Hair mercury levels and seafood consumption in pregnant women – a randomised controlled trial with dietary cod

Synnøve Næss

Master thesis in Clinical Nutrition

Department of Clinical Medicine, Faculty of Medicine
University of Bergen

Institute of Marine Research (IMR)

2018

Supervisors:

PhD	Lisa Kolden Midtbø [a]
PhD	Maria Wik Markhus [a]
Cand. Scient	Ive Nerhus [a]
Dr. Scient	Robin Ørsnrud [a, b]

[a] Institute of Marine Research
[b] University of Bergen

Acknowledgements

This master thesis was completed at the Institute of Marine Research (IMR), Section of Food Security and Nutrition and is part of the study Mommy's Food. I am truly grateful for having the opportunity to write my master thesis in such an inspiring and including environment.

Firstly, I would like to express my gratitude towards my supervisors Lisa Kolden Midtbø, Maria Wik Markhus and Ive Nerhus. Thank you for all the guidance and help you have provided me throughout this year. Thank you for always being available answering questions, giving me constructive feedback and your positivism and encouragement throughout the year.

Thanks to everyone else at the section of Food Security and Nutrition for including us master students, both scientifically and socially with always having time for questions.

I also wants to thank Robin Ørnsrud for reading through my thesis, giving me constructive feedback and answering questions. That was greatly appreciated.

Further, I want to thank Berit Solli for help, guidance and always having time answering questions regarding analyses at the lab. Also, thanks to everyone else at IMR answering questions and helping when necessary.

Finally, I want to thank all my fellow students here at IMR and at UiB. Thank for all the support, discussions, coffee breaks, fun and laughter. I have loved studying these years, and you are all a huge part of that!

Synnøve Næss

Bergen, May 2018

Abstract

Background: Dietary seafood contributes with nutrients important for optimal foetal development, and consumption during pregnancy is associated with beneficial foetal health outcomes. However, seafood is also a source of undesirable contaminants such as methylmercury (MeHg), known to have adverse effects on foetal neurodevelopment when exposed prenatally. Thus, intake of seafood with high levels of MeHg is of great concern in pregnant women. Humans are predominantly exposed to MeHg through seafood consumption. In Norway, dietary cod is the fish species contributing with the largest part of the exposure, mainly because of the high consumption.

Objective: To investigate if an increased intake of cod during pregnancy has an impact on total hair mercury (THHg) levels, and to investigate the impact of the habitual dietary seafood intake on THHg levels in pregnant women.

Methods: A total of 137 pregnant women from Bergen, Norway were enrolled in a dietary two-armed randomised controlled trial with supplementary cod. The pregnant women were randomised to consume 400 gram of cod per week or to continue with their habitual diet for 16 weeks (gestational week 20-36). THHg levels were measured pre- and post-intervention and at 6 months postpartum. Seafood intake and MeHg intake from seafood were estimated from a food frequency questionnaire.

Results: There were no significant differences in THHg levels between the intervention (median: 554 µg/kg) and the control group (median: 485 µg/kg) post-intervention (p= 0.19). However, the change in THHg levels from pre- to post-intervention (ΔTHHg) was significantly different between the two groups (p= 0.046). The intervention with cod did not lead to an increased number of participants exceeding the THHg reference level of 1000 µg/kg set by the US Environmental Protection Agency. At 6 months postpartum, there was no difference between the groups in THHg levels. THHg levels were positively correlated with total seafood intake pre- (r= 0.38, p <0.001) and post-intervention (r= 0.58, p <0.001).

Conclusion: The change in THHg levels from pre- to post-intervention (ΔTHHg) was significantly different between the intervention and the control group, despite no significant difference in total seafood intake. However, THHg levels and estimated MeHg intake from seafood were generally low in this study group. These findings support the dietary recommendations for seafood intake for pregnant women, including limitations in consumption of seafood known to contain high levels of Hg.

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Abbreviations

BMI	Body Mass Index (kg/m^2)
bw	Body weight
CI	Confidence intervals
DHA	Docosahexaenoic acid
DMA-80	Direct Mercury Analyzer
EFSA	European Food Safety Authority
EPA	Eicosapentaenoic acid
FAO	Food and Agriculture Organization
FDA	The United States Food and Drug Administration
FFQ	Food frequency questionnaire
g	Gram
Hg	Mercury
IMR	Institute of Marine Research (Havforskningsinstituttet)
IQR	Interquartile range
JECFA	Joint FAO/WHO Expert Committee on Food Additives
LiN	"Little in Norway" study
LOAEL	Lowest observed adverse effect levels
LOD	Limit of detection
LOQ	Limit of quantification
MeHg	Methylmercury
MoBa	Norwegian Mother and Child Cohort
n-3 LCPUFA	Long-chain omega-3 polyunsaturated fatty acid
NOAEL	No observed adverse effect levels
PCB	Dioxin-like polychlorinated biphenyl
PTWI	Provisional tolerable weekly intake
RCT	Randomised controlled trial
RKBU	Regional Centre for Child and Youth Mental Health and Child Welfare (Regionalt kunnskapssenter for barn og unge)
SD	Standard deviation
THHg	Total hair mercury
TWI	Tolerable weekly intake
US EPA	United States Environmental Protection Agency
VKM	Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø)
WHO	World Health Organization

1 Introduction

1.1 Seafood

1.1.1 General background

Nutrition and maternal diet during pregnancy play an essential part for optimal growth, development and health of the foetus (1). Nutrition during pregnancy has also been related to development of diseases in offspring in later years of life (2). Seafood is a food group that contributes with nutrients important for optimal foetal development and consumption during pregnancy is associated with beneficial foetal health outcomes (1, 3). Seafood is an important source of several essential nutrients including high quality proteins, the marine long-chain omega-3 polyunsaturated fatty acids (n-3 LCPUFAs) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), vitamin D, vitamin B12, iodine, zinc and selenium (4). These are all nutrients important for optimal foetal development during pregnancy (3). In addition to beneficial nutrients, seafood is also a source of undesirable contaminants such as mercury (Hg), dioxin and dioxin-like polychlorinated biphenyls (PCBs) known to have adverse effects on foetal development when exposed prenatally (5).

The term seafood is in this thesis denoted as fish and shellfish as in agreement with the European Food Safety Authority (EFSA) (6). Aquatic animals, aquatic reptiles, echinoderms, jellyfish and aquatic plants are not included in this term. The terms fish and shellfish are denoted as vertebrate finfish and invertebrate aquatic animals (crustaceans and molluscs) respectively, of either marine or freshwater origin, whether farmed or wild (6). The terms fish and seafood are sometimes used interchangeably in this thesis due to used mutually in other literature. In Norway, fish is the biggest group within the term of seafood (7).

1.1.2 Health benefits of seafood consumption

Epidemiological studies have documented several health benefits of fish consumption with different health outcomes, thereby the strongest evidence of beneficial effects are on cardiovascular disease (5, 7). Fish intake during pregnancy has also been associated with beneficial foetal health and development as improved neurodevelopment (8-11), increased birth weight (12, 13) and lower risk of preterm birth (14, 15). However, these associations have been documented in observational studies and not in randomised controlled trials (RCTs), which are considered the gold standard of evidence, due to the lack of RCTs with fish as a whole food in pregnant women and foetal health as an outcome (3).

1.1.3 Dietary recommendations

The Norwegian food based dietary guidelines consist of thirteen advices regarding diet, nutrition and physical activity. These are primarily aimed to healthy adult individuals but can additionally be used in other population groups such as pregnant and breastfeeding women with modification to the population groups' special requirements (7).

Regarding seafood, the dietary recommendation is to eat fish equivalent to 2-3 dinner portions a week corresponding to 300-450 gram (g) of pure fish per week. Of this quantity, 200 g should be fatty fish. Fish as spread can alternatively replace fish as dinner and approximately six portions of fish spread are equivalent to one dinner portion of fish. Shellfish and other seafood are not included in the dietary recommendation of eating 2-3 dinner portions of fish per week. However, it is encouraged to include shellfish and other seafood in the diet as they contain essential nutrients important in a healthy and varied habitual diet (7). Pregnant women are advised to follow the general recommendation of fish consumption, though they are advised to limit some sources of fish and seafood because of its potential content of undesirable contaminants such as Hg. This includes large freshwater fish (pike, trout >1 kg, perch >25 cm, char >1 kg), fish liver, seal meat, Greenland halibut >3 kg, shark, swordfish, skate, fresh tuna (canned tuna is considered safe) and brown meat from crab (16).

The dietary guidelines are also in agreement with the benefit-risk assessment of fish and fish products in the Norwegian diet from the Norwegian Scientific Committee for Food and Environment (VKM) from 2014, which concluded that pregnant women should follow the recommendations of fish intake for the general population. They also stated, that pregnant women who eat less than one serving of fish per week, may miss the beneficial effects of optimal neurodevelopment in foetuses and infants (5).

The Norwegian food based dietary guidelines of fish consumption correspond to most other European food based dietary guidelines in which most countries recommend two servings of about 150 g each per week (6). The American dietary guidelines recommend an intake of at least 8 ounces (2-3 portions) of seafood per week (17). The rationale of the national recommendations for fish consumption are predominantly based on the content of essential nutrients in fish and the evidence of preventing cardiovascular disease (6, 7). However, the guidelines seem to be consistent in agreement that fish and seafood are beneficial in regards to foetal health outcomes (6).

1.1.4 Seafood consumption in pregnant women

About one third of the population in Norway follow the recommendations of seafood intake according to the national dietary survey among adults in Norway, Norkost 3 (2010-11) (18). In the Norwegian Mother and Child Cohort (MoBa) the average weekly intake of total seafood in pregnant women was 255 g (median 234 g) (n= 67.007) (14). Lean fish constituted with an average of 56% of the total seafood intake with an average weekly intake of 142 g (median 130 g). Fatty fish constituted with an average of 34% of the total seafood intake with an average weekly intake of 85 g (median 58 g). Shellfish constituted with an average of 10% of the total seafood intake with an average weekly intake of 25 g (median 17 g).

Compared to other European countries, pregnant women in Norway eat more fish than in most other countries (19). However, the Mediterranean and Atlantic countries Spain, Italy and Portugal have the highest intake of fish in pregnant women in Europe and compared to Norway, Spain and Portugal have an intake more than twofold as high. Compared to other Nordic countries, the intake of fish in pregnant women are higher on Iceland (12), though lower in Denmark (20).

Women of fertile age and pregnant women in Norway have a lower seafood intake compared to the general adult population (5). In addition, pregnant women tend to reduce their seafood intake during pregnancy (21). An explanation for this may be due to warnings and recommendations of reducing fish species high in contaminants such as Hg (22, 23).

1.2 Mercury (Hg)

1.2.1 General background

Hg is a toxic non-essential element and metal with atomic number 80 in the periodic table (24). The World Health Organization (WHO) considers Hg as one of the top ten chemicals of major public health concern (25). Hg occurs naturally in the environment and cycles between the atmosphere, water, ocean and land where it undergoes complex transformations between the different forms of Hg (25, 26). Humans are exposed to Hg during these biogeochemical cycles and this may result in various health implications (26). Both natural and anthropogenic sources contributes to Hg emissions throughout the environment (27).

1.2.2 Chemical forms

Depending on chemical state, Hg has various differences in toxicokinetics and toxicity (26). Hg exists in three main chemical forms: metallic or elemental Hg (Hg_0), inorganic Hg (Hg_2^{2+} and Hg^{2+}) compounds and organic Hg (Hg combined with carbon) compounds (26, 28). Metallic Hg is not combined with other elements and exists as a silvery liquid at ambient temperatures (29). Though it can evaporate and form Hg vapour (26) which is the predominant form of Hg in the atmosphere (27).

Inorganic Hg are compounds where Hg_2^{2+} and Hg^{2+} are combined with other elements such as oxygen, sulphur and chlorine. They are also referred to as Hg salts. Mercuric sulphide (cinnabar) is the main source of Hg that occurs naturally in the earth's crust and is the main component of Hg that is mined. Metallic Hg is extracted from Hg salts through high temperatures and is further used in several industrial processes due to the chemical and physical properties of Hg (29).

Organic Hg is Hg combined covalently with carbon. Methylmercury (MeHg) is the most common type of organic Hg and the compound of Hg of most concern due to its toxicological properties (30). Humans are predominantly exposed to MeHg through fish and seafood consumption (31). Intake of fish and seafood contaminated with MeHg are of particularly concern in pregnant women because of the neurotoxic effect of MeHg on foetal brain development (32). This thesis will mainly focus on the form MeHg.

1.2.3 Toxicokinetics of methylmercury

1.2.3.1 Absorption

It has generally been assumed that MeHg consumed from fish is highly absorbed in the gastrointestinal tract of humans with approximately 95-100% being absorbed (29, 33, 34). This is dissimilar to other Hg compounds where less than 0.01% of metallic Hg and less than 20% of inorganic Hg is absorbed from the gastrointestinal tract (29, 35, 36). However, a recent review from Bradley et al. (31) challenge the assumption that nearly 100% of MeHg is absorbed showing that there are large variations of absorption and bioavailability of MeHg. This variation was proposed to be due to several factors, including sources of Hg (type of fish species), cooking methods, gut microbiome, genetics and interaction with other nutrients (31).

