI) of 40 (range 0-100), indicating a modest diet quality globally. The study based on the GDD included both men and women, age groups <1 to ≥95, from 185 countries that covered 99% of the world's population in 2018. Studies from the UK [32] and the US [33] which included samples of adolescents and young adults have also reported a suboptimal diet quality (DASH score: 35/80, and HEI-2010 score: 45/100, respectively). Patetta et al. [34] found an overall increase in diet quality score of 7 points (HEI2015 score: 49 to 56/100) in US young adults between 1989-1991 and 2011-2014. The mean total DQS in the present study of 60/100 points indicates a higher diet quality than for the studies above but is comparable to the findings of Patetta et al. [34] from 2011-2014. Moreover, our observations of higher DQS among women compared to men are in line with global trends [31] and among UK adolescents and young adults [32].

Looking into the individual DQS components in this study, modest to high scores for fruit (6/10) and vegetables (8/10) were observed, which is better than what other studies have found. Winpenny et al. [32] found that fruit intake was low in both gender and age groups in adolescent and young adults in the UK, and Patetta et al. [34] found that vegetable intake decreased between 1989-1991 and 2011-2014. The discrepancies for both total DQS and DQS components fruits and vegetables may possibly be explained by differences in gender balance in the samples (comparative studies ≈50% females [31-34]). In addition, people with a higher level of education also have a higher diet quality compared to people with a lower level of education [31]. As the sample in the present study was overrepresented by highly educated participants, this may partly explain the higher total DQS observed in this study compared to other studies, e.g. the study by Patetta et al. [34], who report 53% low-income participants in the sample from 2011-2014.

There seems to be a J- or U-shaped relationship between diet quality and age, and diet quality has been observed to worsen especially in adolescence. Miller et al. [31] observed this relationship for most regions worldwide, and Lipsky et al. [33] as a modest improvement in diet quality during the transition from adolescence to emerging adulthood. This relationship has also been observed in Norway. In a 1990-2007 study evaluating dietary trajectories in adolescents and young adults, a decrease in consumption of fruits and vegetables was observed from the age of 14 through the early 20s, before improving again towards the age of 30 [12]. SSB and, to a lesser extent, confectionary consumption showed the opposite pattern. The cross-sectional DQS findings in the present study do not reflect the low diet quality score of about 32/100 observed by Miller et al. [31] for the same age group in high-income countries. Regardless of this discrepancy, the total DQS in this study was still suboptimal, which is strongly in line with all the aforementioned studies.

DOHaD$_{KNOWLEDGE}$ associated with DQS – Comparison with other studies

Only one other published study, by McKerracher et al. [17], has previously evaluated an association between DOHaD$_{KNOWLEDGE}$ and diet quality. They found that DOHaD$_{KNOWLEDGE}$ was positively associated with diet quality in a sample of pregnant Canadian women. This study supports their findings, showing a slightly stronger association in this sample of Norwegian preconception women and men, with little evidence of an interaction effect by gender. There is clearly a need to further confirm these findings in other populations in future studies.

Strengths and limitations

Our study has several strengths. The large sample size gave sufficient precision to our findings. The inclusion of male participants is in line with the relatively new extension of DOHaD, Paternal Origins of Health and Disease (POHaD) [20], and helps filling the research gap which calls for epidemiological studies exploring the influences of the paternal environment on the health of the offspring. Other strengths include the use of a validated dietary screener, shown to satisfactorily rank high and low intakes compared to a semi-quantitative food frequency questionnaire [24], and the use of a DOHaD$_{KNOWLEDGE}$ scale that has high internal consistency (Cronbach's α =.82), indicating that the statements that make up the scale measure the same mental construct [17]. However, the DOHaD$_{KNOWLEDGE}$ scale has not been validated and has an imbalance of positively and negatively phrased statements, as pointed out by McKerracher et al. [17]. Moreover, four out of the five DOHaD$_{KNOWLEDGE}$ statements regard the risk of obesity in offspring, and all are directed toward what a woman eats. There is only one DOHaD$_{KNOWLEDGE}$ statement that includes what a man eats and whether it affects the growth and health of the offspring. It is doubtful that this scale adequately measures DOHaD knowledge beyond these aspects. Future studies could benefit from a $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ scale that is tailored to a preconception population by including early life exposures and specific nutritional aspects, e.g., intake of fruits and vegetables and folic acid supplements.

We believe our results are generalisable to the young adult population in Norway, for the following reasons. First, a relatively large sample with a nationwide sampling method is included. Second, the proportion of overweight, including obese, participants is similar to the proportion of 20 to 29-year-olds in a large Norwegian cohort, The Trøndelag Health Study (The HUNT Study) [35], and third, the study includes participants from both lower and higher education levels. However, the findings are probably most generalisable to women and persons with higher education in the age group. This is supported by data on the level of education for both sexes aged 20-39 from Statistics Norway [36] per 2021, which shows that the sample in this study is underrepresented by participants with lower education (16% vs 56%), and overrepresented for vocational education (7% vs 3%), and higher education (<4 years 39% vs 30%, ≥4 years 38% vs 11%). It is likely that the overrepresentation of selected characteristics may be due to convenience sampling.

This study is not without limitations. First, the cross-sectional nature of the baseline data used in this study is a major limitation, as we do not know whether the observed improved $\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$ leads to changes in diet, as the exposure ($\mathrm{DOHaD}_{\mathrm{KNOWLEDGE}}$) was assessed at the same time as the diet. Second, the dietary data in this study was based on self-reported data and a frequency-based dietary screener. Self-reported dietary assessment methods, and frequency-based questionnaires, have been criticized for a lack of accuracy [37]. Nevertheless, a dietary screener was considered appropriate to assess the level of detail in dietary intake needed in this study, as the dietary screener has a great advantage by limiting the total burden of data collection imposed on participants. Third, the absence of another indicator of health literacy and pregnancy intention limits the evaluation of the association observed between $DOHaD_{KNOWLEDGE}$ and diet quality. The low number of male participants should also be seen as a limitation.

Considering the burden of non-communicable diseases, deteriorating eating habits in adolescents and young adults, and the missed opportunities of preconception health, especially in unintended pregnancies, the importance of DOHaD and early intervention should not be underestimated. Research on how to promote DOHaD knowledge and diet in preconception years is in its infancy. Cost-effective, scalable, individual-level interventions, such as the PREPARED study [23], targeting modifiable nutritional determinants through increased knowledge for informed dietary decisions, have the potential to become impactful digital public health initiatives, if successful. In addition to approaches like the PREPARED intervention, community and policy-level promotion strategies should be evaluated to exploit the opportunity of preconception health. Combining individual- and structural-level strategies to address modifiable determinants of preconception nutrition, as detailed in the Determinants Of Nutrition and Eating framework [38], may lead to synergistic effects.

Conclusions

In this study, a moderate level of both $DOHaD_{KNOWLEDGE}$ (12/20 points) and diet quality (60/100 points) was observed in a sample of preconception Norwegian young adults, with gender differences in diet quality favouring women and $DOHaD_{KNOWLEDGE}$ favouring men. This study indicates that there is a potential to improve $DOHaD_{KNOWLEDGE}$ in young adults and corroborates previous research that shows clear potentials for dietary improvements. A positive association was observed between $DOHaD_{KNOWLEDGE}$ and diet quality, adjusted for sociodemographic factors, with little evidence of an interaction effect by gender. As very little research is done on $DOHaD_{KNOWLEDGE}$ alone or in combination with diet quality, future research is clearly needed to confirm the findings in other populations.

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Conflicts of Interest: None.

Ethical Standards: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national guidelines on human experimentation (the Regional Ethics Committee, REC: 78104) and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by the institutional committees (the Norwegian Data Protection Service, NSD: 907212, and our Faculty Ethical Committee, FEC: 20/10119).

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Tables

Table 1. Descriptive statistics, the PREPARED study.

	Total[†] (*n*=1362) 100%		**Women**[‡] (*n*=1201) 88%		**Men** (*n*=155) 11%		**Non-binary** (*n*=6) <1%	
Age, years *Mean (SD)*	27 (4)		27 (4)		27 (4)		28 (2)	
BMI categories, *n* %								
Underweight (<18.5)	36	3%	34	3%	2	1%	-	-
Healthy weight (18.5 to <25)	826	61%	747	62%	75	48%	4	67%
Overweight (25 to <30)	317	23%	264	22%	53	34%	-	-
Obesity (≥30)	173	13%	146	12%	25	16%	2	33%
Ethnicity (non-Norwegian mother tongue), *n* %	119	9%	105	9%	14	9%	-	-
Level of education, *n* %								
Lower education	216	16%	178	15%	437	24%	1	17%
Vocational secondary school	88	7%	66	6%	22	14%	-	-
Higher education (<4 years)	526	39%	468	39%	54	35%	4	67%
Higher education (≥4 years)	517	38%	475	40%	41	27%	1	17%
Other	15	1%	14	1%	1	1%	-	-

Abbreviations: SD, standard deviation; BMI, body mass index. Reporting body weight was optional, resulting in sample variation for BMI categories: [†]*n*=1352, [‡]*n*=1191. BMI calculated as kg/m^2. Level of education: Lower education (primary school and secondary school).

Table 2. The total DQS and the individual DQS components derived from the dietary screener MyFoodMonth 1.1, the PREPARED study.

DQS	**Total** (*n*=1356)	**Women** (*n*=1201)	**Men** (*n*=155)	***p*-value**[*]
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	
Total score	60 (14)	60 (13)	55 (14)	<.001
Components	*Median (IQR)*	*Median (IQR)*	*Median (IQR)*	
Vegetables	8 (6, 9)	8 (6, 9)	8 (4, 8)	<.001
Fruit	6 (4, 10)	6 (4, 10)	4 (1, 8)	<.001
Whole grain	8 (6, 10)	8 (6, 10)	8 (4, 10)	.19
Sugar-sweetened beverages[†]	9 (6, 10)	9 (6, 10)	6 (4, 9)	<.001
Sugary foods[†]	4 (1, 6)	4 (1, 6)	4 (4, 6)	.003
Legumes	4 (2, 6)	4 (2, 6)	4 (1, 6)	.26
Unsalted nuts and seed	4 (2, 6)	4 (2, 6)	4 (1, 6)	.27
Red and processed meats[†]	4 (2, 8)	4 (2, 8)	2 (1, 6)	<.001
Fish[‡]	10 (7, 10)	10 (7, 10)	10 (10, 10)	.5
Salty snacks[†]	6 (4, 8)	6 (4, 8)	6 (4, 8)	.41

Abbreviations: DQS, diet quality score; SD, standard deviation; IQR, interquartile range. Participants identifying as non-binary (*n*=6) were excluded from the total sample. Each diet quality score component scored 0-10 points, resulting in a total score of 0-100 points. [†]Component inversely scored, meaning that a higher score reflects a lower intake. [‡]Includes fatty fish products, lean fish products, and fish spread. [*]Mann Whitney *U* Tests except for variable Total score that used independent samples t-test.

Table 3. Standard linear regression analysis, crude, and standard multiple regression analysis, adjusted, assessing an association between DOHaD$_{\text{KNOWLEDGE}}$ and total DQS, the PREPARED study.

Independent variable		**95% CI**		
(*n*=1356)	**B**	**Lower**	**Upper**	***p*-value**
DOHaD$_{\text{KNOWLEDGE}}$, crude	0.71	[0.52	0.91]	<.001
DOHaD$_{\text{KNOWLEDGE}}$, adjusted[†]	0.60	[0.41	0.79]	<.001

Abbreviations: CI, confidence intervals; DOHaD$_{\text{KNOWLEDGE}}$, Developmental Origins of Health and Disease knowledge.

[†]*n*=1346, adjusted for the independent variables: gender; body mass index; education.

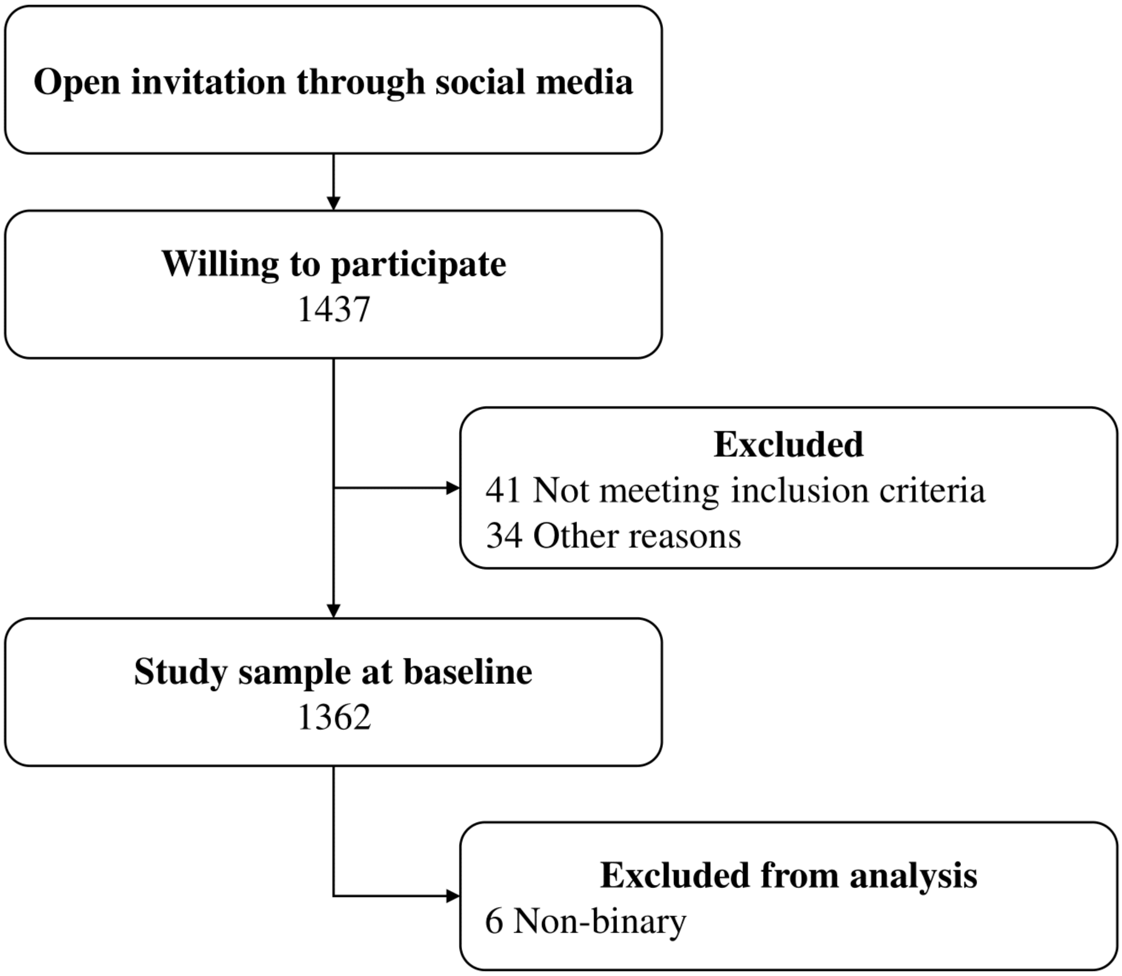

Figure 1. Recruitment flowchart for the baseline data in the PREPARED study.