1.2.3.2 Distribution

MeHg has a high affinity for sulfur and thiol (sulfhydryl, SH-) groups and when absorbed, MeHg from the diet is regularly bound to thiol groups of proteins or amino acids such as the amino acid cysteine (37). After absorption, MeHg is distributed from the blood towards all body tissues (29). However, the brain has shown higher affinity of MeHg compared to other body compartments and concentrations of MeHg in the brain are about 3-6 times higher compared to blood (37, 38). The complex of MeHg and cysteine is structurally analogous to the amino acid methionine and the transport of MeHg transport over the blood brain barrier is therefore most likely through the large neutral amino acid transporters (39, 40).

1.2.3.3 Excretion

MeHg has an overall biological half-life of 70-80 days in humans (41, 42). MeHg is excreted through several routes including faeces, urine, breast milk and hair. Excretion through bile and faeces are the main routes of elimination (26). MeHg is secreted into bile via formation of a glutathione complex in the hepatocyte. This complex can be reabsorbed from the intestine, although microorganisms in the intestine can demethylate MeHg and form inorganic Hg, which is poorly absorbed, and further be excreted through faeces (29).

1.2.3.4 During pregnancy

During pregnancy, the foetus is exposed to MeHg via placental transport, most likely, via the large neutral amino acid transporters (43). Several studies have found higher concentrations of Hg in cord blood than in corresponding maternal blood indicating that Hg accumulates at higher concentrations in foetuses compared to mothers (44, 45). The foetus brain is thereby exposed to MeHg via transport over the blood brain barrier (39). The foetus is more sensitive to the neurotoxic effects of MeHg than adults are and the toxic effects can cause irreversible damage to the brain (41).

1.2.4 Toxicity of methylmercury

1.2.4.1 Mechanisms of toxicity

All chemical forms of Hg are toxic to humans though toxicity depends of several factors including chemical form of Hg, exposure route, dose, age at exposure and duration of exposure (37). The toxic effects of Hg affects several body compartments and studies have shown adverse effects on central and peripheral nervous system, kidneys, cardiovascular system, liver, gastrointestinal system and immune system (37). MeHg is the compound of Hg

of most toxicological concern due to the primary target of toxicity are the brain and the central nervous system (38).

There seem to be no single mechanism that can explain the toxicity of MeHg in the nervous system. The literature describes a multiple approach of MeHg toxicity that leads to induced cell death, disturbed neuronal migration and differentiation in several neuronal cell types that are important for brain development, function and plasticity (38). One mechanism that has been suggested to explain the toxic effects is connected to the high affinity of MeHg to sulfhydryl and thiols groups (26). Sulfhydryl and thiol groups are important parts of the amino acids cysteine and methionine that are incorporated in proteins. MeHg may therefore interfere conformation and functions of proteins with binding to these amino acids. This can further disrupt protein, DNA and RNA synthesis and additionally affect important functions of these (37, 38).

The developing brain and central nervous system are particularly vulnerable to MeHg toxicity and foetuses are more sensitive to MeHg toxicity than adults are (38). Thereby, prenatal MeHg exposure is of most concern and pregnant women being the most vulnerable group of MeHg exposure (5).

1.2.4.2 Toxicity in humans

There have been two major epidemic poisonings where humans have been exposed to MeHg, occurring in Iraq and Japan (46).

From the late 1940-ies until 1968 a chemical factory in Japan released MeHg as a byproduct of acetaldehyde into the wastewater in Minimata Bay (47). Consumption of contaminated seafood with high concentrations of MeHg was the main source of exposure. Adults exposed to high concentrations of MeHg were found to develop serious neurological symptoms. Prenatally exposed children also presented severe disturbances in mental and motor development though the pathological changes in the affected foetal brain were more widespread and confused compared to the adult brain (46, 47).

In Iraq during the winter of 1971-1972, more than 6000 patients were hospitalised and 469 deaths occurred due to consumption of contaminated bread made from seed grains that were treated with fungicides containing MeHg (48). In adults, serious neurological symptoms were found, similar to those seen in Minimata, Japan (48, 49). Children born after prenatal high

exposure of MeHg had delayed onset of walking and talking, and abnormal findings on neurological examination.

The outbreaks of Minimata and Iraq were extremely high and thus these data cannot be extrapolated to general populations where MeHg exposure is much lower. Data on low and moderate prenatal MeHg exposure from seafood and child development are more inconclusive and studies have shown inconsistent results (50). This has been speculated to be because of different types of seafood consumed, maternal nutritional status, different study populations and use of different biomarkers (29, 41).

1.2.5 Mercury content in seafood

The main exposure to Hg in most humans are through dietary intake of fish and seafood in the form of MeHg (31). 80-100% of total Hg in fish is in the form of MeHg and 100% is often used as a conservative approach in exposure estimates (5, 6, 28). MeHg is primarily produced by methylation of inorganic Hg by microbial activity of microorganisms in aquatic systems. MeHg bioaccumulates through the aquatic food chain and reaches higher concentrations in the upper trophic levels of organisms. Thus, long-lived predatory fishes contain the highest concentrations of MeHg (30, 41). Thereby MeHg content in fish and seafood species varies extensively and depends on a variety of factors including species, trophic level, size, age and feeding (32). Hg content in different fish and seafood species are listed in Table 1.

Maximum levels for contaminants in food, including Hg, are listed in the Norwegian legislation “Lovdata” and follows the maximum levels set by the European Union Commission Regulation (EC). No. 1881/2006 of 19 December 2006. The maximum levels for total Hg in fishery products and muscle meat of fish are set to 0.5 mg/kg wet weight with the exception of some certain fish species that are not of regularly consume by humans (e.g. tuna and halibut) that are set to 1.0 mg/kg wet weight (51, 52). These limits are not based on health risk assessments and thus it is not necessarily safe to consume fish with Hg levels corresponding to these maximum levels in all population groups (53). VKM published a risk assessment of Hg in cod fillet in 2006. They concluded that pregnant women who eat more than one meal of cod per week, with a level of Hg exceeding 0.2 mg/kg, and has a general high seafood intake, may exceed the tolerable weekly intake (TWI) of MeHg and cod with a Hg content above 0.2 mg/kg is considered greatly contaminated (53).

Table 1. Mercury (Hg) levels in fish and seafood.

Seafood/fish species	mg Hg/kg [a]
Fish	
Atlantic cod fillet (wild)	0.069
Atlantic halibut (wild)	0.109 [b]
Atlantic herring fillet (wild)	0.052
Atlantic mackerel fillet (wild)	0.030
Atlantic salmon fillet (farmed)	0.017
Atlantic salmon fillet (wild)	0.018
Atlantic wolffish fillet (wild)	0.13
Haddock fillet (wild)	0.076
Ling fillet (wild)	0.180
Pollock fillet (wild)	0.140
Pollock fillet (wild)	0.140
Rainbow trout fillet (farmed)	0.018
Saithe fillet (wild)	0.059
Trout fillet (wild)	0.25
Shellfish	
Blue mussel meat (wild)	0.016
Brown crab claw meat (wild)	0.082
Brown crab innards (wild)	0.075
Lobster white meat (wild)	0.220
Scallop muscle and roe (wild)	0.018
Shrimp unpeeled (wild)	0.040
Predatory fish	
Perch, freshwater	0.150 [c]
Shark	0.979 [c]
Swordfish	0.995 [c]
Tuna	0.386 [c]
Other	
Atlantic cod liver	0.028
Atlantic cod roe	0.03 [d]
Whale meat	0.15 [e]

[a] Data are retrieved from Seafood data (https://sjomatdata.nifes.no) (54) and values are given in mean mg/kg from latest analysis year unless otherwise specified

[b] Hg content of atlantic halibut retrieved from Nilsen et al. 2016 (55) as latest analysis year in Seafood Data had a low sample size (n= 3) and large variations of Hg content in Atlantic halibut. Mean value of median Hg content in weight group 11-20 kg (0.098 mg Hg/kg. n= 154) and 21-40 kg (0.12 mg Hg/kg. n= 85) retrieved as this is most relevant for human consumption.

[c] Data retrieved from United States Food and Drug Administration (FDA) (56)

[d] Hg content of atlantic cod roe <limit of quantification (LOQ) of 0.03 mg/kg

[e] Hg content of whale meat retrieved from Julshamn et al. 2012 (57)

Seafood is the only notable source of MeHg for most humans. In other foods, Hg is generally present as inorganic Hg (5, 58). In MoBa, seafood contributed with 88% of total Hg exposure. The dietary groups of cereals, eggs, fruit and vegetables, chocolate and sweats contributed with 6%, 3%, 1% and 1%, respectively (13). In Norway, the main dietary source of MeHg is through consumption of lean fish contributing with about 80% of the exposure in adults and pregnant women (5). Cod is the fish species contributing with the largest part of the exposure, mainly because of the high consumption of cod (5).

1.2.6 Tolerable intakes of mercury

TWI is defined as the maximum intake of a substance, or a substance group, in food which can be consumed weekly over a lifetime without risking adverse health effects (59). These values are based on no observed effect levels (NOAELs) and/or lowest observed adverse effect levels (LOAEL) (60). NOAEL is defined as the highest level of a substance, where no detectable adverse effects occur in an exposed population. LOAEL is defines as the lowest level of a substance that has been observed to cause harm in an exposed population (59).

The Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Expert Committee on Food Additives (JECFA) established in 2003 a provisional TWI (PTWI) of MeHg of 1.6 µg/kg body weight (bw) (61). EFSA established in 2012 a TWI of MeHg of 1.3 µg/kg bw (28). Both the PTWI from JECFA and the TWI from EFSA are based on the most sensitive toxicological endpoint, being neurodevelopmental outcomes after prenatal exposure of MeHg. Both JECFA and EFSA have established a PTWI and TWI of 4 µg/kg bw for inorganic Hg (28, 62).

1.2.7 Measurement of mercury exposure

1.2.7.1 Biological samples

Human exposure to MeHg can be assessed by measuring Hg in several body matrices such as hair, blood, urine, cord blood, faeces, breast milk and nails (63). Biomarkers of MeHg exposure most commonly used are total Hg in hair and blood, which both are accepted as validated biomarkers to reflect dietary MeHg exposure from seafood (64-67). Several studies have shown strong correlations between fish consumption and biological Hg levels in humans (66, 68, 69).

1.2.7.2 Hair mercury levels

Measurement of total hair Hg (THHg) levels is frequently used in population studies and has several advantageous as it can reflect exposures that occurred several months earlier and exposure over a longer period of time. In addition, it is a non-invasive and inexpensive method that is easy to collect, transport, store and analyse (63, 70, 71). The predominant form of Hg in hair is MeHg, as it accumulates in hair at higher concentrations, with more than 80% of total Hg in the form of MeHg (64, 72, 73).

Incorporation of MeHg in hair occurs during formation of the hair follicle through binding to sulfhydryl groups (cysteine) of keratin (74). The amount incorporated is proportional to blood Hg levels at the time of formation and once incorporated in the hair, Hg does not return to the blood (37, 63).

In the case of MeHg, hair levels correlate well with Hg levels in blood and brain. At equilibrium, the ratio of hair-to-blood is approximately 1:250 (29). This ratio is used in most epidemiological studies, though it is a rough estimate and the ratio may vary according to individual variations such as age, gender, genetics, differences in hair growth and metabolism (74, 75).

1.2.7.3 Reference levels of mercury in hair

The United States Environmental Protection Agency (US EPA) has set a reference value of THHg of 1.000 µg/kg hair. This level is estimated to be without any harmful health effects during a lifetime, including sensitive subgroups such as foetus. The reference value were determined from NOAEL which were defined as 11.000 µg/kg. From this value, an uncertainty factor of 10 were used to determine the reference value of 1.000 µg/kg. Lowest LOAEL was defined as 52.500 µg/kg (76-78). The TWI of MeHg from EFSA are based on based on maternal THHg levels of 11.500 µg/kg as the basis for derivation of a health-based guidance value (28).

According to WHO, if average THHg concentrations in a study population exceeds the levels of 2.000 µg/kg there should be conducted a more comprehensive risk assessment of the population. If the average THHg level is < 2.000 µg/kg and there are few individuals that exceed the level of 2.000 µg/kg, no further actions are required (63).

1.3 Mercury exposure from seafood during pregnancy

Three large-scale, longitudinal prospective cohort studies in island populations have investigated the effects of moderate MeHg exposure from seafood intake during pregnancy and neurodevelopmental outcomes in offspring (79). These were performed at New Zealand, the Seychelles and the Faroe Islands and were established in the 1970s and 1980s. In the studies from the Faroe Islands (80) and from New Zealand (81), they found an association between in prenatal MeHg exposure and undesirable neurological development of the children including decreased IQ, language skills, motor speed, attention and visuospatial function. In the studies from the Seychelles, these findings were not seen, though the Hg levels in the children were similar to those seen in the studies from the Faroe Islands. In contrast, improved child development was correlated with increased MeHg exposure for some endpoints (82-84). Later findings from the Seychelles suggested that this contradictory effect may be explained by the beneficial effects of seafood and maternal status of n-3 LCPUFA that modulate the toxicological effects of MeHg from seafood (85, 86).

The birth cohort MoBa have also investigated associations between maternal seafood intake and prenatal Hg exposure with birth weight and child language development. They found positive associations between maternal seafood intake during pregnancy and increased birth weight and language and communication skills at three and five years. However, they also found that MeHg exposure from seafood intake reduced the beneficial effects of seafood in the highest group of MeHg exposure (though still below the TWI set by EFSA). The studies concluded that seafood and fish intake during pregnancy have an overall beneficial effect on prenatal development but highlights that the effect of low-MeHg exposure still needs our attention and that more knowledge is needed in the case of prenatal MeHg exposure below the TWI of 1.3 ug/kg bw set by EFSA (13, 87, 88).

In the British birth cohort the Avon Longitudinal Study of Parents and Children (ALSPAC) they found that fish intake during pregnancy was associated with increased development of language and communication skills in infant. Total Hg concentrations of umbilical cord blood were analysed and levels increased with maternal fish intake, but were not associated with development in infant (11).

1.4 Dietary assessment

There are several dietary assessment tools used to measure dietary intake and the habitual diet in a population or individuals. This includes food frequency questionnaire (FFQ), 24-hour dietary recall, duplicate diet approach, weighed dietary record and dietary history. FFQs are commonly used in large population studies because of being feasible, timesaving and cost-efficient (89). A FFQ measures dietary intake retrospectively and the participants are asked of how often they consume specific food groups over a specific period of time (e.g. last month, last six months etc.) (90). In addition, several FFQs includes questions regarding portions sizes to estimate quantity of the foods eaten (semi-quantitative FFQ) (91). In order to develop a valid and reliable FFQ that can assess the true dietary intake each FFQs developed must be validated for the specific population (e.g. pregnant women) and food group (e.g. seafood) investigated (92). This has often been performed with other more accurate dietary assessment methods such as 24-hour recalls and weighed dietary records (90) or with biochemical markers of intake (93).

2 Aim of thesis

This thesis is a part of the study Mommy´s Food where the overall aims are to investigate if an increased intake of cod during pregnancy has an impact on maternal iodine status and infant development in a two-armed RCT with cod for 16 weeks (gestational week 20-36) (94).

When studying the positive health effects of maternal seafood intake on foetal health it is in addition important to take into account the compounds in seafood that impact foetal health in an undesirable manner. This includes the impact of MeHg. To my knowledge, there are currently no other dietary RCTs with fish during pregnancy investigating the impact on THHg levels. Cod is a fish species relatively low in Hg, though because of the high amounts eaten it contributes to the largest amount of dietary MeHg exposure in Norway (5).

Based on the above, the overall aims in this thesis were to investigate if an increased intake of cod during pregnancy has an impact on THHg levels, and to investigate the impact of the habitual dietary seafood intake on THHg levels in pregnant women.

The specific aims were to investigate:

- If there are any difference in THHg levels between the control and the intervention group post-intervention.
- If there are any difference in the change of THHg levels (ΔTHHg) from pre- to post-intervention between the control and the intervention group.
- If there are any difference in THHg levels between the control and the intervention group at 6 months postpartum.
- If THHg levels and dietary MeHg intake from seafood estimated from a FFQ are within the reference value of THHg set by US EPA and the TWI of MeHg set by EFSA, respectively, pre- and post-intervention.
- If THHg levels are correlated with seafood intake and dietary MeHg intake from seafood estimated from a FFQ pre- and post-intervention.

3 Methods

3.1 Study design

The study Mommy's Food is a collaboration between section of Food Security and Nutrition at Institute of Marine Research (IMR) and Regional Centre for Child and Youth Mental Health and Child Welfare (RKBU). Mommy's Food is a dietary two-armed RCT with cod during pregnancy. The overall aims in the study are to investigate if an increased intake of cod during pregnancy has an impact on maternal iodine status and infant development. The intervention trial with cod lasted from gestational week 20-36. The study design is further described in detail in Markhus et al. (94). A flow-chart of the study design, participants and data relevant for this thesis are presented in Figure 2.

3.2 Study population

3.2.1 Recruitment

The recruitment process took place from December 2015 to February 2017. The participants were recruited through the Women's clinic at Haukeland University Hospital, Bergen and were given information about the study in the postal mail with the invitation for the routine ultrasound in gestational week 17-19. In addition, information about the trial and invitation to participate were broadcasted through social media (Facebook, Instagram and Babyverden.no). Those who were interested in participating in the study contacted the researchers at IMR. Inclusion criteria were prim parous, singleton pregnancy, ≤ gestational week 19 and Norwegian speaking (due to validated tests of the child in Norwegian). Exclusion criteria were fish allergies and chronic diseases known to affect iodine status (hypothyroidism, hyperthyroidism, Grave's disease, Thyroiditis, Thyroid Nodules).

The participants met for first meeting with the researchers at IMR in gestational week 18 where informed consent were filled out, instructions from the researchers given and baseline samples (including hair samples) collected.

3.2.2 Randomisation, allocation and blinding

The participants returned in gestational week 19 and were allocated into two groups (intervention group or control group) by the researchers at IMR. The participants randomised themselves by individual lottery. To ensure equal allocation to both study groups the lottery were in blocks of 10. Each participant received a random study ID-number between 1 and

200. The RCT was not blinded as blinding of the pregnant women were not possible. Analyses of data were completed blinded considering intervention groups with use of dummy variables of ID-number.

3.2.3 Sample size and power

The power calculation of sample size is based on data of daily iodine intake and urinary iodine concentration from the cohort "Little in Norway" (LiN) study as the primary outcome in Mommy's Food was maternal and infant iodine status. A sample size of 60 women per group were calculated to have a 95% power to detects a 30% higher urinary iodine concentration in the intervention group compared to the control group with a significance level of $\alpha = 0.05$. A dropout rate of 20% were expected and totally 144 participants aimed to be enrolled in the study.

3.3 Ethics

The study was approved by the Regional Committees for Medical and Health Research Ethics West (REK west, 2015/879) and is registered in ClinicalTrials.gov (NCT02610959). The study is conducted and performed according to the declaration of Helsinki (1975). Participation in the study was voluntary and written informed consent was obtained from the pregnant women. The participants could withdraw from the study at any time without giving any reason and this was highlighted in the declaration of informed consent. Providing of biological samples from mother and child were optional. Data from all participants were treated confidential. Biological samples are stored in a specific research biobank at IMR that is scheduled to expire in 2025. Optimally, in a RCT with cod the control group should be instructed to exclude cod from the diet. However, due to ethical reasons for this vulnerable group (pregnant women) this was not possible. There were no restrictions of foods or dietary supplements in either the intervention or the control group.

3.4 Dietary intervention

The intervention group received frozen skin- and boneless cod fillets (Lerøy A/S, Bergen, Norway, bought after tender) of 200 g and were instructed to consume two intervention meals weekly (a total of 400 g cod per week). They also received cod for their living partner and a recipe booklet for inspiration, but were free to choose preparations methods and recipes

themselves, including choice of side dishes. The control group was instructed to continue with their habitual diet.

3.4.1 Dietary compliance

To record dietary compliance the participants in the intervention group received a scale (Kitchen Scale, article no. 34-1207-16, ClasOhlson.com) and were instructed to weigh the cod fillet after thawing and before preparing the meal and eventual after the meal if there were any leftovers. The participants recorded the data in a weight registration form together with week number of the intervention and cooking method.

3.4.2 Food safety

Before study start, the maximum intake of 400 g of cod fillets per week was estimated to contribute with 22% of the TWI of MeHg and 4% of the TWI of dioxins and dl-PCBs (data from https://sjomatdata.nifes.no). This calculation was based on the 5-percentile weight of the women in the LiN study (56 kg). The cod fillets the participants in the intervention group received were further analysed for total Hg content (n= 30). The cod fillets were freeze-dried prior Hg analysis with Direct Mercury Analyzer (DMA-80) (principles of DMA-80 total Hg analysis are given in section 3.6.2). When calculating MeHg intake from study meals and comparing it with the TWI of MeHg set by EFSA, a conservative approach of 100% of total Hg in the form of MeHg was used.

3.5 Data collection

3.5.1 Hair samples

Collection of hair samples for Hg analysis of the mothers were performed by the researchers at IMR in gestational week 18 and 36, pre- and post- the intervention period respectively, and at 6 months postpartum. Hair samples were obtained by cutting a hair-bundle of 2-5 mm with a stainless steel scissor, as close to the scalp as possible from the occipital area of the head. A dental floss was tied around the hair-bundle closest to the hair root to makes sure of using this end for analysis. Hair samples were stored in zip-bags in room temperature in a locked safe, labelled with project number, mother and ID-number pending on analysis.

3.5.2 Dietary assessment

The participants answered an electronic questionnaire in gestational week 18 and 35 (pre- and post-intervention, respectively), and 3, 6, and 11 months postpartum. A FFQ was included in the questionnaire and was used to acquire information about the participants' habitual diet. The questionnaire from pre- and post-intervention were used in this thesis (appendix III and IV), in addition to some dietary data from the questionnaire at 6 months postpartum.

The FFQ was based on a validated semi-quantitative short seafood FFQ developed to analyse intake of seafood (fish and shellfish) and dietary supplements during pregnancy and postpartum (95), and further extended specifically for this study. The FFQ included detailed questions about seafood intake and the participants were asked to give an estimate of their diet the past months (from pregnancy until gestational week 18 at pre-intervention, last 16 weeks at post-intervention, last 3 months at 6 months postpartum).

The FFQ included three summary questions regarding frequency of seafood intake as dinner, warm lunch and as bread spread, in salads or as a snack meal (from now on referred to as spread). For the summary questions frequency intervals ranged between *"never"* to *"four times a week or more*" for seafood as dinner and lunch, and from *"never"* to "*five times a week or more"* for seafood as spread. Due to a more frequent intake of bread in Norway, the maximum frequency was higher for spread than for dinner and warm lunch. There were in addition 26 detailed questions regarding frequency of seafood intake as dinner and warm lunch and 14 detailed questions regarding frequency of seafood intake as spread, focusing on type of seafood species and products. For all detailed questions frequency intervals ranged from *"never"* to *"three times a week or more"*. Both summary and detailed questions had follow-up questions concerning portion sizes per meal, with five different sizes ranging from *"half a portion or less"* to *"three portions"* (*"three portions or more"* for summary questions of dinner and lunch). One portion was equivalent to 150 g fatty fish, 200 g lean fish, 12 bites of sushi, 3 fish cakes, 6 fish balls, 7 fish fingers or 2 dl shrimps without shell. The report "Weights, measures and portion sizes for foods" from the Norwegian Food Safety Authority, University of Oslo and the Norwegian Directorate of Health was used to estimate portion sizes (96). Estimated portion sizes of the seafood species from the FFQ are given in appendix II. If the participants had eaten other seafood items than those specified in the detailed questions, they could specify it in two open spaces questions. There was also one question regarding intake of fish roe and fish liver with frequency interval ranged from *"never"* to *"≥*

10 times a year". The participants were asked to include intake of the eventual received cod in the FFQ from gestational week 35 (post-intervention).

In addition, the questionnaire included questions about consumption of other food items (such as dairy products, meat, grain products, fruit and vegetables), demographics, anthropometry, physical activity, social environment and lifestyle.

3.6 Data processing

3.6.1 Processing of hair samples

To investigate Hg exposure during pregnancy, before and during the intervention with cod, 2 cm of the hair sample closest to the scalp was used for analysis. According to LeBeau et al. (97), 2 cm hair sample collected as close to the scalp as possible will equal Hg exposure 5.2±0.8 to 12.4±1.6 (95% confidence intervals (CI)) weeks prior to collection. This calculation was based on a literature review of published growth rates of human head hair that showed an average hair growth of 1.06 cm/month and the assumption that it takes two weeks before hair formed in the follicle reaches the scalp. In addition, the calculations from LeBeau et al. were based on a separate study where they evaluated the ability to uniformly collect hair as close to the scalp as possible. They revealed that an average of 0.8±0.1 cm (95% CI) of the hair is left at the scalp after cutting when instructed to cut the hair as close to the scalp as possible. Based on this calculation, 2 cm hair sample from pre- and post-intervention will correspond to Hg exposure from gestational week 5.6±1.6 to gestational week 12.8±0.8 (95% CI) and from gestational week 23.6±1.6 to gestational week 30.8±0.8 (95% CI), respectively. 2 cm hair sample from 6 months postpartum correspond to Hg exposure 2.9± 0.4 to 4.7±0.2 (95% CI) months postpartum.

2 cm of each hair sample was measured precisely with a ruler and further cut off with a stainless steel scissor. The 2 cm hair sample was positioned in separate metal boats (nickel) and weighed on a calibrated four decimal scale from Sartorius (CP124S, USA) or Ohaus (Explorer Analytical, USA). The calibration of the scales are controlled every week.

Optimally the hair sample should weigh between 10 to 20 mg though the hair samples in this study varied between 3.4 mg to 27.0 mg with a mean (standard deviation (SD)) of 12.0 (4.9) mg. Weight and ID-number of each hair sample were manually noted, and the metal boats were put on tray marked with position number prior analysis.

3.6.2 Analysis of hair samples with DMA-80

The hair samples were analysed for total Hg with atomic absorption spectrophotometry in DMA-80, Milestone Srl, Italy. There are 40 positons for metal boats per analysis series in DMA-80. There was analysed 32 hair samples per full analysis series where there were empty metal boats in position 1 and 2 to make sure of no contamination and reference material at position 3, 4, 21, 22, 39 and 40 to check the accuracy of the analysis. The hair samples from pre- and post-intervention were analysed in similar analysis series. Samples from 6 months postpartum were analysed separately as collection of these hair samples was not completed until April 2018. There were equal number of samples from the intervention and the control group in each analysis series. Prior to analysis in DMA-80 the metal boats were burned/cleaned in a muffle furnace, Carbolite ELF 11/14B at 650°C in 30 minutes to make sure of avoidance of contamination from previous samples.