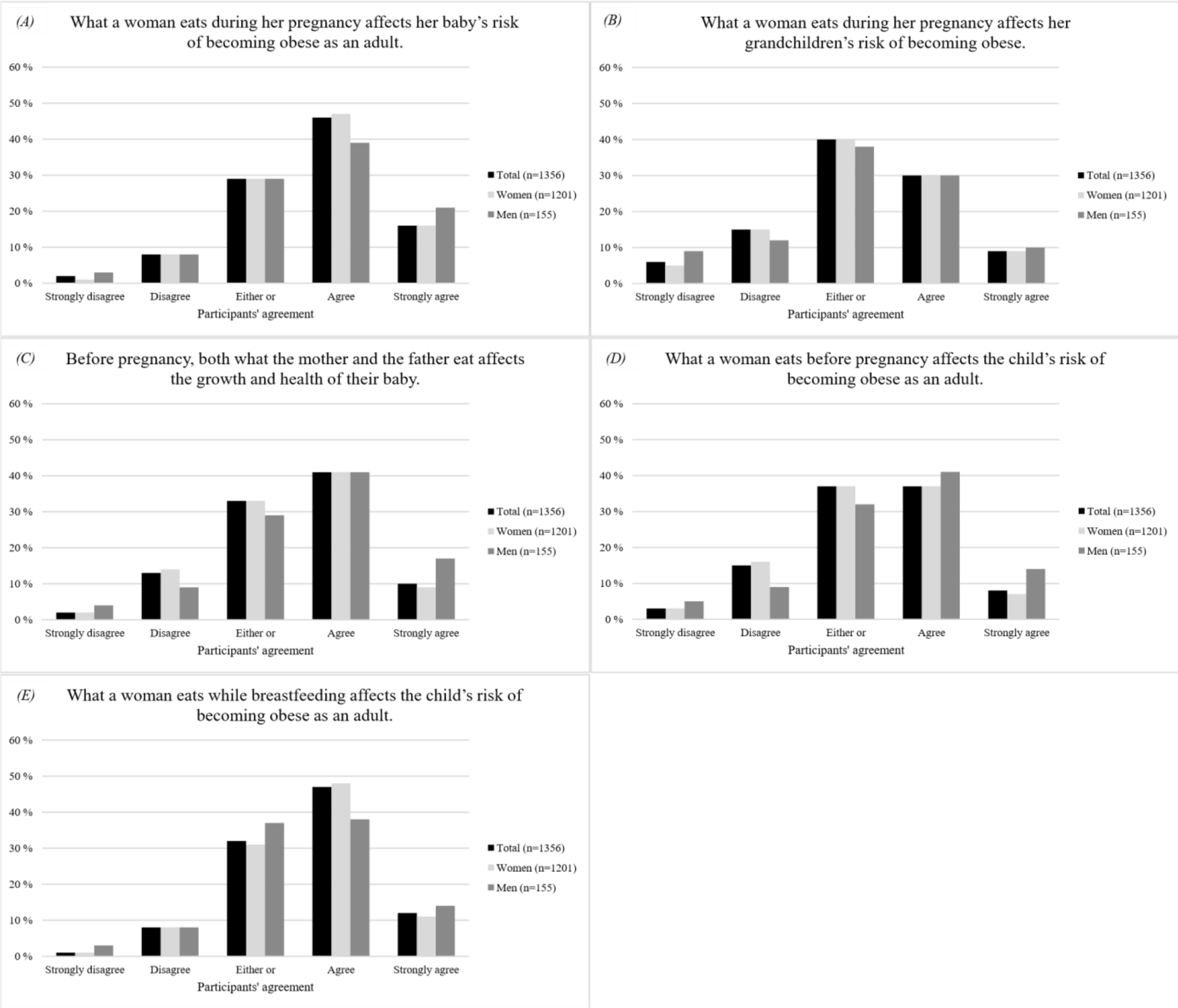

Figure 2. Knowledge of the Developmental Origins of Health and Disease approach, shown as participants agreement with the five DOHaD$_{\text{KNOWLEDGE}}$ statements (A-E), presented in percentage, the PREPARED study. Participants identifying as non-binary (n=6) were excluded from the total sample.

Supporting information

Supplementary Table S1: Knowledge of the Developmental Origins of Health and Disease approach, shown as mean total $\mathrm{DOHaDK_{NOWLEDGE}}$ and the participants' agreement with the five $\mathrm{DOHaD_{KNOWLEDGE}}$ statements, presented in percentage, the PREPARED study.

Supplementary Table S2. Aspects of diet quality, including intake for iodine-rich and calcium-rich foods, derived from the dietary screener MyFoodMonth 1.1, the PREPARED study.

Table S1. Knowledge of the Developmental Origins of Health and Disease approach, shown as mean total $DOHaD_{KNOWLEDGE}$ and the participants' agreement with the five $DOHaD_{KNOWLEDGE}$ statements, presented in percentage, the PREPARED study.

		Total (*n*=1356)	**Women** (*n*=1201)	**Men** (*n*=155)	***p*-value***
Total $DOHaD_{KNOWLEDGE}$ (0-20 points)	Mean (SD)	12 (3.7)	12 (3.6)	12 (4.1)	.47
Individual $DOHaD_{KNOWLEDGE}$ Statements (Likert scale)	Participants agreement, %				
What a woman eats during her pregnancy affects her baby's risk of becoming obese as an adult.	Strongly disagree	2%	1%	3%	.27
	Disagree	8%	8%	8%	
	Either or	29%	29%	29%	
	Agree	46%	47%	39%	
	Strongly agree	16%	16%	21%	
What a woman eats during her pregnancy affects her grandchildren's risk of becoming obese.	Strongly disagree	6%	5%	9%	.26
	Disagree	15%	15%	12%	
	Either or	40%	40%	38%	
	Agree	30%	30%	30%	
	Strongly agree	9%	9%	10%	
Before pregnancy, both what the mother and the father eat affects the growth and health of their baby.	Strongly disagree	2%	2%	4%	.009
	Disagree	13%	14%	9%	
	Either or	33%	33%	29%	
	Agree	41%	41%	41%	
	Strongly agree	10%	9%	17%	
What a woman eats before pregnancy affects the child's risk of becoming obese as an adult.	Strongly disagree	3%	3%	5%	.006
	Disagree	15%	16%	9%	
	Either or	37%	37%	32%	
	Agree	37%	37%	41%	
	Strongly agree	8%	7%	14%	
What a woman eats while breastfeeding affects the child's risk of becoming obese as an adult.	Strongly disagree	1%	1%	3%	.13
	Disagree	8%	8%	8%	
	Either or	32%	31%	37%	
	Agree	47%	48%	38%	
	Strongly agree	12%	11%	14%	

Abbreviations: $DOHaD_{KNOWLEDGE}$, Developmental Origins of Health and Disease knowledge; SD, standard deviation. Participants identifying as non-binary (*n*=6) were excluded from the total sample. *Chi-squared tests for independence except for variable Total $DOHaD_{KNOWLEDGE}$ that used independent samples t-test.

Table S2. Aspects of diet quality, including intake for iodine-rich and calcium-rich foods, derived from the dietary screener MyFoodMonth 1.1, the PREPARED study.

Aspects of diet quality	**Frequency of intake**	**Total** (n=1356)	**Women** (n=1201)	**Men** (n=155)	***p*-value***
Fruit and vegetables	<1 a day	19%	18%	32%	<.001
	1 to 2.5 a day	33%	32%	36%	
	>2.5 to <5 a day	29%	30%	19%	
	≥5 a day	20%	20%	14%	
Whole grain	<3.5 a week	11%	10%	19%	.15
	3.5 a week to <1 a day	16%	16%	17%	
	1 to 2 a day	34%	35%	26%	
	>2 a day	38%	38%	39%	
Fish	Never	12%	12%	11%	.20
	>0 to <1 a week	22%	23%	20%	
	1 to <2.5 a week	37%	38%	36%	
	≥2.5 a week	29%	28%	34%	
Red and processed meats	Never	17%	18%	9%	<.001
	>0 to <weekly	12%	13%	5%	
	Weekly to <3.5 a week	22%	23%	16%	
	3.5 a week to <1 a day	33%	32%	39%	
	≥1 a day	16%	14%	31%	
Sugary foods	Never	1%	1%	3%	.004
	>0 to <weekly	8%	8%	16%	
	Weekly to <3.5 a week	32%	32%	34%	
	3.5 a week to <1 a day	39%	40%	32%	
	≥1 a day	19%	19%	16%	
Sugar-sweetened beverages	Never	34%	36%	23%	<.001
	>0 to <weekly	36%	37%	31%	
	Weekly to <3.5 a week	13%	13%	19%	
	3.5 a week to <1 a day	8%	8%	11%	
	≥1 a day	8%	7%	16%	
Beans, lentils, chickpeas, peas (not green beans)	Never	13%	12%	17%	.11
	>0 to <weekly	43%	43%	44%	
	Weekly to <3.5 a week	26%	27%	22%	
	3.5 a week to <1 a day	7%	7%	9%	
	≥1 a day	11%	12%	8%	
Alcoholic beverages	Never	14%	14%	16%	.40
	>0 to <2 a month	22%	22%	17%	
	2 a month to <weekly	47%	47%	47%	
	Weekly to <3.5 a week	16%	16%	19%	
	≥3.5 a week	1%	1%	1%	
Iodine-rich foods†	<1 a day	24%	24%	27%	.25
	1 to 2.5 a day	43%	44%	32%	

	>2.5 to <5 a day	27%	26%	33%	
	≥5 a day	6%	6%	8%	
Calcium-rich foods	<1 a day	27%	27%	29%	.28
	1 to 2.5 a day	43%	45%	34%	
	>2.5 to <5 a day	24%	23%	30%	
	≥5 a day	6%	6%	8%	

Participants identifying as non-binary (*n*=6) were excluded from the total sample. *Mann Whitney *U* Tests. †One woman participant missing.

Appendix 1

Background questionnaire and DOHaD knowledge questionnaire, PREPARED

Spørreskjema

Er du...

Mann
Kvinne
Annet

Beskriv hvis du ønsker

Dette elementet vises kun dersom alternativet «Annet» er valgt i spørsmålet «Er du...»

Hvilken sivilstand beskriver din situasjon nå?

Singel
I et forhold (ikke samboer/gift)
Samboer
Gift
Skilt/separert
Enke/enkemann
Annet

Beskriv hvis du ønsker

Dette elementet vises kun dersom alternativet «Annet» er valgt i spørsmålet «Hvilken sivilstand beskriver din situasjon nå?»

Hvor mange personer bor det i husstanden din?

Regn med deg selv.

Hvor mange barn under 18 år bor i husstanden din?

Hvilket fylke bor du i?

Viken
Innlandet
Vestfold og Telemark
Agder
Vestland
Trøndelag
Troms og Finnmark
Rogaland
Møre og Romsdal

Nordland
Oslo
Svalbard
Annet, ikke i Norge

Beskriv hvis du ønsker
Dette elementet vises kun dersom alternativet «Annet, ikke i Norge» er valgt i spørsmålet «Hvilket fylke bor du i?»

Omtrent hvor mange innbyggere bor det der du bor?
F.eks.:
0-4999: Kirkebygda, Beitostølen
5000-14999: Askim, Førde
15000-49999: Bodø, Hamar
Over 50000: Oslo, Trondheim, Kristiansand

0-4999
5000-14999
15000-49999
Over 50000

Har du et annet morsmål enn norsk?
Ja
Nei

Hvilket morsmål, beskriv
Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «Har du et annet morsmål enn norsk?»

Har dine foreldre et annet morsmål enn norsk?
Ja, en
Ja, begge
Nei
Vet ikke

Hvilket morsmål, beskriv
Dette elementet vises kun dersom alternativet «Ja, en eller Ja, begge» er valgt i spørsmålet «Har dine foreldre et annet morsmål enn norsk?»

Hvilken utdannelse har du?
Velg høyeste fullførte utdanning.

Mindre enn 9/10 års grunnskole
Grunnskole
Videregående skole
Videregående yrkesfag
Universitet/høyskole inntil 4 år
Universitet/høyskole mer enn 4 år
Annen utdanning

Beskriv om du ønsker
Dette elementet vises kun dersom alternativet «Annen utdanning» er valgt i spørsmålet «Hvilken utdannelse har du?»