3.6.2.1 Analysis quality

Certified Reference Material for trace metals were included in the analyses to assess the accuracy and quality of the analysis. To check the accuracy of the analysis 10 mg of Reference Material Human Hair, IAEA-086 (International Atomic Energy Agency, Austria) and Tort-3: Lobster Hepatopancreas Reference Material for Trace Metals (National Research Council, Canada) were used as reference material. The certified values of Reference Material Human Hair, IAEA-86 and Tort-3 are respectively 573 µg/kg and 292 µg/kg for Hg. The values were registered in a control card at MRI and with the exception of one value (77.3% of certified value of Reference Material Human Hair), all registered values were within accepted area of the analysis (± 20%). Human Hair had a mean accuracy of 88.3% (% relative SD: 4.5%) and Tort-3 had a mean accuracy of 92.1% (% relative SD: 1.8).

3.6.2.2 Principles of DMA-80

An illustration of DMA-80 is given in Figure 1. Samples are separately submitted automatically into a sample exchanger (auto sampler) and enters a chamber where the sample is dried and thermally and chemically decomposed in an oxygen rich furnace (450°C), which releases all Hg from the sample through evaporation. The decomposed products, including evaporated Hg, are carried to the catalytic section of the furnace by a constant flow of oxygen. Evaporated Hg (elemental Hg) is then selectively trapped on a gold amalgamator. To remove remaining decomposition products the system is flushed with oxygen. The gold amalgamator is reheated (650°C) and evaporated Hg is released and carried through two cuvettes, long cell

(specific for lower concentrations) and short cell (specific for higher concentrations), positioned in the light of a Hg lamp with specific wavelength for Hg. Hg content is determined by single wavelength atomic absorption spectrophometry at 253.65 nm. The amount of light absorbed is proportional to the amount of Hg in the cuvette. Determination of the amount of Hg in the hair sample is through an external calibration curve.

Certified Reference Material used for the calibration were:

- Bovine Liver 1577c, Standard Reference Material, National Institute of Standards and Technology, US. 5.36 µg Hg/kg
- Skimmed Milk Powder, ERM-BD150, European Reference Materials, 60 µg Hg/kg
- Tort-3, Lobster Hepatopancreas Reference Material for Trace Metals, National Research Council of Canada, 292 µg Hg/kg
- Fish Muscle, ERM-BB422, European Reference Material, 601 µg Hg/kg
- Dolt-4, Dogfish Liver Certified Reference Material for Trace Metals, National Research Council of Canada, 1330 µg Hg/kg
- Tuna Fish, ERM-CE464, European Reference Material, 5240 µg Hg/kg

DMA-80 is calibrated in the linear area of Hg from 1.5-1000 ng. For samples in this area the accuracy is 80-120%. Of 363 hair samples analysed 3.9% (n= 14) had an Hg content of < 1.5 ng. The limit of detection (LOD) is calculated to 0.02 ng and the limit of quantification (LOQ) is calculated to 0.08 ng. The results of total Hg in the hair samples were manually obtained from the software system of DMA-80.

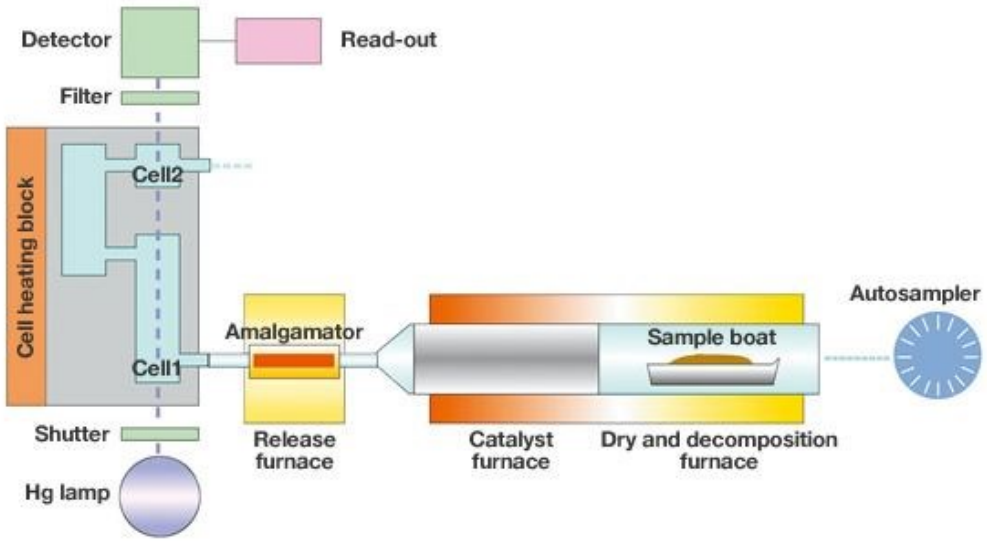

Figure 1. Principles for analysis of total mercury in hair with Direct Mercury Analyzer (DMA-80) (Picture: www.milestone-general.com (98))

3.6.3 Dietary intake of seafood estimated from the FFQ

The data from the FFQ provided ordinal categorical variables (e.g. 1-3 times/month and 2-3 times/week). In order to use the data from the FFQ to summarize and quantify estimation of seafood intake the ordinal categorical data were converted to numerical continuous data through calculation of indexes. The calculations of indexes were based on the development and validation of a seafood index from a validated semi-quantitative short seafood FFQ developed from Markhus et al. (95). This method stratifies the seafood intake into numerical interval and thereby making it possible to summarize several types of seafood (e.g. lean fish, fatty fish, and processed seafood) and estimate intake of total seafood in g per week, which further was used in statistical analyses.

The reported frequency of seafood from the FFQ were firstly converted to numerical interval of intake per week and then to a seafood index. The seafood index is calculated to correspond to seafood intake per week. For example, a seafood index of 2 is equivalent to twice a week. When calculating seafood index for summary questions, the average weekly frequency of seafood from the FFQ was used if the alternative of the answer contained an interval (Table 2 and Table 3). For example, an interval of 2-3 times/week is equivalent to a seafood index of 2.5 per week for summary questions. When calculating seafood index for the detailed questions, the lowest possible weekly intake was used if the alternative of the answer contained an interval (Table 4). This due to recall is prone to overestimate low intakes when asked about several detailed species separately (95). For example, an interval of 1-2 times/week is equivalent to a seafood index of 1 per week for detailed questions.

Table 2. Conversion of ordinal categorical data from the FFQ to numerical continuous data and seafood index (95). Summary questions for seafood intake as dinner and warm lunch.

Reported frequency	Numerical interval per week [a]	Seafood index (intake/week) [b]
Never	0	0
< 1 time/month	>0-0.25	0.15
1-3 times/month	0.25-0.75	0.5
1 time/week	1	1
2-3 times/week	2-3	2.5
≥ 4 times/week	≥ 4	4

Abbreviations: FFQ, food frequency questionnaire

[a] Numerical interval per week based on the reported average weekly frequency of seafood from the FFQ

[b] Seafood index based on the average weekly intake of summary question of seafood as dinner and warm lunch

Table 3. Conversion of ordinal categorical data from the FFQ to numerical continuous data and seafood index (95). Summary questions for seafood intake as spread.

Reported frequency	Numerical interval per week [a]	Seafood index (intake/week) [b]
Never	0	0
Rare	>0-0.25	0.15
1-3 times/month	0.25-0.75	0.5
1-2 times/week	1-2	1.5
3-5 times/week	3-5	4
≥ 5 times/week	≥ 5	5

Abbreviations: FFQ, food frequency questionnaire
[a] Numerical interval per week based on the reported average weekly frequency of seafood from the FFQ
[b] Seafood index based on the average weekly intake of summary questions of seafood as spread

Table 4. Conversion of ordinal categorical data from the FFQ to numerical continuous data and seafood index (95). Detailed questions for seafood intake as dinner, warm lunch and spread.

Reported frequency	Numerical interval per week [a]	Seafood index (intake/week) [b]	Processed fish products [d]	Sushi [e] and shrimps (unpeeled) [f]
Never	0	0	0	0
< 1 time/month	> 0-0.25	0.1 [c]	0.05	0.0333
1-3 times/month	0.25-0.75	0.25	0.125	0.0833
1-2 times/week	1-2	1	0.5	0.333
≥ 3 times/week	≥ 3	3	1.5	1

Abbreviations: FFQ, food frequency questionnaire
[a] Numerical interval per week based on the reported average weekly frequency of seafood from the FFQ
[b] Seafood index is based on the lowest possible weekly intake of detailed questions of seafood as dinner, warm lunch and spread
[c] Seafood index set to 0.1 to enable distinction between the two lowest intake frequencies
[d] Processed fish products as dinner/lunch halved prior calculating seafood index due to typically 40-60% content of fish (5)
[e] Sushi as dinner/lunch divided by three prior calculating seafood index due to typically 33% content of fish (5)
[f] Shrimps (unpeeled) as dinner/lunch divided by three due to 33% edible part (96)

Processed fish products usually consist of 40-60% pure fish (5). Thus, the lowest possible weekly intake of processed fish as dinner/lunch was halved prior calculating the seafood index for processed fish products. Sushi as dinner/warm lunch was divided by three prior calculating the seafood index as also performed by VKM in the benefit-risk assessment of fish and fish products in the Norwegian diet from 2014 (5). Shrimps (unpeeled) as dinner/lunch was divided by three prior calculating seafood index as 33% of unpeeled shrimps are edible (96). The calculated seafood index for each questions was thereby multiplied by the reported portion sizes to calculate seafood consumption in portions per week. Portions per week of the specific seafood/fish species was further multiplied by estimated portion sizes in g from the FFQ (appendix II) to calculate seafood consumption in g per week. Detailed questions of dinner and warm lunch of similar seafood/fish species were summarized to get a total intake

of the specific species in g per week (e.g. cod for dinner and warm lunch were summarized). Seafood intake in g per week was thereby summarized into categories as shown in Table 5.

Table 5. Summarization of seafood and fish categories derived from the FFQ

Summarized category	Questionnaires from the FFQ
Summary questions	
Seafood as dinner, warm lunch and spread	Seafood as dinner, seafood as warm lunch and seafood as spread
Detailed questions	
Fatty fish	>5% fat content: Salmon/trout, mackerel, halibut, herring
Lean fish	≤5% fat content: Cod, saithe, pollock, ling, wolffish and dried and salted cod
Processed seafood	Fish burgers, fish balls, fish pudding, fish au gratin, fish fingers
Shellfish	Shrimps (unpeeled), brown crab claw meat, brown crab innards, lobster, blue mussel, scallop
Spread	All questions regarding seafood and fish spread in FFQ
Total fish	Fatty fish, lean fish, sushi, fish soup and processed seafood for dinner or lunch
Total seafood	Fatty fish, lean fish, sushi, fish soup, processed seafood, shellfish, spread, fish roe and fish liver (all questions regarding seafood in the FFQ)

Abbreviations: FFQ, food frequency questionnaire

3.6.4 Dietary compliance of the intervention with cod

Data from the weight registration form were used to calculate dietary compliance in the intervention group. To calculate total g cod eaten each meal, g cod *after* preparation of the meal were subtracted from g cod *before* preparing the meal. Total g cod for each meal during the intervention period was then summarized to get a value of total g cod eaten during the intervention period. Total intake of cod was divided by 16 weeks to get a mean weekly intake of cod. Total intake of cod was divided by maximum intake of cod during the intervention period (200 g x 32 meals= 6400 g) and multiplied with 100 to get a compliance score. Example a total intake of 6400 g during the intervention or a mean intake of 400 g cod per week provided a compliance score of 100.

Participants who reported eating cod or fish other than delivered (e.g. at restaurants or work) in the weight registration form were recorded as zero due to not eating delivered cod as by protocol.

3.6.5 Calculation of dietary MeHg intake from study meals and seafood intake

When calculating MeHg intake from the study meals of cod and from seafood intake reported from the FFQ, a conservative approach of 100% of Hg in the form of MeHg was used and estimated intake of Hg is presented as estimated MeHg intake.

Total and weekly intake of MeHg from the study meals in the intervention group were calculated using the analysed value of the cod the participants in the intervention group received. The analysed value of Hg in the study meals of cod was not used when calculating MeHg intake from the FFQ from post-intervention in the intervention group. This was due to there was no distinction between cod received or cod bought in the FFQ.

To calculate MeHg exposure from seafood intake from the FFQ, concentrations of total Hg of fish, seafood and seafood products of the Norwegian market were retrieved from Seafood Data (https://sjomatdata.nifes.no) (54), or elsewhere if not available here and are specified. Data on Hg content in different seafood and seafood species used for calculation are given in appendix II. Mean values of Hg content in mg/kg from latest analysis year were compiled unless otherwise specified. Hg content of sushi, processed fish products (fish burgers, fish balls, fish pudding, fish gratin and fish fingers) and fish soup were not available. To calculate dietary MeHg intake from these products the seafood species used for calculation of MeHg consumption in the benefit-risk assessment of fish and fish products in the Norwegian diet from VKM in 2014 was used (5).