Hva er din hovedaktivitet?
- Arbeid heltid
- Arbeid deltid
- Hjemmeværende
- Sykemeldt
- Permisjon
- Permittert
- Ufør
- Under attføring/rehabilitering
- Student/skoleelev
- Arbeidsledig
- Annet

Beskriv
Dette elementet vises kun dersom alternativet «Annet» er valgt i spørsmålet «Hva er din hovedaktivitet?»

Hvor høy er du?
Svar i antall cm.

Omtrent hvor mye veier du nå?
Svar i antall kg.

Omtrent hvor mye veide du da du ble født?
- Mindre enn 1500 g
- 1500 til 2500 g
- 2500 til 3000 g
- 3000 til 3500 g
- 3500 til 4000 g
- 4000 til 4500 g
- Mer enn 4500 g
- Vet ikke

Ble du ammet som barn?
Svar ja uansett lengde på ammeperioden.
- Ja
- Nei
- Vet ikke

Ønsker du å få barn?
- Ja, nå eller i fremtiden

Nei
Vet ikke

Hvis relevant, hvor lenge har du forsøkt å få barn?
Dette elementet vises kun dersom alternativet «Ja, nå eller i fremtiden» er valgt i spørsmålet «Ønsker du å få barn?»

Har ikke forsøkt
Under 3 måneder
3-6 måneder
6-12 måneder
Mer enn 12 måneder
Usikker

Hvor mange timer sover du vanligvis per døgn i ukedagene?
Tenk på de siste fire ukene.

Hvor mange timer sover du vanligvis per døgn i helgen?
Tenk på de siste fire ukene.

Snuser eller røyker du?

Tenk på det siste året.

Snus

Aldri
Sjeldent
Av og til
Daglig

Sigarett

Aldri
Sjeldent
Av og til
Daglig

E-sigarett

Aldri
Sjeldent
Av og til
Daglig

Annet

Aldri

Sjeldent
Av og til
Daglig

Tobakksbruk, annet
Tenk på det siste året, beskriv hvis du ønsker.

Omtrent hvor mange timer sitter du vanligvis i løpet av et døgn?
Tenk på jobb, transport, TV, lesing, PC eller lignende over de siste fire ukene.

På fritiden: Omtrent hvor mange timer per døgn bruker du til sammen ved en TV, PC/nettbrett eller smarttelefon?
Tenk utenom ev. jobb/skole/studier over de siste fire ukene. Velg antall timer ved å bruke skalaen og legg inn verdi.

Hvor ofte driver du mosjon?
Med mosjon mener vi at du f.eks. går tur, går på ski, sykler, svømmer eller driver trening/idrett. Ta et gjennomsnitt for de siste fire ukene.
Aldri
Sjeldnere enn en gang i uken
En gang i uka
2-3 ganger i uka
Omtrent hver dag

Dersom du driver mosjon så ofte som en eller flere gang er i uka: Hvor hardt mosjonerer du?
Dette elementet vises kun dersom alternativet «En gang i uka eller 2-3 ganger i uka eller Omtrent hver dag» er valgt i spørsmålet «Hvor ofte driver du mosjon?»
Ta et gjennomsnitt for de siste fire ukene.
Tar det rolig uten å bli andpusten eller svett
Tar det så hardt at jeg blir andpusten og svett
Tar meg nesten helt ut

Hvor lenge holder du på hver gang?
Dette elementet vises kun dersom alternativet «Tar det rolig uten å bli andpusten eller svett eller Tar det så hardt at jeg blir andpusten og svett eller Tar meg nesten helt ut» er valgt i spørsmålet «Dersom du driver mosjon så ofte som en eller flere gang er i uka: Hvor hardt mosjonerer du?»
Ta et gjennomsnitt for de siste fire ukene.
Mindre enn 15 minutter
15-29 minutter
30-60 minutter
Mer enn 60 minutter

Eier du egen bolig?

Ja
Nei

Er økonomien slik at du vil klare en uventet utgift på ca. 5000 kr?
F.eks. til tannlege eller reparasjon.
Ja
Nei
Vet ikke

Har det i løpet av det siste halve året hendt at du har hatt vansker med å klare løpende utgifter til mat, transport, husleie og lignende?
Nei, aldri
Ja, en sjelden gang
Ja, av og til
Ja, ofte

Kryss av om du er enig eller uenig i følgende påstander:

På de fleste måter er livet mitt nær idealet mitt
Helt uenig
Uenig
Litt uenig
Verken eller
Litt enig
Enig
Helt enig

Livsbetingelsene mine er svært gode
Helt uenig
Uenig
Litt uenig
Verken eller
Litt enig
Enig
Helt enig

Jeg er fornøyd med livet mitt
Helt uenig
Uenig
Litt uenig
Verken eller
Litt enig

Enig
Helt enig

Så langt har jeg oppnådd det som er viktig for meg i livet

Helt uenig
Uenig
Litt uenig
Verken eller
Litt enig
Enig
Helt enig

Hadde jeg kunnet leve livet på nytt, ville jeg nesten ikke forandret noe

Helt uenig
Uenig
Litt uenig
Verken eller
Litt enig
Enig
Helt enig

Stort sett, vil du si at helsen din er:

Utmerket
Veldig god
God
Nokså god
Dårlig

De neste spørsmålene handler om aktiviteter som du kanskje utfører i løpet av en vanlig dag. Er helsen din slik at den begrenser deg i utførelsen av disse aktivitetene nå?

Hvis ja, hvor mye?

Moderate aktiviteter som å flytte et bord, støvsuge, gå en spasertur eller drive med hagearbeid

Ja, begrenser meg mye
Ja, begrenser meg litt
Nei, begrenser meg ikke i det hele tatt

Gå opp trappen flere etasjer

Ja, begrenser meg mye
Ja, begrenser meg litt

Nei, begrenser meg ikke i det hele tatt

I løpet av de fire siste ukene, har du hatt noen av de følgende problemene i arbeidslivet ditt eller i andre daglige aktiviteter på grunn av din fysiske helse?

Fått gjort mindre enn du ønsket

Ja
Nei

Vært begrenset i type arbeidsoppgaver eller andre aktiviteter

Ja
Nei

I løpet av de siste fire ukene, har du vært engstelig eller deprimert i arbeidet ditt eller i andre daglige aktiviteter på grunn av følelsesmessige årsaker?

Fått gjort mindre enn du ønsket

Ja
Nei

Utført arbeid eller andre aktiviteter mindre grundig enn vanlig

Ja
Nei

I løpet av de siste fire ukene, hvor mye har smerter påvirket det vanlige arbeidet ditt?

Gjelder både arbeid utenfor hjemmet og husarbeid.

Ikke i det hele tatt
Litt
Moderat
Ganske mye
Ekstremt mye

De neste spørsmålene handler om hvordan du føler deg og hvordan du har hatt det i løpet av de siste fire ukene.

For hvert spørsmål, ber vi deg velge det svaret som best beskriver hvordan du har følt deg. Hvor ofte i løpet av de siste fire ukene:

Har du følt deg rolig og avslappet?

Hele tiden
Mesteparten av tiden

En god del av tiden
Noe av tiden
Litt av tiden
Aldri

Har du hatt mye overskudd?

Hele tiden
Mesteparten av tiden
En god del av tiden
Noe av tiden
Litt av tiden
Aldri

Har du følt deg nedfor og deprimert?

Hele tiden
Mesteparten av tiden
En god del av tiden
Noe av tiden
Litt av tiden
Aldri

I løpet av de siste fire ukene, hvor mye av tiden har den fysiske helsen din eller følelsesmessige problemer påvirket dine sosiale aktiviteter? Som å besøke venner, slekninger osv.

Hele tiden
Mesteparten av tiden
En del av tiden
Litt av tiden
Aldri

Ta stilling til påstandene under. Velg det alternativet som passer din oppfatning.

Det en kvinne spiser UNDER svangerskapet påvirker BARNETS risiko for fedme i voksen alder

Svært uenig
Uenig
Verken eller
Enig
Svært enig

Det en kvinne spiser UNDER svangerskapet påvirker BARNEBARNS risiko for å utvikle fedme

Svært uenig
Uenig

Verken eller
Enig
Svært enig

Både mor og fars kosthold FØR svangerskapet påvirker BARNETS vekst og helse

Svært uenig
Uenig
Verken eller
Enig
Svært enig

Det en kvinne spiser FØR svangerskapet påvirker BARNETS risiko for fedme i voksen alder

Svært uenig
Uenig
Verken eller
Enig
Svært enig

Det en kvinne spiser i ammeperioden påvirker BARNETS risiko for fedme i voksen alder

Svært uenig
Uenig
Verken eller
Enig
Svært enig

Spørsmål om kostholdet ditt

Spørsmålene gjelder utvalgte mat- og drikkevarer den siste måneden, det vil si **de siste 30 dagene**. Angi hvor ofte du har spist og drukket de nevnte mat- og drikkevarene til måltider, mellommåltider eller som snacks når du har vært hjemme, på farten, på kafé, eller hvor som helst.

Hvor ofte spiste/drakk du følgende siste måned?

Tenk på den siste måneden.

Frokostblandinger og grøt, søte og halvsøte (f.eks. Special K, Honnikorn)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke

2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Frokostblandinger og grøt, usøtede (f.eks. 4-Korn, havregryn/havregrøt, Go'dag og Weetabix)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Grovt brød/knekkebrød/rundstykke (>50% grovt)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Fiskepålegg (f.eks. makrell i tomat)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Hvitost (alle typer)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Brunost/prim

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Yoghurt, skyr o.l. (alle typer)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Kumelk (alle typer)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag

1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Plantebasert melk (alle typer)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Juice/smoothie (ikke nektar)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Frukt og bær, inkl. ferske, frosne og hermetiske (ikke juice eller smoothie)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned

1 gang per måned
Aldri

Usaltede nøtter og frø

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Grønnsaker, inkl. salat, kål, gulrot, grønne bønner osv. (ikke potet og søtpotet)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Bønner, linser, kikerter, erter (ikke grønne bønner)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Friterte poteter/søtpoteter (f.eks. pommes frites, røstipoteter)

6+ ganger per dag

4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Andre poteter/søtpoteter (f.eks. bakt, kokt, most)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Fullkorn-middagsprodukter (f.eks. byggris, fullkornspasta, couscous)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Pizza (alle typer)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke

1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Tomatsaus, inkl. saus/salsa til taco, ketchup, til pasta o.l. (ikke pizza)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Plantebaserte ferdigprodukter (alle typer kjøtterstatning)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Rødt kjøtt, oppmalt eller stykker (storfe, lam/sau, svin, kje/geit)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Bearbeidet kjøtt (f.eks. bacon, pålegg, pølser)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Fet fisk og fiskeprodukter (f.eks. laks, makrell)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Mager fisk og fiskeprodukter (f.eks. torsk, sei)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Salt snacks (f.eks. popcorn, chips, salte nøtter)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag

- 5-6 ganger per uke
- 2-4 ganger per uke
- 1 gang per uke
- 2-3 ganger per måned
- 1 gang per måned
- Aldri

Godteri, inkl. sjokolade

- 6+ ganger per dag
- 4-5 ganger per dag
- 2-3 ganger per dag
- 1 gang per dag
- 5-6 ganger per uke
- 2-4 ganger per uke
- 1 gang per uke
- 2-3 ganger per måned
- 1 gang per måned
- Aldri

Vafler, boller, kake, kjeks o.l.

- 6+ ganger per dag
- 4-5 ganger per dag
- 2-3 ganger per dag
- 1 gang per dag
- 5-6 ganger per uke
- 2-4 ganger per uke
- 1 gang per uke
- 2-3 ganger per måned
- 1 gang per måned
- Aldri

Iskrem, panna cotta, pudding, mousse o.l.

- 6+ ganger per dag
- 4-5 ganger per dag
- 2-3 ganger per dag
- 1 gang per dag
- 5-6 ganger per uke
- 2-4 ganger per uke
- 1 gang per uke
- 2-3 ganger per måned
- 1 gang per måned
- Aldri

Brus, saft og nektar med sukker

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Energidrikker med sukker (f.eks. Gatorade, Red Bull)

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Kaffe/te/iskaffe/iste med sukker/sirup/honning

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Alkoholholdig drikke

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag

5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Vann

6+ ganger per dag
4-5 ganger per dag
2-3 ganger per dag
1 gang per dag
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
2-3 ganger per måned
1 gang per måned
Aldri

Har du tatt kosttilskudd som vitaminer, proteintilskudd o.l.?

Tenk på den siste måneden.

Nei
Ja

Hva og hvor ofte?

Dette elementet vises kun dersom alternativet «Ja» er valgt i spørsmålet «Har du tatt kosttilskudd som vitaminer, proteintilskudd o.l.?»

Tenk på den siste måneden.

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

Tenk på den siste måneden.

Frokost

7 ganger i uken
6 ganger i uken
5 ganger i uken
4 ganger i uken
3 ganger i uken
2 ganger i uken
1 ganger i uken
Sjelden/aldri

Formiddagsmat/lunsj

7 ganger i uken
6 ganger i uken
5 ganger i uken
4 ganger i uken
3 ganger i uken
2 ganger i uken
1 ganger i uken
Sjelden/aldri

Middag

7 ganger i uken
6 ganger i uken
5 ganger i uken
4 ganger i uken
3 ganger i uken
2 ganger i uken
1 ganger i uken
Sjelden/aldri

Kveldsmat

7 ganger i uken
6 ganger i uken
5 ganger i uken
4 ganger i uken
3 ganger i uken
2 ganger i uken
1 ganger i uken
Sjelden/aldri

Hvor ofte spiser du mellommåltid/snacks?
Tenk på den siste måneden.

6+ ganger daglig
4-5 ganger daglig
2-3 ganger daglig
1 gang daglig
5-6 ganger per uke
2-4 ganger per uke
1 gang per uke
Sjelden/aldri

Jeg unngår enkelte mat- og drikkevarer på grunn av...

Tenk på den siste måneden.

...allergi(er) eller intoleranse(r)

Nei, aldri
Av og til
Ja, alltid

...helsen min

Nei, aldri
Av og til
Ja, alltid

...religionen min

Nei, aldri
Av og til
Ja, alltid

...vekten min

Nei, aldri
Av og til
Ja, alltid

...klimahensyn

Nei, aldri
Av og til
Ja, alltid

...dyrevelferd

Nei, aldri
Av og til
Ja, alltid

...veganisme

Nei, aldri
Av og til
Ja, alltid

...økonomi

Nei, aldri

Av og til
Ja, alltid

...andre grunner enn de som er nevnt (beskriv under)

Nei, aldri
Av og til
Ja, alltid

Andre grunner til at du unngår mat- og drikkevarer (hvis aktuelt):

Tenk på den siste måneden.

Beskriv mat- og drikkevarene du unngår (hvis aktuelt):

Tenk på den siste måneden.

Kommentarer relatert til mitt kosthold (hvis aktuelt):

Tenk på den siste måneden.

Er den siste måneden typisk for hva du pleier å spise til vanlig?

Ja
Nei

Hvorfor ikke?

Dette elementet vises kun dersom alternativet «Nei» er valgt i spørsmålet «Er den siste måneden typisk for hva du pleier å spise til vanlig?»

Referanse-ID

Generert: 2021-09-14 08:47:22.

Appendix 2

StudentKost2 food frequency questionnaire

Hei!
Takk for at du vil være med på denne undersøkelsen! Din deltagelse er viktig for oss, og det er veldig fint hvis du kan fylle ut dette spørreskjemaet så nøyaktig du klarer.

Spørreskjemaet handler om hva du spiser og drikker.
Vi ønsker at du tenker tilbake på de **4 siste ukene**, og vi vil spørre om hva du har spist og drukket i denne perioden og om dine måltidsvaner.
På slutten av spørreskjemaet kommer det noen spørsmål om aktivitet, skjermbruk, søvn og andre vaner.

Takk for at du vil delta!

VI VIL GJERNE VITE NOE OM DEG

1. Hva er alderen din?
(år)

_____

2. Er du?

(1) ❍ Kvinne

(2) ❍ Mann

3. Hvilket av UiAs fakulteter studerer du ved?

(1) ❍ Fakultet for helse- og idrettsvitenskap

(2) ❍ Fakultet for humaniora og pedagogikk

(3) ❍ Fakultet for kunstfag

(4) ❍ Fakultet for samfunnsvitenskap

(5) ❍ Fakultet for teknologi og realfag

(6) ❍ Handelhøyskolen ved UiA

(7) ❍ Lærerutdanningen ved UiA

(8) ❍ Ingen av de nevnte, studerer ved en annen institusjon enn UiA

(9) ❍ Er ikke student

3b. Hvor lenge har du studert ved UiA?

(1) ❍ Dette er mitt første semester ved UiA

(2) ❍ Jeg har studert minst 1 semester ved UiA tidligere (uavhengig av studiepoeng

4. Hvilket fylke regner du som ditt hjemfylke? (Hvor du opprinnelig kommer fra)

(1) ❍ Viken (Østfold, Akershus og Buskerud)

(2) ❍ Innlandet (Hedmark og Oppland)

(3) ❍ Vestfold og Telemark

(4) ❍ Agder (Aust-Agder og Vest-Agder)

(5) ❍ Vestland (Hordaland og Sogn og Fjordane)

(6) ❍ Trøndelag

(7) ❍ Troms og Finnmark

(8) ❍ Rogaland

(9) ❍ Møre og Romsdal

(10) ❍ Nordland

(11) ❍ Oslo

(12) ❍ Annet, ikke i Norge

5. Hvor høy er du?
(i cm)

_____

6. Hvor mye veier du? (Frivillig å svare)
(i kg)

_____

7. Har du vært stabil i vekt siste år? (Frivillig å svare)

(1) ❍ Ja

(2) ❍ Nei, jeg har økt i vekt

(3) ❍ Nei, jeg har gått ned i vekt

(4) ❍ Vet ikke

8. Hva tenker du om din nåværende vekt? (Frivillig å svare)

(1) ❍ Jeg er fornøyd

(2) ❍ Jeg ønsker å gå opp i vekt

(3) ❍ Jeg ønsker å gå ned i vekt

9. Har du noen former for matvareallergier eller matintoleranser?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Vet ikke

9b. Spesifiser hvilke(n)

(1) ❍ Melkeprotein

(2) ❍ Laktose

(3) ❍ Gluten

(4) ❍ Egg

(5) ❍ Nøtter

(6) ❍ Fisk eller skalldyr

(7) ❍ Annet ______

**10. Er det noe du unngår å spise?
Hvis ja; hva og hvorfor?**

(1) ❍ Ja ______

(2) ❍ Nei

**11. Har du i løpet av de siste 4 ukene fulgt en diett?
Hvis ja; hvilken?**

(1) ❍ Ja ______

(2) ❍ Nei

12. Er den siste måneden typisk for hva du pleier å spise til vanlig?
Hvis nei, hvorfor ikke?

(1) ❍ Ja

(2) ❍ Nei _____

VI VIL GJERNE VITE HVOR AKTIV DU HAR VÆRT DE SISTE 4 UKENE

13. Hvor ofte er du fysisk aktiv i minst 30 minutter totalt i løpet av dagen?
Med fysisk aktivitet menes all aktivitet hvor hjertet ditt slår fortere enn vanlig og hvor du blir andpusten innimellom, f.eks. rask gange.

(1) ❍ Aldri

(2) ❍ Mindre enn 1 gang per uke

(3) ❍ 1 gang per uke

(4) ❍ 2 ganger per uke

(5) ❍ 3 ganger per uke

(6) ❍ 4 ganger per uke

(7) ❍ 5 ganger per uke

(8) ❍ 6 ganger per uke

(9) ❍ Hver dag

14. Hvor mange timer fysisk trening utøver du per uke?
Systematisk trening for å utvikle, forbedre eller opprettholde ferdigheter, evner og/eller egenskaper.

(1) ❍ Aldri

(2) ❍ 1-2 timer per uke

(3) ❍ 3-4 timer per uke

(4) ❍ 5-6 timer per uke

(5) ❍ 7-8 timer per uke

(6) ❍ 8 timer eller mer per uke

VI VIL GJERNE VITE NOE OM DIN SKJERMBRUK DE SISTE 4 UKENE

15. Hvor mange timer om dagen pleier du å se på TV/film/serie/spille på fritiden din (på TV, PC, nettbrett, mobil etc.)?
Huk av ett kryss for ukedager og ett kryss for helg

	Ikke i det hele tatt	1 time	2 timer	3 timer	4 timer	5 timer	6 timer	7 timer	8 timer eller mer
Ukedager	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
Helg	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍

16. Hvor mange timer om dagen pleier du å bruke PC/nettbrett/mobil etc. til chatting, surfing på internett, e-post o.l. på fritiden din?
Huk av ett kryss for ukedager og ett kryss for helg

	Ikke i det hele tatt	1 time	2 timer	3 timer	4 timer	5 timer	6 timer	7 timer	8 timer eller mer
Ukedager	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍
Helg	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍	(8) ❍	(9) ❍

VI VIL GJERNE VITE NOE OM HVOR MYE SØVN DU HAR FÅTT DE SISTE 4 UKENE

17. Hvor mange timer sover du hver natt på ukedager?

(1) ❍ Mindre enn 5 timer

(2) ❍ 5 timer

(3) ❍ 6 timer

(4) ❍ 7 timer

(5) ❍ 8 timer

(6) ❍ 9 timer

(7) ❍ 10 timer eller mer

18. Hvor mange timer sover du hver natt i helgen?

(1) ❍ Mindre enn 5 timer

(2) ❍ 5 timer

(3) ❍ 6 timer

(4) ❍ 7 timer

(5) ❍ 8 timer

(6) ❍ 9 timer

(7) ❍ 10 timer eller mer

19. Tobakksbruk

	Aldri	Sjeldent	Av og til	Daglig
Sigarett	(1) ❍	(2) ❍	(3) ❍	(4) ❍
El-sigarett	(1) ❍	(2) ❍	(3) ❍	(4) ❍
Snus	(1) ❍	(2) ❍	(3) ❍	(4) ❍
Annet	(1) ❍	(2) ❍	(3) ❍	(4) ❍

20. Hvilken utdannelse har dine foreldre/foresatte?

	Grunnskole	Videregående skole	Fagskole nivå	Universitets- og høgskole nivå, kort (mindre enn fire år)	Universitets- og høgskole nivå, lang (mer enn fire år)	Annen utdanning	Vet ikke/ikke relevant
A. Velg høyeste fullførte utdanning til foresatt 1	(2) ❍	(3) ❍	(8) ❍	(5) ❍	(9) ❍	(7) ❍	(10) ❍
B. Velg høyeste fullførte utdanning til foresatt 2	(2) ❍	(3) ❍	(8) ❍	(5) ❍	(9) ❍	(7) ❍	(10) ❍

VI VIL GJERNE VITE HVA DU HAR SPIST OG DRUKKET DE SISTE 4 UKENE

DRIKKEVARER

1. Hvor ofte har du drukket følgende?

	Aldri	1-3 glass per måned	1-3 glass per uke	4-6 glass per uke	1 glass per dag	2-3 glass per dag	Mer enn 3 glass per dag
Helmelk (søt/sur, f.eks. Kefir)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Lettmelk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Ekstra lettmelk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Skummet melk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Soyamelk, rismelk eller annen type melk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Cultura, Biola	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Sjokolademelk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

2. Hvor ofte har du drukket følgende?

	Aldri	1-3 glass per måned	1-3 glass per uke	4-6 glass per uke	1 glass per dag	2-3 glass per dag	Mer enn 3 glass per dag
Vann fra springen, flaskevann eller mineralvann	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Saft, med sukker (f.eks. solbærsaft, husholdningssaft)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Saft, sukkerfri (f.eks. FUN light, ZERoh!)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Appelsinjuice	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Eplejuice	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Annen juice og nektar (f.eks. tropisk juice, frokostjuice)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

3. Hvor ofte har du drukket følgende?

	Aldri	1-3 stykk per måned	1-3 stykk per uke	4-6 stykk per uke	1 stykk per dag	2-3 stykk per dag	Mer enn 3 stykk per dag
Brus med sukker (f.eks. Coca Cola, Fanta, Solo, Sprite)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Brus uten tilsatt sukker (f.eks. Pepsi Max, Sprite Zero, Coca Cola light)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Sportsdrikk (f.eks. Powerade, Gatorade)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Energidrikk (f.eks. Red Bull, Battery, Burn)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

4. Hvor ofte har du drukket følgende?

	Aldri	1-3 kopper per måned	1-3 kopper per uke	4-6 kopper per uke	1 kopp per dag	2-3 kopper per dag	Mer enn 3 kopper per dag
Kaffe, svart	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Cafe latte, cappuccino eller annen kaffe med litt melk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Frappuccino, moccachino, iskaffe eller lignende	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Te	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

5. Hvor mange teskjeer med sukker tilsetter du kaffe og/eller te?

(1) ❍ Ingen

(2) ❍ 1-3 teskjeer per måned

(3) ❍ 1 teskje per uke

(4) ❍ 2-3 teskjeer per uke

(5) ❍ 4-6 teskjeer per uke

(6) ❍ 1 teskje eller flere per dag

6. Hvor mange teskjeer med kunstig søtning (f.eks. suketter) tilsetter du kaffe og/eller te?

(1) ❍ Ingen

(2) ❍ 1-3 teskjeer per måned

(3) ❍ 1 teskje per uke

(4) ❍ 2-3 teskjeer per uke

(5) ❍ 4-6 teskjeer per uke

(6) ❍ 1 teskje eller flere per dag

Hvor ofte har du drukket følgende?

7. Alkohol og alkoholfritt

	Drikker ikke	1-3 stykk per måned	1-3 stykk per uke	4-6 stykk per uke	1 stykk per dag	2-3 stykk per dag	Mer enn 3 stykk per dag
Alkoholfritt, øl, vørterøl, lettøl (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Øl (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Cider (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Rusbrus	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Vin (1 glass)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Brennevin, likør (1 dram)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

8. Alkohol og alkoholfritt

	Drikker ikke	1-3 stykk per måned	1-2 stykk per helg	3-4 stykk per helg	5-6 stykk per helg	Mer enn 6 stykk per helg
Alkoholfritt, øl, vørterøl, lettøl (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Øl (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Cider (0,5 liter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Rusbrus	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Vin (1 glass)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Brennevin, likør (1 dram)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

YOGHURT

1.Hvor ofte har du spist følgende?