Estimated dietary Hg intake from seafood was calculated using data from weekly consumption (g/week) of different seafood species and products calculated from the FFQ and thereby multiplied with the Hg content of seafood species (appendix II). Dietary MeHg intake are given in µg per week. Dietary MeHg intake from seafood was thereby summarized in separate categories as shown in Table 5. Mean intake of MeHg from each category was divided by mean total MeHg intake from seafood and multiplied with 100 to get a percentage (%) of total MeHg intake from seafood. To calculate estimated MeHg intake from seafood per kg/bw, total dietary MeHg intake from seafood, fish and spread were divided by pre-pregnancy bw in kg reported from the questionnaire. This value was further divided by the TWI of MeHg (1.3 µg/kg) set by EFSA and multiplied with 100% and presented as percent MeHg intake from total seafood of TWI of MeHg.

3.7 Statistics

All statistical analyses were performed using IBM SPSS Statistics version 25 (IBM Corporation). Figures and tables were made using Microsoft Office Excel 2013 or IBM SPSS Statistics version 25 (IBM Corporation). *P* values <0.05 were considered statistically significant. Two-sided statistical tests were performed.

Descriptive results are reported as frequency (%) for categorical variables and mean (SD) or median (interquartile range (IQR)) for continuous variables where appropriate. Where appropriate, minimum and maximum values are in addition reported.

The variables were tested for normality by using the Kolmogorov-Smirnov test and by visual inspection of Q-Q plots and histograms. For non-normally distributed data, variables were $\log_{10}$ transformed with the attempting to fulfil normality.

For categorical data, chi-square test or Fisher's exact test (if > 20% of expected values had frequencies < 5) were used to compare differences between groups. For continuous normally distributed data, parametric statistical tests were used. Independent *t*-test was used to compare differences between groups and paired sampled *t*-test was used for differences within groups. If data were not normally distributed after $\log_{10}$ transformations, non-parametric statistical tests were used. Mann-Whitney U-test was used to compare differences between groups and Wilcoxon signed-rank test was used test for differences within groups.

THHg levels was not normally distributed and $\log_{10}$ transformed values are thus used in statistical analyses of comparisons between groups, difference between pre- and post-intervention and difference between post-intervention and 6 months postpartum. For the changes in THHg levels between the intervention and control group independent *t*-test was performed. In addition, a one-way analysis of covariance (ANCOVA) was performed with using pre-THHg as a covariate for adjustments.

Most variables of seafood intake in portions/week, seafood intake in gram/week and dietary MeHg intake from seafood were not normally distributed after $\log_{10}$ transformations and thereby original values were used in non-parametric statistical tests.

For correlation analyses between THHg levels with seafood intake and dietary MeHg intake from seafood, Spearman's rank order correlation coefficient was used. Most variables of seafood intake and dietary MeHg intake were not normally distributed (also after $\log_{10}$ transformation) and contained outliers. Compared to Pearson correlation, Spearman

correlation is not as sensitive to extreme values and may be more reliable where outliers are present (99). Correlations between original THHg values were performed with seafood intake in portions/week (summary questions), gram/week (detailed questions) and estimated MeHg intake in μg/week from seafood. The correlation coefficients strength (effect size) was considered small if <0.30, moderate if 0.30-0.49 and large if ≥0.50 in according to Cohen's (100) and previously used dietary methods (101).

4 Results

4.1 Study population

A flow chart of the participants in Mommy's Food and data included in this thesis are shown in Figure 2. There were in total 137 women enrolled in the study, which signed the informed consent. Between baseline (gestational week 18) and randomisation (gestational week 19), 4 women withdraw from the study and thus 133 women were randomised to the study. During the intervention period, 8 women withdraw from the study (5 in the intervention group and 3 in the control group) and 4 women were lost to follow-up (2 in the intervention group and 2 in the control group) at the follow-up visit post-intervention (gestational week 36). In total 121 participants were analysed for THHg levels pre- and post-intervention, which was the main outcome of this thesis. In addition, 105 participants were analysed for THHg levels at 6 months postpartum.

4.2 Baseline characteristics

4.2.1 Demographics

Baseline characteristics of the study population are given in Table 6. There were no significant differences in baseline characteristics between the control and the intervention group. Mean (SD) age was 29.3 (3.8) years. Mean (SD) pre-pregnancy body mass index (BMI) was 23.2 (4.1) and 76% of the participants had a BMI within 18.5 and 25.0, which is the range of normal weight (102). 86% of the participants had a college or university degree and 60% had more than four years of college or university education. Participants who withdrew or were lost to follow-up (dropouts) during the intervention (from pre- to post-intervention) had lower age (p= 0.003), lower level of education (p= 0.015) and lower income (p= 0.014) compared to the completers at pre-intervention (data not shown). In the group of dropouts that were randomised there were no significant differences between the control and the intervention group (data not shown). Other variables of demographics did not differ significantly between completers and dropouts.

4.2.2 Total hair mercury (THHg) levels

The median (IQR) levels of THHg for all participants (n=137) enrolled in the study were 510 (327-747) µg/kg pre-intervention (Table 6). Mean (SD) levels were 573 (349) µg/kg. THHg levels ranged from 27 to 2048 µg/kg. There was no significant difference between the

intervention (525 (362-747) µg/kg) and the control group (519 (306-791) µg/kg) pre-intervention. In total 14 participants (10.2%) had THHg levels above 1000 µg/kg, 4 in the control group and 10 in the intervention group. The completers of the study had higher THHg levels pre-intervention compared to dropouts (median (IQR): 532 (357-789) µg/kg vs. 344 (229-612) µg/kg, however, not significant (p= 0.07). Pre-intervention, in the group of dropouts, there was no significant difference (data not shown, p= 0.38) in THHg levels between the intervention and the control group of the randomised participants.

Table 6. Baseline characteristics of all participants (pregnant women) enrolled in Mommy's Food and by randomly allocated control- or intervention group.

Characteristics	N	All	Control	Intervention	*P*
Demographics					
Age (years), mean (SD)	127	29.3 (3.8)	29.1 (3.6)	29.7 (3.9)	0.39 [a]
Gestational age (weeks), mean (SD)	127	19.0 (1.3)	19.0 (1.2)	19.1 (1.4)	0.55 [a]
Pre-pregnancy BMI (kg/m^2), mean (SD)	124	23.2 (4.1)	23.3 (4.37)	23.1 (3.9)	0.76 [a]
Marital status, n (%)					
Married	127	42 (33)	19 (32)	22 (34)	0.92 [b]
Cohabiting		81 (64)	39 (65)	40 (63)	
Other		4 (3)	2 (3)	2 (3.)	
Education level, n (%)					
Lower secondary school	127	2 (1.6)	0 (0)	1 (1.5)	0.87 [b]
Higher secondary school		16 (13)	7 (12)	9 (14)	
≤4 y university/college		33 (26)	15 (27)	18 (28)	
>4 y university/college		76 (60)	38 (63)	37 (57)	
Total household income (NOK), n (%)					
<200,000-349,000	127	12 (10)	6 (10)	5 (8)	0.30 [b]
350,000-749,999		35 (28)	16 (27)	19 (29)	
750,000-1,249,999		63 (50)	30 (50)	32 (49)	
1,250,000->2,000,000		17 (13)	8 (13)	9 (14)	
THHg (µg/kg), median (IQR)	137	510 (327-747)	525 (362-747)	519 (306-791)	0.67 [c]
Habitual diet (portions per week)					
Seafood intake as dinner, mean (SD)	127	1.6 (1.0)	1.4 (0.9)	1.8 (1.2)	0.20 [d]
Seafood intake as warm lunch, mean (SD)	127	0.4 (0.5)	0.4 (0.6)	0.3 (0.4)	0.96 [d]
Seafood intake as spread, mean (SD)	127	2.1 (2.9)	2.2 (3.1)	2.0 (2.7)	0.81 [d]
Cod, mean (SD)	125	0.4 (0.4)	0.4 (0.5)	0.5 (0.5)	0.12 [d]
Supplement					
Fish oil – yes, n (%)	111	39 (35)	18 (35)	20 (35)	0.42 [b]
Omega-3 capsules – yes, n (%)	112	44 (39)	20 (36)	22 (40)	0.85 [b]

Abbreviations: IQR, interquartile range; NOK, Norwegian kroner; SD, standard deviation; THHg, total hair mercury; y, years

[a] Independent *t*-test for difference between intervention and control group

[b] Fisher's exact test for difference between intervention and control group

[c] Independent *t*-test of $\log_{10}$ values for difference between intervention and control group

[d] Mann-Whitney U-test for difference between intervention and control group

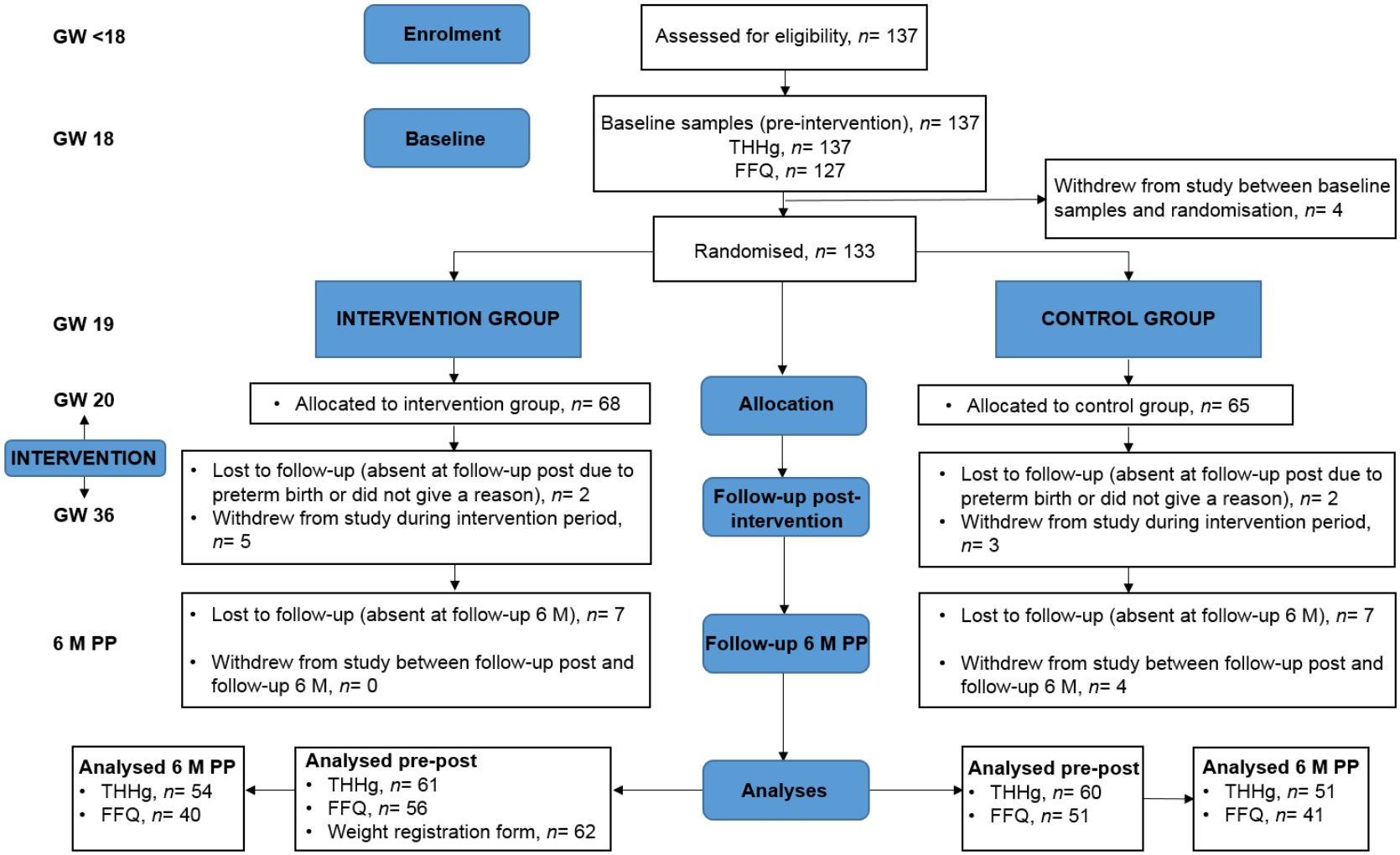

Figure 2. Flow chart of the participants (pregnant women) in the randomised controlled trial with cod, Mommy's Food, and data included in this thesis.
Abbreviations: FFQ, food frequency questionnaire; GW, gestational week; M, months; PP, postpartum; THHg, total hair mercury

4.3 Seafood intake pre-intervention reported from the FFQ

Of the 137 participants enrolled in the study, data from the FFQ were available for 127 pre-intervention (replied in gestational week 18). Pre-intervention, there were no significant differences in seafood intake between completers and dropouts of the intervention, except for seafood as warm lunch (mean (SD): completers: 0.3 (0.5) vs. dropouts: 0.7 (0.7) (p= 0.026) (data not shown).