	Aldri	1-3 beger per måned	1 beger per uke	2-3 beger per uke	4-6 beger per uke	1 beger per dag	Flere enn 1 beger per dag
Yoghurt Naturell	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Fruktyoghurt/drikke	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

yoghurt, vanlig type							
Fruktyoghurt/drikke yoghurt, sukkerfri/redusert sukkerinnhold (F.eks Skyr, Go'Morgen Zero)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Biola, Activia, Actimel	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

BRØD OG KORNPRODUKTER

1. Hvor ofte har du spist følgende?

	Aldri	1-3 boller per måned	1 bolle per uke	2-3 boller per uke	4-6 boller per uke	1 bolle per dag	Flere enn 1 bolle per dag
Cornflakes, Havrefras, Special-K, Havreloops o.l	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Havregryn/havregrøt (F.eks. AXA Bjørns havregryn, lettkokte havregryn)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Müsli (F.eks. Go'dag)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

2. Hvor ofte har du spist følgende?

	Aldri	1 skive per uke	2-4 skiver per uke	5-7 skiver per uke	2-3 skiver per dag	Mer enn 3 skiver per dag
Loffbrød, fint (F.eks. baguette, pitabrød, spiralloff, fine rundstykker)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Kneipbrød, halvgrovt (F.eks. rundstykker, baguette)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Grovbrød, grovt/ekstra grovt (F.eks. fiberbrød, grove rundstykker)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

3. Hvor ofte har du spist følgende?

	Aldri	1-7 stykk per måned	2-4 stykk per uke	5-7 stykk per uke	2-3 stykk per dag	Mer enn 3 stykk per dag
Knekkebrød, fin type	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Knekkebrød, grov type	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

4. Hvor ofte benytter du følgende?

	Aldri	1-3 brødskiver per uke	4-6 brødskiver per uke	1-3 brødskiver per dag	4-6 brødskiver per dag	Mer enn 6 brødskiver per dag
Smør eller tilsvarende på brødskiven/knekkebrød? (F.eks. Tine Smør, Bremykt)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Margarin eller tilsvarende på brødskiven/knekkebrød? (F.eks. Vita, Soft Flora, Brelett)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

PÅLEGG

1. På hvor mange brødskiver/knekkebrød har du spist følgende pålegg?

	Aldri	1 brødskive per uke	2-3 brødskiver per uke	4-6 brødskiver per uke	1 brødskive per dag	2-3 brødskiver per dag	Mer enn 3 brødskiver per dag
Gulost (F.eks. Norvegia, Synnøve Finden Gulost, Gräddeost)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Brunost og prim (F.eks. Gudbrandsdalsost, Synnøve Finden Brunost, Tine prim)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Smøreost (F.eks. Skinkeost, Philadephia, ost på tube, Tine kremost, Snøfrisk)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Leverpostei (F.eks. Ovnsbakt leverpostei, baconpostei, kyllingleverpostei)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

2. På hvor mange brødskiver/knekkebrød har du spist følgende pålegg?

	Aldri	1 brødskive per uke	2-3 brødskiver per uke	4-6 brødskiver per uke	1 brødskive per dag	2-3 brødskiver per dag	Mer enn 3 brødskiver per dag
Skinke, roastbeef, hamburgerrygg o.l.	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Salami, servelat, spekesinke o.l.	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Kylling- eller kalkunpålegg	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

3. På hvor mange brødskiver/knekkebrød har du spist følgende pålegg?

	Aldri	1 brødskive per uke	2-3 brødskiver per uke	4-6 brødskiver per uke	1 brødskive per dag	2-3 brødskiver per dag	Mer enn 3 brødskiver per

							dag
Egg (F.eks. kokt, stekt, speilegg, eggerøre)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Majonessalat (F.eks. Italiensk salat, rekesalat o.l.)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Kaviar (F.eks. Mills kaviar, Stabbur-kaviar)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Fiskepålegg (F.eks. Makrell i tomat, tunfisk, sild, røykelaks)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

4. På hvor mange brødskiver/knekkebrød har du spist følgende pålegg?

	Aldri	1 brødskive per uke	2-3 brødskiver per uke	4-6 brødskiver per uke	1 brødskive per dag	2-3 brødskiver per dag	Mer enn 3 brødskiver per dag
Sjokoladepålegg eller nøttepålegg, vanlig type (F.eks. Nugatti, Nutella)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Sjokoladepålegg eller nøttepålegg, sukkerredusert type (F.eks. Nugatti Max)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

Syltetøy, vanlig type	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Syltetøy, sukkerredusert type	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Honning	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍
Peanøttsmør	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍	(7) ❍

HOVEDRETTER - MIDDAG

1. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Kjøttkaker/karbonader	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pølser av svin og/eller storfe (F.eks. Wienerpølse, grillpølse, ostepølse)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Svinekjøtt (F.eks. stek, filet, kotelett)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Oksekjøtt, lammekjøtt (F.eks. biff, stek, lår,	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

kotelett)					
Taco (tacoskjell eller wraps med kjøttdeig)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

2. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Hamburger	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pizza	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Gryterett (F.eks. risotto, lapskaus, gryterett med kjøtt)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pastaretter med kjøtt (F.eks. lasagne, spagetti med kjøttsaus)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

3. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Kylling eller kalkun (F.eks. grillet, filét, lår)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Bearbeidede kyllingprodukter (F.eks. Nuggets, klubber, vinger, burger, pølser)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Egg (F.eks. stekt, speilegg, omelett)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pai med kjøtt eller grønnsaker	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

4. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Fet fisk, kokt eller stekt (F.eks. laks, ørret, makrell)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Mager fisk, kokt eller stekt (F.eks. torsk, sei)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Skalldyr (F.eks. reker, svampi, hummer, krabbe)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Fiskeprodukter (F.eks. fiskeboller, -kaker, -pudding, -pinner)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

5. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Retter med bønner, linser eller erter (F.eks. Falafel, hummus, linsesuppe, bønnegryte)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Suppe (F.eks. tomatsuppe, grønnsakssuppe)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pannekaker	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Risengrynsgrøt	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

TILBEHØR TIL MIDDAG

1. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Poteter (kokt eller most)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pommes frites	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Potetsalat eller gratinerte poteter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Stekte eller ovnsbakte poteter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

2. Hvor ofte har du spist følgende?
Ris, pasta/spagetti og nudler

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Ris	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pasta/spagetti	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Nudler	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

3. Hvor ofte har du spist følgende?
Ris, pasta/spagetti og nudler

	Aldri	1-3 ganger per måned	1 gang per uke	2-4 ganger per uke	Mer enn 4 ganger per uke
Ris	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Pasta/spagetti	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Nudler	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

4. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Saus (F.eks. brun saus, hvit saus, bernaisesaus)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Rømme eller creme fraiche, vanlig type	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Rømme eller creme fraiche, magert alternativ	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Cottage Cheese (F.eks. på brødskive, som tilbehør eller mellommåltid)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

5. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Pesto	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Dressing	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Ketchup	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Sennep	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Majones eller remulade	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

6. Hvor mange teskjeer med sukker tilsetter du middagsmåltid? F.eks. på risengrynsgrøt, pannekaker ol.

(1) ❍ Ingen

(2) ❍ 1-3 teskjeer per måned

(3) ❍ 1 teskje per uke

(4) ❍ 2-3 teskjeer per uke

(5) ❍ 4-6 teskjeer per uke

(6) ❍ 1 teskje eller flere per dag

7. Hvor ofte salter du middagsmåltid når du spiser?

(1) ❍ Aldri

(2) ❍ 1-3 ganger per måned

(3) ❍ 1 gang per uke

(4) ❍ 2-3 ganger per uke

(5) ❍ 4-6 ganger per uke

(6) ❍ 1 eller flere ganger per dag

Godt jobba, du er nå halvveis...
Keep up the good work!

FRUKT OG GRØNNSAKER

1. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Epler (1 eple)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Pærer (1 pære)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Banan (1 banan)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Appelsin, mandarin, klementin, grapefrukt (1/2 - 1 frukt)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Nektarin, fersken eller plomme (1 frukt)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Melon (1 skive)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

2. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Kiwi (1 kiwi)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Ananas, fersk (1 skive)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Bær, friske eller frosne (1 neve)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Druer (1 neve)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Rosiner (1/2 neve)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Tørket frukt (1/2 neve) (F.eks. aprikos, svisker, dadler)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

3. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Brokkoli (2 buketter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Blomkål (2 buketter)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Løk, hvitløk eller purre (1 spiseskje)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Avokado (1/2 avokado)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

4. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Mais (1/2 kolbe = 2 spiseskjeer)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Sopp (1 spiseskje)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Erter (1 spiseskje)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Blandet salat (1 porsjon) (F.eks. isberg/hjertesalat med tomat og agurk)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

5. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Spinat (2 spiseskjeer)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Grønn, gul, oransje eller rød paprika (1 ring)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Gulrøtter (1 gulrot)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Agurk (ca 4-5 cm)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Tomat (1 tomat)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

6. Andre grønnsaker
Om ja, hvilke(n)?

(1) ❍ Ja ______

(2) ❍ Nei

DESSERT OG KAKER

1. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Fløteis (1 kule eller pinne) (F.eks. vanilje, sjokolade, krokan, jordbær)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Saftis (1 pinne)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Pudding, fromasj, gele (1 porsjon) (F.eks. Sjokoladepudding, sitronfromasj)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Rislunsj og riskrem (1 porsjon) (F.eks. rislunsj, pianodessert)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Hermetisk frukt (1 porsjon) (F.eks. hermetiske aprikoser, pærer, ananas)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

2. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Pai (1 stykke) (F.eks. eplepai, blåbærpai, sjokoladepai)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Fløte, krem (1/2 kopp) (F.eks. som tilbehør til jordbær, kake, varm sjokolade)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Vaniljesaus (1/2 kopp) (F.eks. som tilbehør til sjokoladepudding, varme bær)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Bakst (1 enhet) (F.eks. bolle, wienerbrød, skolebrød)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Kake (1 stykke) (F.eks. bløtkake, brownie, sjokoladekake)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Småkaker (1 kjeks) (F.eks. cookies, safarikjeks)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

SNACKS

1. Hvor ofte har du spist følgende?

	Aldri	1-3 ganger per måned	1 gang per uke	2-3 ganger per uke	4-6 ganger per uke	1 eller flere ganger per dag
Chips, potetgull, tortillachips (1 liten pose)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Popcorn (1/2 pose)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Nøtter (1 neve)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Blandet godteri, smågodt (1 neve) (F.eks. vingummi, lakris, karamell)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Lys sjokolade, 6 ruter (1/4 plate) (F.eks. melkesjokolade, firkløver)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Mørk sjokolade, 6 ruter (1/4 plate) (F.eks. kokesjokolade, Freya Premium)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Sjokoladebar (1 stykk) (F.eks. Mars, Snickers, Japp, Lion)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

MÅLTIDSVANER

1. Hvor mange ganger i uken spiser du frokost, lunsj, middag og kveldsmat?

	Aldri eller nesten aldri	1-2 ganger per uke	3-4 ganger per uke	Hver ukedag
Frokost	(1) ❍	(2) ❍	(3) ❍	(4) ❍
Lunsj	(1) ❍	(2) ❍	(3) ❍	(4) ❍
Middag	(1) ❍	(2) ❍	(3) ❍	(4) ❍
Kveldsmat	(1) ❍	(2) ❍	(3) ❍	(4) ❍

2. Hvor mange ganger i helgen spiser du frokost, lunsj, middag og kveldsmat?

	Aldri eller nesten aldri	1 gang i helgen	Hver dag i helgen
Frokost	(1) ❍	(2) ❍	(3) ❍
Lunsj	(1) ❍	(2) ❍	(3) ❍
Middag	(1) ❍	(2) ❍	(3) ❍
Kveldsmat	(1) ❍	(2) ❍	(3) ❍

3. Hvor ofte spiser du frokost eller middag sammen med andre (f.eks. samboer)?

(1) ❍ Aldri eller nesten aldri

(2) ❍ 1-2 ganger per uke

(3) ❍ 3-4 ganger per uke

(4) ❍ 5-6 ganger per uke

(5) ❍ Hver dag

4. Hvor får du vanligvis din lunsj fra?
Kryss av kategorien(e) som gjelder for deg

(1) ❑ Spiser lunsj hjemme

(2) ❑ Tar matpakke med hjemmefra

(3) ❑ Kjøper på universitetet/høyskole/jobb

(4) ❑ Kjøper utenfor universitet/høyskole/jobb

(5) ❑ Spiser ikke lunsj

5. Hvor ofte spiser du på restaurant eller "take away"?
F.eks. Jonas B., Egons, Pizzabakeren

(1) ❍ Aldri

(2) ❍ 1-3 ganger per måned

(3) ❍ 1 gang per uke

(4) ❍ 2-3 ganger per uke

(5) ❍ 4-6 ganger per uke

(6) ❍ 1 eller flere ganger per dag

6. Hvor ofte spiser du mat fra en fast-food restaurant? F.eks. McDonalds, Burger King, bensinstasjon

(1) ❍ Aldri

(2) ❍ 1-3 ganger per måned

(3) ❍ 1 gang per uke

(4) ❍ 2-3 ganger per uke

(5) ❍ 4-6 ganger per uke

(6) ❍ 1 eller flere ganger per dag

7. Hvor ofte har du tatt følgende?

	Aldri	1-2 ganger per måned	3-5 ganger per måned	1-3 ganger per uke	4-6 ganger per uke	Hver dag
Tran eller andre flytende omega-3 tilskudd (1 spiseskje)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Tran- eller fiskeoljekapsler	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Multivitamintilskudd (f.eks. Nycoplus, Sana Sol, vitaminbjørner)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

Multivitaminer med mineraler	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Jerntabletter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Vitamin A	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Vitamin C	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Vitamin D	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Folat	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Proteintilskudd (pulver/shake/bar etc.)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍
Måltidserstatter (pulver/shakes/bar etc.)	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍	(6) ❍

8. Annet
Har du tatt noe annet kosttilskudd enn det som står nevnt overfor? Hvis ja; hva og hvor ofte?

(1) ❍ Ja ______

(2) ❍ Nei

VI VIL GJERNE VITE HVA SOM FÅR DEG TIL Å SPISE SUNT/USUNT

1. I hvilken grad er du opptatt av at det du spiser skal være sunt?

(1) ❍ I svært liten grad

(2) ❍ I liten grad

(3) ❍ I noen grad

(4) ❍ I stor grad

(5) ❍ I svært stor grad

2. Hva motiverer deg til å spise sunt?

(1) ❑ Helseeffekter

(2) ❑ Skoleprestasjoner

(3) ❑ Konsentrasjonsevne

(4) ❑ Utseende

(5) ❑ Overskudd/velvære

(6) ❑ Bedre selvfølelse

(7) ❑ Annet ______

3. I hvilken grad opplever du at følgende faktorer hindrer deg fra å spise sunt?

	I svært liten grad	I liten grad	I noen grad	I stor grad	I svært stor grad
Matens smak	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matens lukt	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matens utseende	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matvarepriser	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Utvalg og tilgjengelighet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Tidsbruk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Arbeidsmengde	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Kunnskaper	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Ferdigheter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Annet

(1) ❑ Ja ______

(2) ❑ Nei

4. I hvilken grad opplever du at følgende faktorer gjør det lettere å spise sunt?

	I svært liten grad	I liten grad	I noen grad	I stor grad	I svært stor grad
Matens smak	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matens lukt	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matens utseende	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Matvarepriser	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Utvalg og tilgjengelighet	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Tidsbruk	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Arbeidsmengde	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Kunnskaper	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Ferdigheter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Helseeffekter	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Bedre utbytte av trening	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Positiv støtte fra familie og venner	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍
Kjennskap til kostrådene	(1) ❍	(2) ❍	(3) ❍	(4) ❍	(5) ❍

Annet

(1) ❍ Ja ______

(2) ❍ Nei

TUSEN TAKK FOR AT DU DELTOK! :-)

Hvis du ønsker å skrive ut besvarelsen din kan du trykke på printerikonet!