4.3.1 Summary questions of seafood intake from the FFQ pre-intervention

Reported frequency of seafood as dinner, warm lunch and as spread, pre-intervention, in all participants, from the FFQ are presented in Figure 3 and Figure 4. In total, 43% of the participants had seafood for dinner 2-3 times/week. Mean (SD) portions of seafood for dinner and as warm lunch were 1.6 (1.0) and 0.4 (0.5), respectively (Table 6). Approximately 50% of the participants had an intake of more than two portions of seafood for dinner per week (data not shown). Mean (SD) intake of seafood as spread was 2.1 (2.9) portions per week. Median (IQR) was 1.0 (0.2-3.0). There were no differences between the intervention and the control group regarding any of the summary questions of seafood pre-intervention (Table 6).

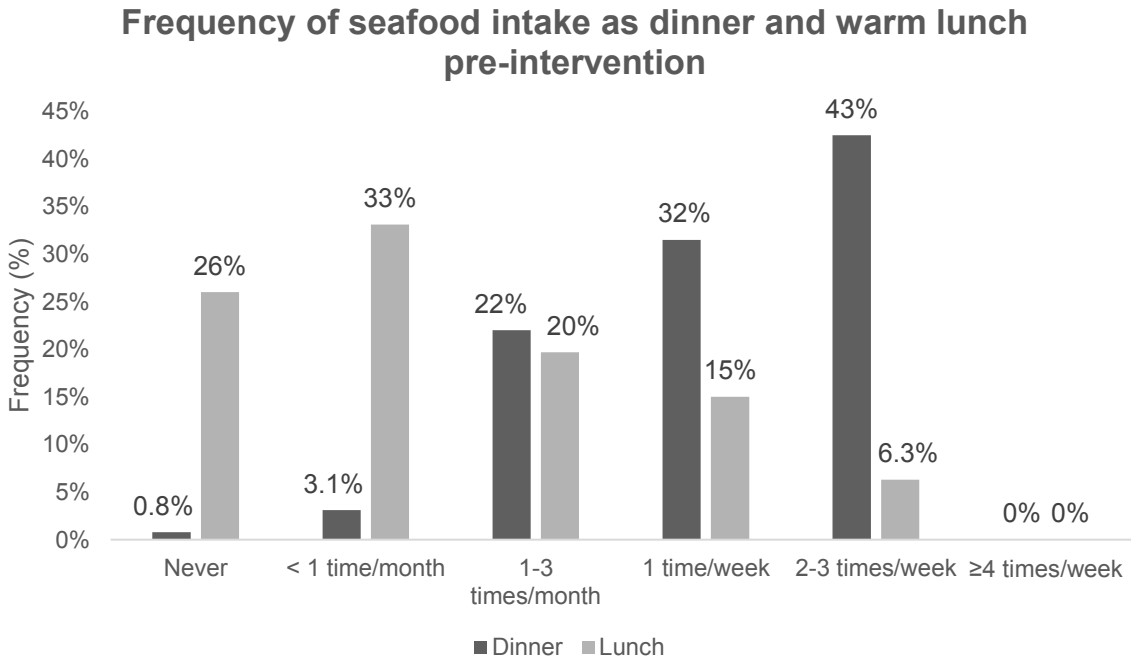

Figure 3. Frequency of seafood intake as dinner and warm lunch, pre-intervention, in pregnant women in Mommy's Food (n= 127).

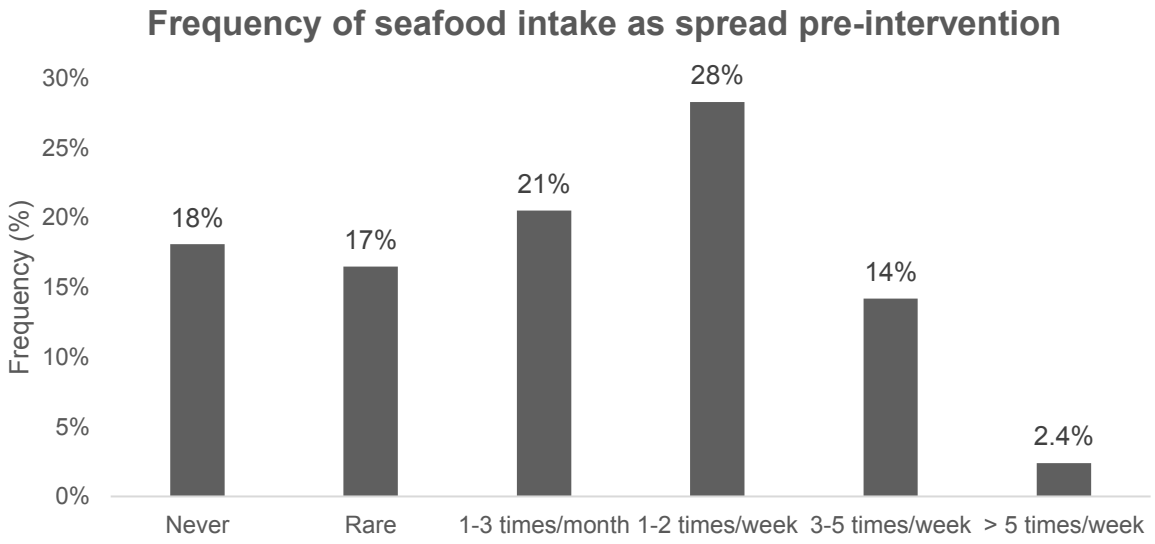

Figure 4. Frequency of seafood intake as spread, pre-intervention, in pregnant women in Mommy's Food (n= 127).

4.3.2 Detailed questions of seafood intake from the FFQ pre-intervention

All detailed questions from the FFQ regarding seafood intake are given in appendix I and summarized as portions/week for each question. There were no significant differences of any of the detailed questions between the intervention and control group pre-intervention. Data from the detailed questions regarding intake of different seafood, fish and fish products were summarized into categories as described in Table 5 and are presented as g per week in Table 7. The participants had a median total seafood intake of 413 g/week. Median intake of total fish was 317 g/week and contributed with 76% of the total intake of seafood. Spread and shellfish contributed with 18% and 5.8% respectively. There were no significant differences between intervention and control group in any of the categories. Intake of lean fish was higher in the intervention group (median (IQR): 115 (60-235) g/week) compared to the control group (median (IQR): 85 (50-157) g/week), however not significant (p= 0.06).

Table 7. Seafood intake reported from the FFQ, pre-intervention, in pregnant women in Mommy's Food.

	All			Control group	Intervention group	
Seafood intake						
Summary questions (portions per week)	**N**	**Mean (SD)**	**Median (IQR)**	**Mean (SD)**	**Mean (SD)**	***P*** [a]
Seafood as dinner	127	1.6 (1.0)	1.3 (0.8-2.5)	1.5 (0.9)	1.8 (1.2)	0.20
Seafood as lunch	127	0.4 (0.5)	0.2 (0.0-0.5)	0.4 (0.7)	0.3 (0.4)	0.96
Seafood as spread	127	2.1 (2.9)	1.0 (0.2-3.0)	2.5 (3.6)	2.3 (3.3)	0.81
Detailed questions (gram per week)		**Mean (SD)**	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**	
Total seafood, fish and spread	112	451 (263)	413 (277-567)	405 (113-544)	411 (250-566)	0.80
Total fish	116	344 (202)	317 (215-432)	323 (243-409)	302 (181-458)	0.98
Fatty fish	121	125 (100)	90 (49-184)	150 (55-203)	71 (37-165)	0.11
Lean fish	123	132 (111)	100 (50-200)	85 (50-157)	115 (60-235)	0.06
Processed fish products	121	57 (44)	49 (28-75)	53 (28-82)	47 (24-72)	0.46
Shellfish	124	26 (29)	16 (4-40)	16 (8-42)	15 (0-40)	0.51
Spread	123	81 (105)	36 (8-120)	54 (10-128)	30 (6-105)	0.21

Abbreviations: IQR, interquartile range; FFQ, food frequency questionnaire; SD, standard deviation

[a] Mann-Whitney U-test for differences between the control and the intervention group pre-intervention

4.4 The dietary intervention with cod

4.4.1 Compliance of the intervention with cod

Compliance of the received cod eaten in the intervention group was reported in the weight registration form by the participants. Total mean intake of cod during the intervention period and mean intake of cod per week were 4897 (992) and 306 (62) g (SD), respectively (Table 8). Mean compliance score was 77, ranging from 35 to 102. More than 70% of the participants had a compliance score of more than 70. Approximately 50% of the participants had a compliance score of more than 80. Less than 10% had a compliance score of <50.

Table 8. Compliance of the received cod in the intervention group reported from the weight registration form during the intervention period (16 weeks) in Mommy's Food (n= 62).

Compliance of intervention	Mean (SD)	Median (IQR)	Min-Max
Total intake of cod (gram)	4897 (992)	5084 (4401 – 5695)	2254 – 6556
Mean intake of cod per week (gram)	306 (62)	318 (275 – 356)	141 – 410
Compliance score *	77 (16)	79 (69 – 89)	35 – 102

Abbreviations: IQR, interquartile range; SD, standard deviation

* A compliance score of 100 is equivalent to have eaten 400 gram cod/week, which was the aim of the intervention.

4.4.2 Dietary intake of MeHg from the intervention with cod

The study meals of cod fillets were analysed for total Hg. Mean (SD) content of Hg was 28 (14) µg/kg (n= 30). Median (IQR) content of Hg was 24 (19-32) µg/kg. With an intake of 400 g of cod per week this corresponds to an intake of 11 µg MeHg per week (28 µg/kg * 0.4 kg) (Table 9). Using data from the weight registration form, the calculated mean (SD) intake of MeHg from the study meals of cod per week was 8.6 (1.7) µg. Maximum mean intake of MeHg per week was 12 µg. Mean intake of MeHg per kg bw was 0.14 µg/kg bw which correspond to 11% of the TWI of 1.3 µg/kg bw. Maximum mean weekly intake of MeHg per kg bw was 0.20 µg/kg bw.

Table 9. Dietary intake of MeHg from the study meals of cod in the intervention group of pregnant women in Mommy's Food (n= 62). Analysed value of Hg in cod used for calculations (mean (SD): 28 (14) µg/kg).

Dietary intake of MeHg [a] from study meals (cod) during intervention	Mean (SD)	Median (IQR)	Min-Max
Weekly intake of MeHg from cod (µg)	8.6 (1.7)	9.0 (7.8-10)	4-12
Weekly intake of MeHg from cod per kg bw (µg MeHg/kg bw)	0.14 (0.03)	0.13 (0.12 - 0.16)	0.04-0.20
% of TWI [b]	11 (2.5)	10 (9.0-13)	3.1-15

Abbreviations: bw, body weight; EFSA, European Food Safety Authority; Hg, mercury; IQR, interquartile range; MeHg, methylmercury; SD, standard deviation; TWI, tolerable weekly intake

[a] A conservative approach of 100% of Hg in the form of MeHg is used for calculations

[b] TWI for methylmercury: 1.3 µg/kg bw (EFSA, 2012) (28).

4.4.3 Seafood intake during the intervention period

Post-intervention, data from the FFQ were available for 106 participants (replied in gestational week 36). Seafood intake post-intervention in the control and the intervention group are given in Table 10 and detailed seafood intake from all questionnaires in the FFQ are given in appendix I. The control group had no significant differences from pre- to post-intervention in seafood intake except for a decrease in intake of sushi (p= 0.002) and pepper mackerel (p= 0.041) and an increase in intake of saithe (p= 0.049) (appendix I). The intervention group increased their intake of seafood as dinner from mean (SD) 1.8 (1.2) portions per week to 2.6 (0.8) portions per week (p= 0.000) (Table 10). This was significantly higher than the control group, which had a mean intake of seafood as dinner 1.9 (1.7) portions per week (p= 0.000). In total, 95% of the participants in the intervention group reported having seafood for dinner 2-3 times per week vs. 41% in the control group (p= 0.000, data not shown).

The intervention group increased their intake of total fish from median 302 g/week to median 355 g/week (p=0.021) from pre- to post-intervention. However, total seafood intake did not increase (p= 0.26). The intervention group increased their intake of lean fish (p=0.000) from pre- to post-intervention, though intake of fatty fish (p=0.001), processed seafood (p= 0.011) and spread (p= 0.023) decreased (Table 10). Compared to the control group, the intervention group had a higher intake of total fish (median 355 g/week vs. median 276 g/week, p= 0.036) and lean fish (median 217 g/week vs. median 95 g/week p= 0.000), but a lower intake of fatty fish (median 37 g/week vs. median 116 g/week, p= 0.000) post-intervention.

Table 10. Post-intervention seafood intake reported from the FFQ in pregnant women in Mommy's Food.

	Control group		**Intervention group**		***P*** [a]	***P*** [b]	***P*** [c]
Seafood and fish intake							
Summary questions (portions per week)	**N**	**Mean (SD)**	**N**	**Mean (SD)**			
Seafood as dinner	51	1.9 (1.7)	56	2.6 (0.8)	0.000	0.29	0.000 ↑
Seafood as lunch	51	0.5 (1.7)	56	0.4 (0.8)	0.33	0.97	0.76
Seafood as spread	50	1.8 (2.7)	56	1.3 (1.9)	0.57	0.86	0.018 ↓
Detailed questions (gram per week)	**N**	**Median (IQR)**	**N**	**Median (IQR)**			
Total seafood, fish and spread	50	354 (242-549)	52	395 (297-550)	0.22	0.79	0.26
Total fish	50	276 (193-448)	52	355 (273-466)	0.036	0.71	0.021 ↑
Fatty fish	50	116 (51-180)	54	37 (15-77)	0.000	0.89	0.001 ↓
Lean fish	51	95 (62-160)	54	217 (200-291)	0.000	0.42	0.000 ↑
Processed seafood	51	39 (19-72)	54	31 (14-56)	0.11	0.27	0.011 ↓
Shellfish	51	20 (7-37)	56	12 (4-30)	0.41	0.70	0.24
Spread	51	35 (3-77)	55	27 (4-74)	0.45	0.11	0.023 ↓

Abbreviations: IQR, interquartile range; FFQ, food frequency questionnaire; SD, standard deviation

[a] Mann-Whitney U-test for difference between control and intervention group post-intervention

[b] Wilcoxon signed-rank test for difference pre- and post-intervention within control group

[c] Wilcoxon signed-rank test for difference pre- and post-intervention within intervention group

↑ Significantly ($p< 0.05$) increased intake from pre- to post-intervention.