Send inn ved å trykke på «Avslutt».

Appendix 3

FEK approval, PREPARED

PROTOKOLL FRA FORSKNINGSETISK KOMITÈ

Dato: 17/11/2020

Arkivsak: 20/10119

Protkollfører: Anne Valen-Sendstad Skisland

MatNyttig - phd - Erlend Larsen Valen

Søknad godkjennes

Appendix 4

REK approval and change notifications, PREPARED

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst B	Ingrid Dønåsen	22845523	11.08.2020	78104
			Deres referanse:	

Nina Cecilie Øverby

78104 PREPARED

Forskningsansvarlig: Universitetet i Agder

Søker: Nina Cecilie Øverby

Søkers beskrivelse av formål:

Prosjektet skal utvikle, implementere og evaluere en digital læringsressurs (digital intervensjon) med mål om å bedre kostholdet til unge voksne i fertil alders. Våre hypoteser er at en slik intervensjon kan bedre kostholdet til unge voksne og at det også kan bedre helseutfall i svangerskap og fosterliv/nyfødtperiode. Vi ønsker å evaluere intervensjonen i en randomisert kontrollert studie. Vi vil rekruttere voksne i alderen 18-40 år som ennå ikke har fått barn. Vi skal kartlegge kostholdet deres med 24-timers-recall (MyFood24) samt bakgrunnsvariabler og livskvalitet vha spørreskjema for seinere å koble data til Medisinsk fødselsregisteret for informasjon om svangerskapshelse og barnets neonatal helse. Nyere forskning peker på at kostholdet til kommende foreldre i tiden før man blir gravid, er viktig kommende barnets helse. Det mangler resultater fra randomiserte kontrollerte studier. Resultatene fra studien vil bidra til kunnskap som er relevant for folkehelsa.

REKs vurdering

Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst B) i møtet 23.01.2020. Det ble besluttet å utsette vedtak i saken. Følgende inngikk i komiteens vurdering jf. brev av 03.02.2020:

«Saksgang

Søknad om forhåndsgodkjenning av prosjektet ble opprinnelig innsendt til fristen 11.06.2019 og behandlet på komiteens møte 21.08.2019 (referanse: 2019/1192). Opprinnelig søknad ble avslått på grunn av mangelfull protokoll og utydeligheter i søknad. Ny prosjektsøknad ble innsendt til fristen 10.12.2019 og behandlet på komiteens møte 15.01.2020.

Komiteen anser den nye søknaden og protokollen som vesentlig forbedret, men har noen spørsmål som må avklares før den kan ta endelig stilling til prosjektsøknaden.

<u>Innholdet i intervensjonen</u>

Det er uklart hva intervensjonen med den digitale læringsressursen innebærer. I prosjektbeskrivelsen er det oppgitt at utvikling og implementering av læringsressursen er en del av prosjektet og på side 6 i protokollen er utvikling av intervensjonen og appen ført *opp som work package 4 (WP4), mens den randomiserte kontrollerte studien som skal undersøke intervensjonens effekt er work package 5 (WP5). Komiteen må vite hva intervensjonen består i for å kunne vurdere forsvarligheten av den, samt for å kunne vurdere den randomiserte studien som helhet. Slik komiteen forstår prosjektet kan ikke WP5 startes opp før WP4 er gjennomført.*

Det bes derfor om en avklaring av om intervensjonen er utviklet, og i så fall beskrivelse av hva den går ut på. Dersom intervensjonen ikke er ferdigutviklet må dette gjøres før REK kan vurdere søknad om godkjenning av den randomiserte studien.

Dersom intervensjonen er ferdigutviklet har komiteen noen ytterligere kommentarer den ønsker tilbakemelding på:

<u>Intervensjonens effekt</u>

Det fremstår for komiteen som at effekten av intervensjonen må være svært stor dersom man skal kunne demonstrere forskjell mellom gruppene etter seks måneder med intervensjon og deretter et ukjent antall år før de får barn. Det bes om refleksjoner knyttet til dette, relatert til hva intervensjonen består i.

<u>Kontrollgruppe</u>

Komiteen diskuterte om kontrollgruppen vil ha lite insentiv til å delta i prosjektet over tid. Det bes om prosjektleders refleksjoner knyttet til dette og hvilke konsekvenser det eventuelt kan ha for prosjektet.

<u>Informasjons- og samtykkeskriv</u>

Komiteen har noen merknader til informasjons- og samtykkeskrivet:

- *Det må forklares hva den digitale læringsressursen er, hvordan den skal brukes, hva deltakelse krever og hvor mye tid det vil ta (i tillegg til spørreskjemaene).*

- *Det må stå tydeligere at intervensjonsgruppa vil få tilgang til den digitale læringsressursen i seks måneder.*

- *Jamfør helseforskningsloven § 38 må det opplyses at prosjektdata av dokumentasjonshensyn skal lagres i fem år etter prosjektslutt.*

- *Begge informasjonsskrivene må oppdateres i henhold til ny personopplysningslov (GDPR). Vi viser til oppdatert mal på REKs nettsider.*

På bakgrunn av ovennevnte bes det om en tilbakemelding på om intervensjonen er utviklet, og i så fall beskrivelse av hva den går ut på. Dersom intervensjonen ikke er ferdigutviklet må dette gjøres før REK kan vurdere søknad om den randomiserte studien. Dersom intervensjonen er klar bes det i tillegg til en beskrivelse av denne om svar på komiteens merknader til intervensjonens effekt, kontrollgruppe og informasjons- og samtykkeskriv».

Prosjektleder har sendt tilbakemelding mottatt 22.06.2020.

Ny vurdering

Komiteens leder har vurdert tilbakemeldingen.

Prosjektleder har beskrevet innhold og effekt av intervensjonen, kontrollgruppe og vedlagt oppdater prosjektbeskrivelse, reviderte informasjonsskriv samt andre relevante vedlegg.

Komiteens leder har vurdering tilbakemeldingen og konkludert med at prosjektleder har gitt tilfredsstillende svar på de spørsmål komiteen stilte, og prosjektet kan nå godkjennes.

Vedtak

Godkjent

REK har gjort en helhetlig forskningsetisk vurdering av alle prosjektets sider. Prosjektet godkjennes med hjemmel i helseforskningsloven § 10.

Vi gjør samtidig oppmerksom på at etter ny personopplysningslov må det også foreligge et behandlingsgrunnlag etter personvernforordningen. Det må forankres i egen institusjon.

Godkjenningen gjelder til 31.12.2040.
Av dokumentasjonshensyn skal opplysningene oppbevares i 5 år etter prosjektslutt. Opplysningene skal oppbevares avidentifisert, dvs. atskilt i en nøkkel- og en datafil. Opplysningene skal deretter slettes eller anonymiseres.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst B. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Med vennlig hilsen

Ragnhild Emblem
Professor, dr. med.
leder REK sør-øst B

Elin Evju Sagbakken
Seniorrådgiver og komitesekretær
REK sør-øst

Kopi til: Forskningsansvarlig(e) institusjon(er)

Sluttmelding
Søker skal sende sluttmelding til REK sør-øst B på eget skjema senest seks måneder etter godkjenningsperioden er utløpt, jf. hfl. § 12.

Søknad om å foreta vesentlige endringer
Dersom man ønsker å foreta vesentlige endringer i forhold til formål, metode, tidsløp eller organisering, skal søknad sendes til den regionale komiteen for medisinsk og helsefaglig forskningsetikk som har gitt forhåndsgodkjenning. Søknaden skal beskrive hvilke endringer som ønskes foretatt og begrunnelsen for disse, jf. hfl. § 11.

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst B	Ingrid Dønåsen	22845523	17.11.2020	78104
			Deres referanse:	

Nina Cecilie Øverby

78104 PREPARED

Forskningsansvarlig: Universitetet i Agder

Søker: Nina Cecilie Øverby

REKs vurdering

REK viser til endringsmelding innsendt 15.11.2020 for prosjekt 78104. Søknaden er behandlet av sekretariatet REK sør-øst på fullmakt fra REK sør-øst B, med hjemmel i helseforskningsloven § 11.

REK har vurdert følgende endringer:

1) Endring i aldersspennet for deltagerne som skal rekrutteres.

- Endring i aldersspennet for deltagere som skal rekrutteres. Prosjektleder har søkt og fått godkjent å rekruttere deltagere i alderen 18-40 år uten egne barn. Når denne aldersgruppen ble satt ønsket man å inkludere alle deltakere i fertil alder. Begrunnelsen som angis er tilfredstillende.

2) rekruttere deltagere per post i tillegg til via sosiale medier.

- Siden det er viktig å nå et representativt utvalg av den aktuelle delen av befolkningen og utvalget kan bli noe skjevt ved sosiale medier som eneste rekrutteringsmetode. Prosjektleder ønsker derfor å utvide rekrutteringsmetodene til å omfatte ordinær post.

REK har vurdert den omsøkte endringen og har ingen forskningsetiske innvendinger til de endringer som er beskrevet i skjema for prosjektendring.

Vedtak

Godkjent

REK godkjenner med hjemmel i helseforskningsloven § 11 annet ledd at prosjektet videreføres i samsvar med det som fremgår av søknaden om prosjektendring og i samsvar med de bestemmelser som følger av helseforskningsloven med forskrifter.

Dersom det skal gjøres ytterligere endringer i prosjektet i forhold til de opplysninger som er gitt i søknaden, må prosjektleder sende ny endringsmelding til REK.
Av dokumentasjonshensyn skal opplysningene oppbevares i 5 år etter prosjektslutt. Opplysningene skal deretter slettes eller anonymiseres. Opplysningene skal oppbevares avidentifisert, dvs. atskilt i en nøkkel- og en datafil.
Prosjektet skal sende sluttmelding til REK, se helseforskningsloven § 12, senest 6 måneder etter at prosjektet er avsluttet.
Vi ber om at alle henvendelser sendes inn via vår saksportal: : https://rekportalen.no
Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Jacob C. Hølen
Sekretariatsleder REK sør-øst

Elin Evju Sagbakken
Seniorrådgiver og komitesekretær
REK sør-øst B

Kopi sendes forskningsansvarlig institusjon og eventuelle medbrukere som er gitt tilgang til prosjektet i REK-portalen.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes til REK sør-øst B. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering.

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst B	Marianne Bjørnerem	22845531	05.05.2022	78104

Nina Cecilie Øverby

Prosjektsøknad: PREPARED
Søknadsnummer: 78104
Forskningsansvarlig institusjon: Universitetet i Agder

Prosjektsøknad: Endring godkjennes

Søkers beskrivelse

Prosjektet skal utvikle, implementere og evaluere en digital læringsressurs (digital intervensjon) med mål om å bedre kostholdet til unge voksne i fertil alders. Våre hypoteser er at en slik intervensjon kan bedre kostholdet til unge voksne og at det også kan bedre helseutfall i svangerskap og fosterliv/nyfødtperiode. Vi ønsker å evaluere intervensjonen i en randomisert kontrollert studie. Vi vil rekruttere voksne i alderen 18-40 år som ennå ikke har fått barn. Vi skal kartlegge kostholdet deres med 24-timers-recall (MyFood24) samt bakgrunnsvariabler og livskvalitet vha spørreskjema for seinere å koble data til Medisinsk fødselsregisteret for informasjon om svangerskapshelse og barnets neonatal helse. Nyere forskning peker på at kostholdet til kommende foreldre i tiden før man blir gravid, er viktig kommende barnets helse. Det mangler resultater fra randomiserte kontrollerte studier. Resultatene fra studien vil bidra til kunnskap som er relevant for folkehelsa.

Vi viser til endringssøknad for ovennevnte forskningsprosjekt mottatt 10.03.2022. Søknaden er behandlet av sekretariatet på delegert fullmakt fra REK sør-øst B, med hjemmel i helseforskningsloven § 11. Vi beklager lang saksbehandlingstid for denne endringssøknaden.

Endringen innebærer

Det er opprinnelig planlagt randomisering av deltakerne som har fylt inn spørreskjema og 2 24-timers recall-kartlegginger. Det er imidlertid mange som ikke fyller ut recall, og siden det uansett gis data på kosthold fra spørreskjemaet, er det ønskelig å randomisere også de som kun har fylt ut spørreskjema, slik at så mange som mulig av personene som har samtykket kan inkluderes i prosjektet.

REKs vurdering

Sekretariatet i REK har vurdert den omsøkte endringen, og har ingen forskningsetiske innvendinger til endringen slik den er beskrevet i skjema for prosjektendring.

Det bes om at forskningsprotokollen revideres i tråd med endringen og sendes REK til orientering.

Vedtak

REK har gjort en forskningsetisk vurdering av endringene i prosjektet, og godkjenner prosjektet slik det nå foreligger, jf. helseforskningsloven § 11.

Godkjenningen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad, endringssøknad, oppdatert protokoll og de bestemmelser som følger av helseforskningsloven med forskrifter.