↓ Significantly ($p<0.05$) decreased intake from pre- to post-intervention.

4.5 Effects of intervention on total hair mercury (THHg) levels

Data on THHg levels from both pre- and post-intervention were available from 121 participants and were included in the main analyses of THHg (Table 11). Pre-intervention, median (IQR) THHg levels was 532 (357–789) µg/kg. There was no difference between the intervention and the control group (p= 0.88) pre-intervention. Post-intervention, the median (IQR) THHg levels for all participants was 505 (373–749) ranging from 60 to 1539 µg/kg. There was no difference between intervention and control group post-intervention (p = 0.19). When adjusting for pre THHg-levels there was a significant difference between the control and the intervention group post-intervention (p = 0.023). The control group had a minor decrease in median (IQR) THHg levels from 517 (366–750) µg/kg to 485 (341–740) µg/kg, though not significant (p = 0.25). The intervention group had a minor increase in median (IQR) THHg levels from 542 (316–823) to 554 (392–805) µg/kg, though not significant (p = 0.11). The change in THHg levels from pre- to post-intervention (ΔTHHg (post THHg – pre THHg)) was significantly different between the control group (median (IQR) ΔTHHg: -22 (-150–49) µg/kg) and the intervention group (median (IQR) ΔTHHg: +36 (-100–103) Pre) (p = 0.046) (Figure 5). Post-intervention, in total, 10 participants had THHg levels >1000 µg/kg (8%), 4 in the control group and 6 in the intervention group. There were no significant correlations between compliance (total g cod eaten during the intervention period) with post THHg levels (r= 0.183, p= 0.157) or ΔTHHg (r= 0.120, p= 0.356) in the intervention group.

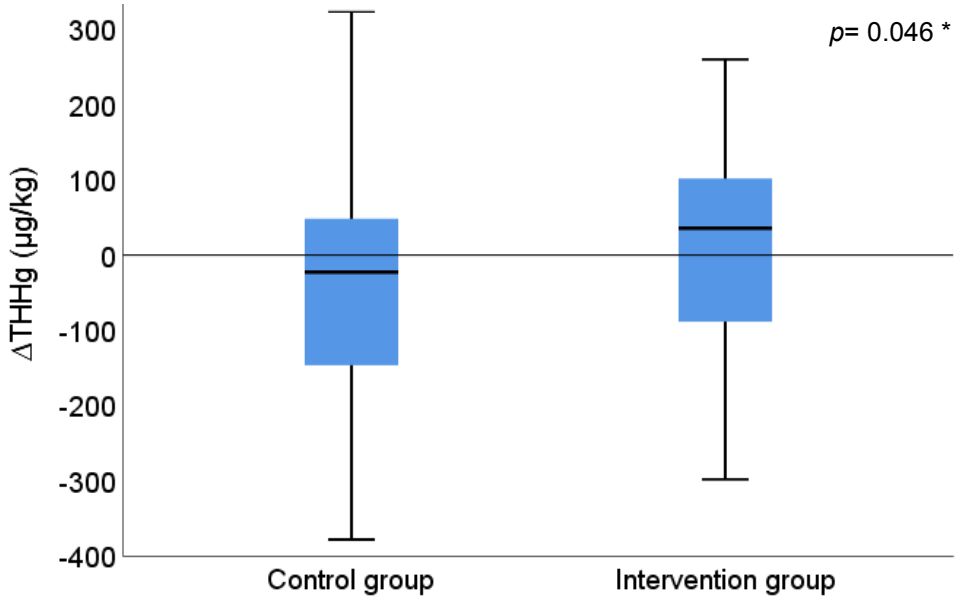

Figure 5. Boxplot of change in THHg levels (µg/kg) from pre- to post-intervention (ΔTHHg (post THHg - pre THHg) in the RCT with cod Mommy's Food. Boxes indicates the upper and lower quartile with the thick black line giving the median. The T-bars indicate 1.5 x length of the box (inter quartile range). Values above 300 µg/kg (n= 5) and lower than -400 µg/kg (n=4) are not included in figure.
* Independent t-test for comparison of difference between the control and the intervention group.

Table 11. Total hair mercury (THHg) levels (µg/kg) pre- and post-intervention in the randomised controlled trial with cod Mommy's Food.

		Crude analyses [a]			**Adjusted analyses** [a]	
					Pre THHg	
	N	**Mean (SD)**	**Median (IQR)**	***P***	**Mean (SE)**	***P***
All				0.51 [b]		
Pre THHg	121	591 (349)	532 (357 – 789)	0.88 [c]		
Post THHg	121	577 (291)	505 (373 – 749)	0.19 [c]	576 (17)	**0.023** [d]
∆THHg, change	121	-14 (225)	0.48 (-123 – 82.3)	**0.046** [c]	-14 (17)	**0.023** [d]
Control				0.25 [b]		
Pre THHg	60	582 (330)	517 (366 – 750)			
Post THHg	60	548 (295)	485 (341 – 740)		553 (24)	
∆THHg, change	60	-34 (229)	-22 (-150 – 49.4)		-37 (24)	
Intervention				0.11 [b]		
Pre THHg	61	600 (370)	542 (316 – 823)			
Post THHg	61	605 (286)	554 (392 – 805)		599 (24)	
∆THHg, change	61	5.3 (221)	36 (-100 – 103)		8.5 (24)	

Abbreviations: IQR, interquartile range; SE, standard error; SD, standard deviation; THHg, total hair mercury

[a] Log transformed data of THHg are used for statistical analyses.

[b] Paired sampled *t*-test for comparison of change between pre THHg and post THHg.

[c] Independent *t*-test for comparison of differences between control and intervention group.

[d] One-way analysis of covariance (ANCOVA) for comparison of differences between control and intervention group with adjustment for pre THHg levels

4.6 Estimated intake of MeHg from seafood pre- and post-intervention

4.6.1 Pre-intervention

Data on estimated MeHg intake from seafood pre-intervention are given in Table 12. Pre-intervention, median (IQR) intake of MeHg from total seafood was 19 (12-27) µg per week. Median (IQR) total weekly intake of MeHg from seafood per kg bw was 0.29 (0.19-0.42) µg/kg bw, ranging from 0.01 to 3.26 µg/kg bw. Median (IQR) % of MeHg intake from total seafood relative to the TWI of MeHg (1.3 µg/kg bw) was 22% (15%-32%). One participant exceeded the TWI of MeHg and had a mean dietary weekly intake of MeHg from seafood of 3.26 µg/kg bw (Figure 6). Overall, lean fish contributed with 49% of MeHg intake from seafood, fatty fish with 14%, processed seafood with 18%, shellfish with 6.5% and spread with 9.6%. There were no significant differences in estimated MeHg intake in any of the categories between the control- and the intervention group pre-intervention.

4.6.2 Post-intervention

Data on estimated MeHg intake from seafood post-intervention are given in Table 13. There were no differences from pre- to post-intervention in the control group in any of the categories. The intervention group increased their intake of MeHg from total seafood from pre- to post-intervention (p= 0.001). Post-intervention, dietary median (IQR) intake of MeHg from total seafood was (23 (18-31) µg per week in the intervention group. The intervention group increased their intake of MeHg from lean fish (p= 0.000) and decreased their intake from fatty fish (p= 0.009), processed seafood (p= 0.011) and spread (p= 0.045) from pre- to post-intervention. Total weekly intake of MeHg from seafood per kg bw increased from pre- to post-intervention in the intervention group (p= 0.001). Post-intervention, median (IQR) MeHg intake was 0.37 (0.28-0.49) µg/kg bw, ranging from 0.09 to 1.23 µg/kg bw in the intervention group. Median (IQR) % of MeHg intake from total seafood relative to the TWI of MeHg (1.3 µg/kg bw) was 28% (22%-38%) in the intervention group. There was a significant higher intake of MeHg from total seafood in the intervention group compared to the control group post-intervention (p= 0.002). Post-intervention, none of the participants, in either the control- or the intervention group exceeded the TWI of MeHg (1.3 µg/kg bw) (Figure 7).

Table 12. Pre-intervention dietary MeHg intake from seafood, mean (%) contribution of total MeHg from seafood and proportion (%) of total MeHg intake from seafood relative the TWI of MeHg. Data are estimated from the FFQ pre-intervention in pregnant women in the randomised controlled trial Mommy's Food.

	Dietary MeHg intake per week (µg)					
	All			**Control**	**Intervention**	
Seafood	**N**	**Median (IQR)**	**% of total MeHg intake from seafood** [a]	**Median (IQR)**	**Median (IQR)**	***P*** [b]
Total seafood	112	19 (12-27)	100%	19 (12-26)	19 (11-28)	0.72
Total fish	116	16 (9.4-23)	83%	14 (9.4-20)	17 (9.3-25)	0.35
Fatty fish	121	2.6 (1.0-4.0)	14%	2.8 (1.1-4.3)	2.9 (1.0-3.8)	0.30
Lean fish	123	7.2 (4.1-15.0)	49%	6.4 (3.5-13)	8.5 (4.5-17)	0.09
Cod	125	3.5 (2.4-7.2)	28%	3.5 (1.7-5.2)	3.5 (3.5-14)	0.12
Processed seafood	121	3.4 (1.9-5.2)	18%	3.7 (1.9-5.7)	3.3 (1.7-5.0)	0.46
Shellfish	124	0.5 (0.2-2.1)	7%	0.5 (0.2-2.5)	0.5 (0.0-1.9)	0.32
Spread	123	1.4 (0.3-3.2)	10%	1.8 (0.4-3.7)	1.0 (0.3-2.4)	0.14
MeHg from total seafood (µg MeHg/kg bw per week)	111	0.29 (0.19-0.42)		0.27 (0.20-0.37)	0.29 (0.19-0.44)	0.59
% MeHg intake from total seafood relative to the TWI of MeHg [c]	111	23 (15-32)		20 (15-29)	22 (14-34)	0.59

Abbreviations: bw, body weight; EFSA, European Food Safety Authority; IQR, interquartile range; MeHg, methylmercury; SD, standard deviation; TWI, tolerable weekly intake

[a] % MeHg intake of total MeHg intake from seafood

[b] Mann-Whitney U-test for difference between the control and the intervention group pre-intervention

[c] TWI of MeHg: 1.3 µg/kg bw (EFSA) (28)

Table 13. Post-intervention dietary MeHg intake from seafood, contribution of total MeHg from seafood (%) and proportion (%) of total MeHg intake from seafood relative to the TWI of MeHg. Data are estimated from the FFQ post-intervention in pregnant women in the randomised controlled trial Mommy's Food.

	Dietary MeHg intake per week (µg)								
	Control			**Intervention**					
Seafood	**N**	**Median (IQR)**	**% of total MeHg intake from seafood** [a]	**N**	**Median (IQR)**	**% of total MeHg intake from seafood** [a]	***P*** [b]	***P*** [c]	***P*** [d]
Total seafood	50	16 (10-25)	100%	52	23 (18-31)	100%	0.002	0.96	0.001 ↑
Total fish	50	13 (8.4-22)	84%	52	21 (16-27)	90%	0.000	0.94	0.000 ↑
Fatty fish	50	2.6 (1.0-4.3)	20%	54	0.9 (0.3-2.6)	7%	0.001	0.79	0.009 ↓
Lean fish	51	7.4 (4.3-14)	46%	54	15 (14-21)	71%	0.000	0.63	0.000 ↑
Cod	51	3.5 (3.5-6.9)	29%	55	14 (14-15)	61%	0.000	0.57	0.000 ↑
Processed seafood	51	2.7 (1.3-5.0)	18%	54	2.1 (0.9-3.9)	11%	0.11	0.28	0.011 ↓
Shellfish	51	0.8 (0.3-1.4)	6%	56	0.6 (0.1-1.8)	4%	0.62	0.49	0.64
Spread	51	1.3 (0.2-2.4)	10%	55	1.0 (0.3-2.0)	6%	0.44	0.15	0.045 ↓
MeHg from total seafood (µg MeHg/kg bw per week)	47	0.26 (0.17-0.40)		47	0.37 (0.28-0.49)		0.003	0.97	0.001 ↑
% MeHg intake from total seafood relative to the TWI of MeHg [e]	47	20 (13-31)		47	28 (22-38)		0.003	0.97	0.001 ↑

Abbreviations: bw, body weight; EFSA, European Food Safety Authority; IQR, interquartile range; MeHg, methylmercury; SD, standard deviation; TWI, tolerable weekly intake

[a] % MeHg intake of total MeHg intake from seafood

[b] Mann-Whitney U-test for difference between control and intervention post-intervention

[c] Wilcoxon signed-rank test for difference between pre- and post-intervention within the control group

[d] Wilcoxon signed-rank test for difference between pre- and post-intervention within the intervention group

[e] TWI of MeHg: 1.3 µg/kg bw (EFSA) (28)

↑ Significantly (p< 0.05) increased intake from pre- to post-intervention.