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 31.12.2040, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Med vennlig hilsen

Jacob C. Hølen
Sekretariatsleder REK sør-øst

Marianne Bjørnerem
Rådgiver, REK sør-øst

Kopi til:

Universitetet i Agder

Appendix 5

NSD approval, PREPARED

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

PREPARED Diet of prospective parents and health in the next generation (PREPARED)

Referansenummer

907212

Registrert

11.06.2019 av Nina Cecilie Øverby - nina.c.overby@uia.no

Behandlingsansvarlig institusjon

Universitetet i Agder / Fakultet for helse- og idrettsvitenskap / Institutt for folkehelse, idrett og ernæring

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Nina Cecilie Øverby, nina.c.overby@uia.no, tlf: 38141324

Type prosjekt

Forskerprosjekt

Prosjektperiode

01.02.2020 - 31.12.2040

Status

18.09.2020 - Vurdert DPIA

Vurdering (2)

18.09.2020 - Vurdert DPIA

NSD har vurdert endringen på meldeskjema registrert 08.09.2020.

Endringen innebærer at godkjenning fra REK er lastet opp.

Det er NSD vurdering er at dette ikke endrer vesentlig på den personvernvurderingen UiA allerede har godkjent, og det er derfor ikke behov for ny godkjenning. Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg 08.09.2020. Behandlingen kan fortsette.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/pågår i tråd med den behandlingen som er dokumentert.

Lykke til med prosjektet!

Kontaktperson hos NSD: Øyvind Straume

Tlf. Personverntjenester: 55 58 21 17 (tast 1)

18.03.2020 - Vurdert DPIA

Prosjektet ble ved innmelding vurdert å innebære en høy risiko for de registrertes rettigheter og friheter, noe som utløser krav om personvernkonsekvensvurdering (DPIA) jf. personvernforordningen art. 35. NSD har i samråd med prosjektansvarlig og personvernombud gjennomført en slik vurdering.

Ved å gjennomføre de planlagte tiltakene, mener NSD at personvernrisikoen er redusert i en slik grad at behandlingen kan gjennomføres i samsvar med personvernforordningen, uten behov for forhåndsdrøfting med Datatilsynet. Behandlingsansvarlig institusjon har bekreftet at vurderingen er tilfredsstillende utført og at prosjektet kan gjennomføres, jf. DPIA versjon 22.01.20 som er signert 23.01.2020. Godkjent DPIA er lastet opp til meldeskjema.

Appendix 6

FEK approval, Paper II

Lorentz Salvesen

Besøksadresse:
Universitetsveien 25
Kristiansand

Ref: 19/07717

Tidspunkt for godkjenning: : 21/10/2019

Søknad om etisk godkjenning av forskningsprosjekt - Mål maten - En evalueringsstudie av bilder av porsjonsstørrelser for unge voksne

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

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

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

UNIVERSITETET I AGDER

POSTBOKS 422 4604 KRISTIANSAND

TELEFON 38 14 10 00

ORG. NR 970 546 200 MVA - post@uia.no - www.uia.no

FAKTURAADRESSE:

UNIVERSITETET I AGDER,

FAKTURAMOTTAK

POSTBOKS 383 ALNABRU 0614 OSLO

Appendix 7

NSD approval, Paper II

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

Mål maten - En evalueringsstudie av bilder av porsjonsstørrelser for unge voksne

Referansenummer

637822

Registrert

02.10.2019 av Anine Christine Medin - anine.medin@uia.no

Behandlingsansvarlig institusjon

Universitetet i Agder / Fakultet for helse- og idrettsvitenskap / Institutt for folkehelse, idrett og ernæring

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Anine Christine Medin, anine.medin@uia.no, tlf: 47463893

Type prosjekt

Forskerprosjekt

Prosjektperiode

04.11.2019 - 04.11.2022

Status

03.10.2019 - Vurdert

Vurdering (1)

03.10.2019 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 3.10.2019. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 4.11.2022.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke behandles til nye, uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet

- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Surveyxact er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og/eller rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/ pågår i tråd med den behandlingen som er dokumentert.

Lykke til med prosjektet!

Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix 8

FEK approval, StudentKost2, Paper III

Anine Christine
Medin

Besøksadresse:
Universitetsveien 25
Kristiansand

Ref: RITM0070447

Tidspunkt for godkjenning: : 25/06/2020

Søknad om etisk godkjenning av forskningsprosjekt - Studentkost2

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

Kommentar fra godkjenner:
FEK godkjenner prosjektet under forutsetning av gjennomføring som beskrevet i søknaden.

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

UNIVERSITETET I AGDER

POSTBOKS 422 4604 KRISTIANSAND

TELEFON 38 14 10 00

ORG. NR 970 546 200 MVA - post@uia.no -

FAKTURAADRESSE:

UNIVERSITETET I AGDER,

FAKTURAMOTTAK

POSTBOKS 383 ALNABRU 0614 OSLO www.uia.no

Appendix 9

NSD approval, StudentKost2, Paper III

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

Studentkost2

Referansenummer

848472

Registrert

01.03.2020 av Anine Christine Medin - anine.medin@uia.no

Behandlingsansvarlig institusjon

Universitetet i Agder / Fakultet for helse- og idrettsvitenskap / Institutt for folkehelse, idrett og ernæring

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Anine Christine Medin, anine.medin@uia.no, tlf: 47463893

Type prosjekt

Forskerprosjekt

Prosjektperiode

03.08.2020 - 20.08.2025

Status

20.05.2020 - Vurdert

Vurdering (1)

20.05.2020 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 20.05.2020, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER

Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:

https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html

Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET

Prosjektet vil behandle særlige kategorier av personopplysninger om helse og alminnelige kategorier av personopplysninger frem til 20.08.2025.

LOVLIG GRUNNLAG FOR DE REGISTRERTE

Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

LOVLIG GRUNNLAG FOR TREDJEPERSON

Under datainnsamlingen vil det fremkomme personopplysninger om respondentenes foresatte. Spørreskjema vil anonymiseres innen kort tid. Det vil kun innhentes informasjonn om de tredjepersonenes utdanning.

Prosjektet vil behandle personopplysninger om tredjeperson med grunnlag i en oppgave av allmenn interesse. Vår vurdering er at behandlingen oppfyller vilkåret om vitenskapelig forskning, jf. personopplysningsloven § 8, og dermed utfører en oppgave i allmenhetens interesse.
Lovlig grunnlag for behandlingen vil dermed være utførelse av en oppgave i allmenhetens interesse, jf. personvernforordningen art. 6 nr. 1 bokstav e), jf. art. 6 nr. 3 bokstav b), jf. personopplysningsloven § 8.

PERSONVERNPRINSIPPER

NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke behandles til nye, uforenlige formål
dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter,
har behandlingsansvarlig institusjon plikt til å svare innen en måned.

RETTIGHETER FOR TREDJEPERSONER
Så lenge tredjepersoner kan identifiseres i datamaterialet vil de ha følgende rettigheter: retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), protest (art 21).

Tredjepersoner identifiseres ikke med navn, og det vil være svært ressurskrevende å spore foreldrene til alle respondenter. Det kan gjøres unntak fra den individuelle informasjonsplikten til tredjepersonene fordi det vil innebære uforholdsmessig stor innsats å informere de registrerte, jf. personvernforordningen art. 14 nr. 5 b.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

SurveyXact og Dietary Assessment limited er databehandlere i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

Personopplysninger skal overføres til Storbritannia utover 2020. NSD presiserer at for at behandlingen skal være lovlig i 2021 må enten Europakommisjonen anse Storbritannia til å ha «tilstrekkelig beskyttelsesnivå» (jf. art. 45) eller må din institusjon motta nødvendige garantier (f.eks ved å anvende EUs standardavtaler), jf. art 46.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer
og/eller rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene pågår i tråd med den behandlingen som er dokumentert.

Lykke til med prosjektet!

Kontaktperson hos NSD: Henrik Netland Svensen
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix 10

Information letter and informed consent, PREPARED

VIL DU DELTA I FORSKNINGSPROSJEKTET ”PREPARED – MAT OG MÅLTIDER FOR HELSE I GENERASJONER”?

FORMÅLET MED PROSJEKTET OG HVORFOR DU BLIR SPURT

Dette er et spørsmål til deg om å delta i et forskningsprosjekt PREPARED for å undersøke hvilken betydning kostholdet ditt har på din egen og eventuelle framtidige barns helse.

Hensikten med prosjektet er å undersøke om kostholdet og levevaner i årene før man får barn kan ha betydning for egen og eventuelle fremtidige barns helse. Som en del av prosjektet skal det utvikles en digital læringsressurs om kosthold som over en periode på 6 måneder vil kunne gi deg tips og råd om kosthold og levevaner i årene før du får barn. Du vil kunne bruke læringsressursen på de tidspunktene som passer best for deg.

For å få svar på spørsmålene våre om sammenhengen mellom foreldres kosthold og seinere barns helse trenger vi kunnskap om hva unge voksne menn og kvinner fra hele landet spiser i månedene eller årene før de blir foreldre. Vi ønsker derfor deltakere som ennå ikke har fått egne barn.

HVA INNEBÆRER PROSJEKTET FOR DEG?

For å teste om tilgang til den digitale læringsressursen har effekt, trenger vi to grupper i prosjektet. Bare én av gruppene vil få tilgang til den digitale læringsressursen (tiltaksgruppen). Den andre gruppen (kontrollgruppen) vil ikke få tilgang, men er svært viktig for at forskningsresultatene skal være gyldige.

Den digitale læringsressursen er en digital plattform med ukentlig oppdatering med informasjon og tips om kosthold og om kort- og langsiktige gevinster av å spise sunt med tanke på helse og overskudd. Tiltaksgruppen får tilgang til ressursen i 6 mnd. Læringsressursen er ment som inspirasjon og idébank for å oppnå gode kostholdsvaner. De som får tilgang, velger selv hvor mye tid de vil bruke på innholdet. Så lite som 5 minutter per uke skal kunne gi et fundament for å oppnå et bedre kosthold, men det er også mulig å dykke dypere i tematikken.

Begge gruppene vil bli bedt om å svare på spørreskjema både ved starten av prosjektet og etter 6 og 12 mnd.

For å kunne undersøke om tiltaket har langsiktig effekt på foreldres og fremtidige barns helse, ber vi om tillatelse til følgende:

- å kontakte deg med et kort spørreskjema årlig til du eventuelt har fått ditt første barn
- å koble svarene dine til Medisinsk fødselsregister som registrerer data om alle svangerskap og fødsler i Norge.

Dataene som samles inn i prosjektet vil først bli lagret i 20 år (prosjektslutt) slik at vi har mulighet til å koble kostholdsdata til registerdata om svangerskapshelse og fødsel hvis og når dette blir aktuelt. Den lange lagringstiden er nødvendig siden vi ikke kan vite om og når du eller andre i prosjektet blir foreldre. Etter prosjektslutt vil dataene lagres i ytterligere fem år av dokumentasjonshensyn, i tråd med helseforskningsloven §38.

I prosjektet vil vi innhente og registrere følgende opplysninger om deg.

For å delta i prosjektet fyller du ut et kort spørreskjema der du samtidig samtykker til å delta i undersøkelsen. Du vil bli bedt om å fylle inn opplysninger om personnummer, alder, utdanning, yrke og noen enkle spørsmål om helse og livskvalitet. Spørreskjemaet er nettbasert og krever innlogging i ID-porten for at opplysningene dine skal være trygge. Svarene dine fra spørreskjemaet går direkte til Tjenester for Sensitive Data (TSD), en forskningsplattform som oppfyller lovens strenge krav til behandling og lagring av sensitive forskningsdata. Det vil ta ca. 10 minutter å svare på spørreskjemaet.

Du vil også bli bedt om å fylle ut et nettbasert kostregistreringsskjema, der du registrerer det du har spist og drukket de siste 24 timene. Dette skjemaet tar ca. 15 minutter å fylle ut. Programmet som brukes kalles *myfood24,* og dataene som blir samlet inn vil først gå via en sikker server i Nederland før de blir lagret i TSD. Det vil ikke være opplysninger som kan identifisere deg som person i dette skjemaet, som f.eks. navn eller personnummer. Du vil bli bedt om å fylle ut kostregistreringsskjemaet to ganger i starten av prosjektet, to ganger etter 6 måneder, og to ganger etter 12 måneder. Brukerdata fra den digitale læringsressursen vil innhentes for deltakere i tiltaksgruppen.

Etter studiens første år vil korte spørreskjema (5 minutter) bli sendt ut årlig til du eventuelt får ditt første barn. Når du har fått ditt første barn vil vi kontakte deg igjen for å be om samtykke til å koble kostholdsinformasjonen din med informasjon om svangerskapet og barnets fødselsvekt, lengde og nyfødthelse fra Medisinsk fødselsregister. Siden tidspunkt for første barn er uvisst, vil opplysningene bli lagret i TSDs sikre plattform til 31. desember 2040. Prosjektet avsluttes i 2040.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE DITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg. Dersom du trekker tilbake samtykket, vil det ikke forskes videre på dine helseopplysninger. Du kan også kreve at dine helseopplysninger i prosjektet slettes eller utleveres innen 30 dager. Adgangen til å kreve sletting eller utlevering gjelder ikke dersom materialet eller opplysningene er anonymisert. Denne adgangen kan også begrenses dersom opplysningene er inngått i utførte analyser.

Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder (se kontaktinformasjon på siste side).

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet under formålet med prosjektet, og planlegges brukt til 2040. Eventuelle utvidelser i bruk og oppbevaringstid kan kun skje etter godkjenning fra REK og andre relevante myndigheter. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene. Du kan klage på behandlingen av dine opplysninger til Datatilsynet og institusjonen sitt personvernombud.

Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun fem personer i prosjektgruppen som har tilgang til denne listen.

Opplysningene om deg vil bli oppbevart i fem år etter prosjektslutt av kontrollhensyn.

Du vil ikke kunne gjenkjennes ved publisering av resultater fra studien.

DELING AV OPPLYSNINGER OG OVERFØRING TIL UTLANDET

Ved å delta i prosjektet, samtykker du også til at kodede opplysninger fra spørreskjema og *myfood24* kan overføres til utlandet som ledd i forskningssamarbeid og publisering. Kodede opplysninger blir behandlet av prosjektmedarbeidere i Bristol, England og Nebraska, USA. Koden som knytter deg til dine personidentifiserbare opplysninger vil ikke bli utlevert.

OPPFØLGINGSPROSJEKT

For å kunne undersøke om dette prosjektet har langsiktig effekt på dine eventuelle fremtidige barns helse vil vi gjennomføre et oppfølgingsprosjekt for å knytte dette prosjektet til opplysninger om svangerskapet og barnets nyfødthelse fra Medisinsk fødselsregister. Dette er nødvendig fordi man ikke kan samtykke på vegne av noen som ikke er født. Nytt samtykke vil gjelde for bruk av følgende opplysninger fra fødselsregisteret: svangerskapshelse (vektoppgang i svangerskapet, svangerskapsforgiftning, svangerskapsdiabetes, for tidlig fødsel og høyt blodtrykk), barnets helse (barnets fødselsvekt, lengde, hodeomkrets, ev. medfødte misdannelser, data om overflyttet til barneavdeling, og om barnet har en nyfødt-diagnose eller ikke).

Vi ber derfor om tillatelse til å kontakte deg med et kort spørreskjema årlig til du har fått ditt første barn, for så å invitere deg til oppfølgingsprosjektet.

ØKONOMI

Alle som svarer på de tre første datainnsamlingene (frem til 12 måneder etter oppstart) vil være med i en trekning av ti pengepremier á 5000 kroner.

GODKJENNINGER

Regional komité for medisinsk og helsefaglig forskningsetikk har gjort en forskningsetisk vurdering og godkjent prosjektet. Søknadsnr. hos REK: 78104.

Toppforskningssenteret *Mat og ernæring i et livsløpsperspektiv* ved Universitetet i Agder og prosjektleder Nina Cecilie Øverby er ansvarlig for personvernet i prosjektet.

På oppdrag fra Universitetet i Agder har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Vi behandler alle opplysninger basert på ditt samtykke.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet eller ønsker å trekke deg fra deltakelse, kan du kontakte Elisabet R. Hillesund på telefon: 381 41 285 eller e-post: elisabet.r.hillesund@uia.no, eller Nina C. Øverby på telefon: 381 41 324 eller e-post: nina.c.overby@uia.no.

Dersom du har spørsmål om personvernet i prosjektet, kan du kontakte personvernombudet ved Universitetet i Agder: Ina Danielsen, personvernombud@uia.no.

Datatilsynets e-postadresse er personvernombudet@nsd.no.

JEG SAMTYKKER TIL Å DELTA I PROSJEKTET OG TIL AT MINE PERSONOPPLYSNINGER BRUKES SLIK DET ER BESKREVET

Jeg har mottatt og forstått informasjon om prosjektet *PREPARED*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☐ *å delta i prosjektet PREPARED og svare på spørreskjema og kostregistreringsskjemaet myfood24, og at mine personopplysninger behandles i tråd med det som er beskrevet over*.

☐ *at mine personopplysninger lagres til 31.12.2040.*

Sted og dato | Deltakers signatur

Deltakers navn med trykte bokstaver

Appendix 11

Information letter and informed consent, Paper II

Vil du delta i forskningsprosjektet

«Mål maten - En evalueringsstudie av bilder av porsjonsstørrelser for unge voksne»

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor målet er å forbedre måten vi måler matinntak på til senere bruk i viktige prosjekter hvor vi studerer sammenhengen mellom mat og helse i livsløpet. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

I studien vil vi undersøke hvor godt det fungerer å bruke noen bilder som hjelpemiddel for å måle mengden man har drukket og spist. Hvis bildene fungerer, vil de bli benyttet i en ny norsk web-basert kostdagbok i flere kommende forskningsprosjekter ved Universitetet i Agder.

Vi vil:

1. Vurdere hvor gode noen nye bildeserier av porsjonsstørrelser er ved å sammenligne med forhåndsveide retter
2. Vurdere hvor relevante noen britiske og tyske bildeserier er

Denne studien er en del av et større doktorgradsstudie og er et delprosjekt i et større prosjekt hvor vi utvikler en ny norsk web-basert matdagbok.

Hvem er ansvarlig for forskningsprosjektet?

Universitetet i Agder er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

I dette prosjektet søker vi unge voksne som regelmessig befinner seg i nærheten av Universitetet i Agder (UiA). Kriterier for å delta er at man er i alderen 18-45 år, behersker norsk språk og har anledning til å møte på UiA én gang. Personer som har kartlagt kostholdet sitt i løpet av det siste året (f.eks. ved hjelp av kostdagbok) kan dessverre ikke delta.

Hva innebærer det for deg å delta?

Hvis du velger å delta i prosjektet, innebærer det at du møter opp på UiA for å vurdere mengden mat i ulike matretter, ser på bilder av mat og fyller ut et web-basert spørreskjema.

Når du fyller ut spørreskjemaet skal du:

1. Vurdere porsjonsstørrelsene av ulike retter opp mot bilder av ulike porsjonsstørrelser for den aktuelle retten
2. Vurdere relevansen av bilder av porsjonsstørrelser for ulike retter fra England og Tyskland
3. Svare på spørsmål om alder, kjønn og utdanning.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Dersom du er student ved UiA og ikke ønsker å delta, eller trekker samtykket senere, vil dette ikke under noen omstendighet påvirke ditt forhold til UiA og dine forelesere der.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Navnet og kontaktopplysningene dine vil erstattes med en kode. Navnelisten med tilhørende koder vil oppbevares i en safe adskilt fra øvrige data. Det er kun prosjektgruppen som vil ha tilgang til opplysningene vi samler inn. Databehandling vil foregå på passordbeskyttede PCer.

Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.
Det web-baserte spørreskjemaet blir laget i SurveyXact (et verktøy for spørreskjemaer). Opplysningene som samles inn vil kun knyttes til koden din, og vil dermed ikke være knyttet til ditt navn, e-post eller andre kontaktopplysninger.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet avsluttes 04.11.2022. Ved prosjektslutt vil navnelisten knyttet til koder slettes, slik at det ikke lenger være mulig å finne tilbake til hvilke opplysninger som er dine.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Agder har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Universitetet i Agder ved å kontakte:
  - Doktorgradsstipendiat Lorentz Salvesen.
    E-post: lorentz.salvesen@uia.no, mobil: 480 87 692.
  - Prosjektansvarlig Anine C. Medin.
    E-post: anine.medin@uia.no, mobil: 47 46 38 93
  - Personvernombud: Ina Danielsen.
    E-post: ina.danielsen@uia.no
- NSD – Norsk senter for forskningsdata AS:
  E-post: personverntjenester@nsd.no, Telefon: 55 58 21 17

Med vennlig hilsen

Anine C. Medin
Prosjektansvarlig
(Forsker/veileder)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet «Mål maten – En evalueringsstudie av bilder av porsjonsstørrelser for unge voksne», og har fått anledning til å stille spørsmål.

Jeg samtykker til:

- ☐ å delta i studien og gjennomføre spørreskjemaet som skissert over

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, den 04.11.2022

(Signert av prosjektdeltaker, dato)

Appendix 12

Information letter and informed consent, StudentKost2, Paper III

Vil du delta i forskningsprosjektet *"Studentkost 2"*?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er **å kartlegge hva studenter spiser og drikker**. Her gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Vi vet at hva man spiser er av stor betydning for helsen og klima. Undersøkelsen Studentkost ble gjennomført høsten 2018 for å få kunnskap om unge voksnes kosthold. Denne kartleggingen involverte 622 studenter som svarte på et spørreskjema om deres kosthold, spisevaner og fysisk aktivitet. Undersøkelsen viste store mangler i kostholdet til studenter.

Nå ønsker vi å gjennomføre en ny tilsvarende undersøkelse, for å se om det har skjedd noen endringer. Vi vil også bruke en ny digital kostdagbok; myfood24 og et veldig kort spørreskjema for å samle inn data.

Vi ønsker også at noen av deltagerne skal bruke både den digital kostdagbok og det korte spørreskjemaet i tillegg til spørreskjemaet som ble brukt i 2018 for å vurdere hvor godt de samsvarer, slik at vi kan sammenlikne resultatene.

Formålet med prosjektet er å gi svar på følgende overordnede spørsmål:

1. Hva spiser studenter i 2020?
2. Har det skjedd noen endringer i studenters kosthold i perioden 2018 til 2020?
3. Hvor godt er samsvaret mellom kosthold rapportert av studenter ved hjelp av en digital matdagbok og minispørreskjema versus lengre spørreskjema?

Dette forskningsprosjektet er en del av arbeidet til tre masterstudenter ved folkehelsevitenskap ved Universitetet i Agder i 2020/2021.

Hvem er ansvarlig for forskningsprosjektet?

Universitetet i Agder er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

Alle studenter som starter på Universitetet i Agder høsten 2020 blir invitert til å delta i denne undersøkelsen. Du må kunne lese og skrive norsk eller et skandinavisk språk ha fylt 18 år.

Hva innebærer det for deg å delta?

Hvis du velger å delta i prosjektet, innebærer det at du beskriver hva du har spist og drukket på to tilfeldige dager med minst fire ukers mellomrom ved hjelp av en digital matdagbok på nett. **Det tar ca. 15-30 minutter å fylle ut den digitale kostdagboken hver gang (totalt 2 ganger).**

Vi vil også spørre deg om hva du vanligvis spiser og drikker i et minispørreskjema i tillegg til bakgrunnsspørsmål om alder, kjønn, fakultetstilhørighet, om du er førsteårsstudent, hjemfylke, vekt, høyde, om du har vært stabil i vekt siste år og om du forsøker å øke eller redusere vekten din, om du har allergier/matintoleranser/kostrestriksjoner, aktivitetesnivå, skjermvaner, søvn, røyking/snusvaner, samt om foresattes utdanningsnivå. Du får også fire spørsmål om endringer relatert til Covid-

19pandemien. Alle disse spørsmålene finner du i siste del av dette skjemaet du har åpnet nå. **Dette tar ca. 10-15 minutter til sammen**.

Dersom du vil, kan du også delta i en utvidet undersøkelse hvor de blir invitert til å bruke spørreskjemaet fra studentkostundersøkelsen fra 2018 i tillegg til det som allerede er beskrevet, enten før eller etter at de har brukt den digitale kostdagboken. **Dette ekstraskjemaet tar ca. 45 minutter å fylle ut.**

Alle dine svar fra spørreskjemaene og den digitale kostdagboken blir registrert elektronisk.

Hvis du fullfører studien, er du automatisk med i **trekningen av en iPhone 11 (vinnersjanse ca. 1/1000).**
Deltar du i den **utvidede studien** (med spørreskjemaet fra 2018), er du med i **trekningen av nok en iPhone 11 (vinnersjanse ca. 1/200).**

Hvis du ønsker det, vil du også få en kortfattet tilbakemelding på kostholdet ditt.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. **Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg**. Det vil ikke påvirke ditt forhold til universitetet/forelesere ved UiA.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette infoskrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- **Kun deltagerne i prosjektgruppen (bestående av 6 personer, hvorav 3 masterstudenter) er de eneste som vil behandle opplysningene du gir oss.**
- Samtykkeskjemaet og minispørreskjemaet samles inn ved hjelp av SurveyXact. En gang hver uke i løpet av høsten 2020 (når vi samler inn data) vil vi aktivt anonymisere alle innkomne skjemaer i SurveyXact.
- Ditt navn, e-postadresse og informasjon om ditt kosthold lagres i databasen til myfood24 som driftes av Dietary Assessment Limited i Storbritannia som bruker Digital Ocean til å drifte servere og datalagringen. **myfood24 er satt opp i tråd med personvernregelverket (GDPR).**
- Før vi begynner å analysere dine data, vil vi koble sammen dine data fra SurveyXact med dine data fra myfood24, men uten opplysninger som gjør at du kan gjenkjennes. Ditt navn og dine kontaktopplysninger (e-post og telefonnummer) erstattes derfor med en kode som lagres på egen navneliste adskilt fra øvrige data, som vil oppbevares nedlåst når den ikke er i bruk.
- Datamaterialet uten navn og kontaktinformasjon lagres på UiAs server på passordbeskyttet PCer med to-trinnsaktivering.

Du vil ikke kunne gjenkjennes når data fra prosjektet publiseres.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet skal etter planen avsluttes 20.08.2025. Alle personopplysninger (inkludert navnelisten og data i myfood24) vil anonymiseres ved prosjektslutt slik at ingen lenger kan finne frem til hvilke svar som kommer fra deg.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg? Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Agder har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?
Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:
- Universitetet i Agder ved prosjektmedarbeider Erlend Larsen Valen på erlend.l.valen@uia.no
- Universitetet i Agder ved prosjektansvarlig Anine C. Medin på anine.medin@uia.no eller telefon: 38 14 14 28
- Vårt personvernombud: Ina Danielsen ina.danielsen@uia.no eller telefon: 38 14 21 40
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Anine C. Medin
Prosjektansvarlig
(Forsker og førsteamanuensis i ernæring)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet Studentkost2, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☐ (A): å delta i **hovedstudien** med digital matdagbok på 2 ulike dager (samt minispørreskjema om mitt vanlige kosthold, bakgrunnsspørsmål og fire Covid-19 relaterte spørsmål).

ELLER

☐ (B): å delta i **utvidet studie** med alt som er beskrevet i (A) i tillegg til digitalt spørreskjema fra 2018.

Tillater du at vi kontakter deg igjen ved en senere anledning (før prosjektet er avsluttes)?
☐ Ja

☐ Nei

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet (20. august 2025).

-- Skriv inn ditt navn, mobilnummer og e-postadresse her