↓ Significantly (p<0.05) decreased intake from pre- to post-intervention.

4.7 Correlation between total hair mercury (THHg) levels with seafood intake and estimated MeHg intake from seafood

Correlations between THHg levels with seafood intake and estimated MeHg intake from seafood are presented in Table 14. There was a positive correlation between intake of seafood as dinner and seafood as spread with THHg both pre (dinner: r= 0.34, p <0.001, spread: r= 0.32, p <0.001) and post-intervention (dinner: r= 0.27, p <0.01, spread: r= 0.37, p <0.001). There was a moderate positive correlation between total intake of seafood and THHg levels pre-intervention (r= 0.38, p <0.001) and a large positive correlation post-intervention (r= 0.58, p <0.001). There was a significant positive correlation between THHg levels and intake of fatty fish, lean fish, shellfish and spread and estimated MeHg intake from these categories both pre- and post-intervention. There was no significant correlation between THHg levels and intake of processed seafood or estimated MeHg intake from processed seafood.

Table 14. Spearman's rho coefficients (r) of the associations between THHg levels with seafood intake and estimated MeHg intake from seafood pre- and post-intervention.

Seafood intake (portions/week)				
Summary questions	***Pre, r***	***Post, r***		
Seafood as dinner	0.34***	0.27**		
Seafood as warm lunch	0.15	0.20*		
Seafood as spread	0.32***	0.37***		
Seafood as dinner, warm lunch and spread (summarized)	0.38***	0.40***		
Seafood intake (g/week)			**Estimated MeHg intake from seafood (µg/week)**	
Detailed questions	***Pre, r***	***Post, r***	***Pre, r***	***Post, r***
Total seafood	0.38***	0.58***	0.37***	0.55***
Total fish	0.27**	0.54***	0.29**	0.53***
Fatty fish	0.21*	0.29**	0.23*	0.32**
Lean fish	0.26**	0.38***	0.27**	0.41***
Cod	0.19*	0.37***	0.19*	0.37***
Processed seafood	0.06	0.05	0.06	0.05
Shellfish	0.46***	0.47***	0.41***	0.40***
Spread	0.38***	0.41***	0.42***	0.39***
Total MeHg intake from total seafood, fish and spread per kg bodyweight (µg/kg bw per week)			0.38***	0.56***

Abbreviations: MeHg, methylmercury; THHg, total hair mercury

* p< 0.05

** p< 0.01

*** p< 0.001

There was a moderate correlation between THHg levels and total weekly MeHg intake from seafood per kg bodyweight (r= 0.38, p <0.001) pre-intervention. Figure 6 illustrates the association between pre THHg levels and pre estimated weekly MeHg intake from total seafood per kg bw.

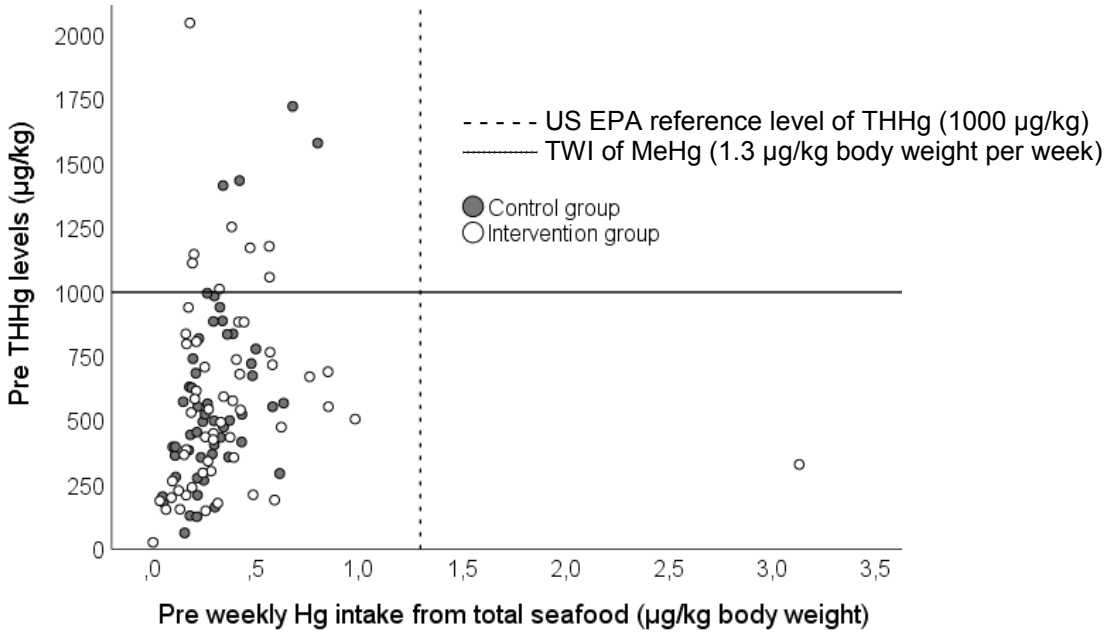

Figure 6. Grouped scatter plot of the association between THHg levels (µg/kg) and estimated weekly MeHg intake from seafood (µg/kg body weight) pre-intervention in Mommy's Food (n= 111).

There was a large correlation between THHg levels and total weekly MeHg intake from seafood per kg bodyweight (r= 0.56,) p <0.001) post-intervention. Figure 7 illustrates the association between post THHg levels and post estimated weekly MeHg intake from total seafood per kg bw.

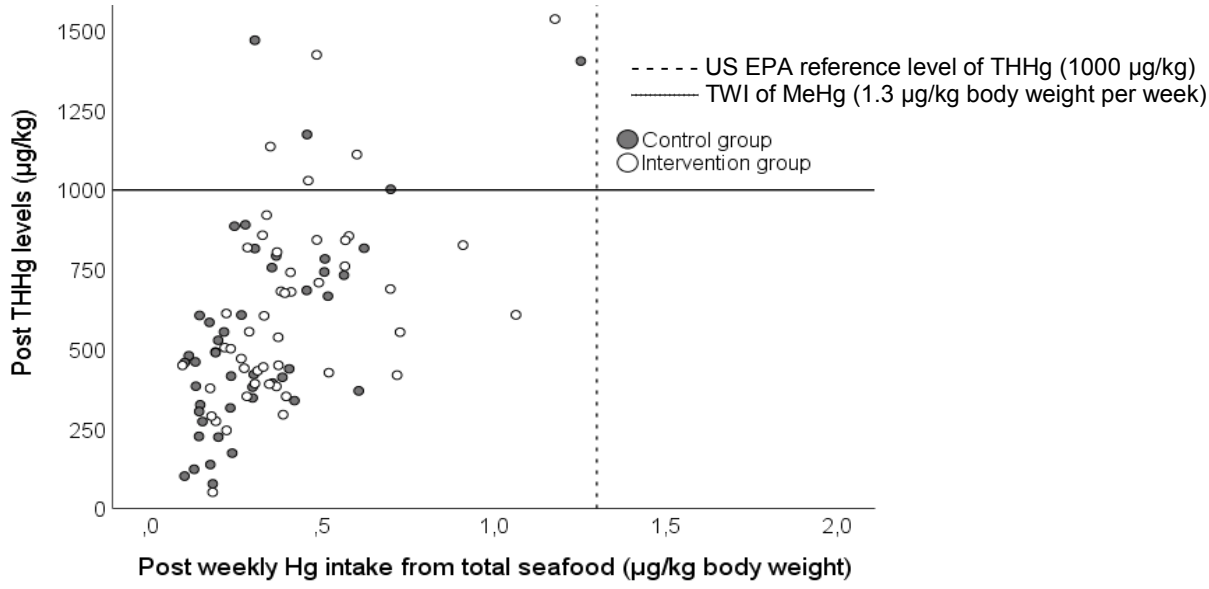

Figure 7. Grouped scatter plot of the association between THHg levels (µg/kg) and estimated weekly MeHg intake from seafood (µg/kg body weight) post-intervention in Mommy's Food (n= 93).

4.8 Total hair mercury (THHg) levels 6 months postpartum

THHg levels 6 months postpartum are given in Table 15. The median (IQR) THHg levels in all participants (n= 105) were 465 (287-636) µg/kg. There was no significant difference between the control and the intervention group (p= 0.14). THHg levels in the control group were median (IQR) 505 (338-638) µg/kg. There was no difference between post-THHg levels and 6 months postpartum THHg levels in the control group (p= 0.81). The intervention group had significantly decreased their levels of THHg from post-intervention to 6 months postpartum to median (IQR) 408 (263-628) µg/kg (p= 0.000).

Table 15. Total hair mercury (THHg) levels (µg/kg) 6 months postpartum in Mommy's Food.

THHg 6 months postpartum	N	Mean (SD)	Median (IQR)	*P* [a]
All	105	512 (310)	465 (287-636)	0.14 [b]
Control group	51	560 (345)	505 (338-638)	0.81 [b]
Intervention group	54	467 (268)	408 (263-628)	0.000 [d]

Abbreviations: IQR, interquartile range; SD, standard deviation; THHg, total hair mercury

[a] Log_{10} transformed data of THHg levels are used for statistical analyses.

[b] Independent *t*-test for difference between intervention and control at 6 months postpartum

[c] Paired samples *t*-test for difference between post THHg and 6 months postpartum THHg in control group

[d] Paired samples *t*-test for difference between post THHg and 6 months postpartum THHg in intervention group

5 Discussion

The overall aims in this thesis were to investigate if an increased intake of cod during pregnancy has an impact on THHg levels, and to investigate the impact of the habitual dietary seafood intake on THHg levels in pregnant women. This was explored by the two-armed RCT Mommy's Food where pregnant women were randomised either to eat 400 g of cod per week or to continue with their habitual diet between gestational week 20-36. THHg levels were measured pre- and post-intervention and at 6 months postpartum. The following chapter will firstly discuss the results and compare them against previous findings in a benefit-risk perspective. Subsequently, methodological strengths and limitations and to what extend this has influenced the results will be discussed.

5.1 Discussion of results

There were no significant differences in THHg levels between the intervention (median: 554 µg/kg) and the control group (median: 485 µg/kg) post-intervention (p= 0.19) in crude analyses. However, when adjusting for pre-THHg levels there was a significant difference between the groups (p= 0.023). The change in THHg levels from pre- to post-intervention (ΔTHHg) was significant between the groups with the control group having a median decrease of 22 µg/kg and the intervention group a median increase of 36 µg/kg from pre- to post-intervention (p= 0.046). This difference was seen despite no significant difference in total seafood intake between the groups. However, the estimated intake of MeHg from total seafood was higher in the intervention group compared to the control group and this plausible explain the observed difference in THHg levels between the groups.

As seafood contains both beneficial nutrients and undesirable contaminants, such as MeHg, when determining food based dietary guidelines, the balancing of benefits and risks must be considered (30). This complicates the advising of seafood consumption, particularly in the vulnerable group of pregnant women. Pregnant women are faced with conflicting results of the risks and benefits of seafood intake during pregnancy, which may results in confusion of the interpretation of the dietary recommendations (15, 103). This thesis provides new knowledge of THHg levels and MeHg exposure from seafood in pregnant women and provides important data for determining health based guidelines in a risk-benefit perspective.

Results from this thesis show that there is a positive correlation between THHg levels with seafood intake and estimated MeHg intake from seafood as in agreement with other studies,

which similarly have found positive correlations between Hg exposure and seafood intake (88, 104-106). Due to the toxicological effects of MeHg on foetal neurodevelopment, from a *risk*-perspective, one would have the intention of zero exposure of MeHg in pregnant women and thus limit the consumption of seafood to a minimum. As seafood is the predominantly source of MeHg exposure in humans one would in this manner eliminate the risk of MeHg exposure to a minimum (31). On the other hand, if pregnant women reduces their seafood intake, they also decreases the intake of beneficial nutrients important for optimal foetal neurodevelopment (3). Several reports have been published where the benefits of seafood intake has been weighed against the risk of MeHg exposure, of among others from EFSA, VKM, FAO/WHO and the United States Food and Drug Administration (FDA) (5, 6, 28, 107-109).

EFSA concluded in a report from 2014 that consumption of seafood in the amount of 1-2 servings per week and up to 3-4 servings per week during pregnancy are associated with better neurodevelopmental outcome in offspring compared to no seafood intake, including when the adverse effects of MeHg has been taken into account (6). An expert consultation from FAO/WHO in 2010 stated that there are convincing evidence that fish consumption during pregnancy contributes with optimal neurodevelopment in offspring (108). VKM in 2014 concluded that by the current levels of MeHg in fish on the Norwegian marked, the benefits of fish consumption, in according to the dietary recommendations, during pregnancy clearly outweighs the risk and that the current exposure of MeHg is of no concern (5).

In the Mommy's Food study, 95% of the participants in the intervention group reported having seafood for dinner 2-3 times per week post-intervention, mostly consisting of cod. This was in contrast to only 41% of the participants in the control group. Comparing these results to the benefit-risk assessments mentioned above, the intervention group would thus have a greater benefit of optimal neurodevelopment in foetus compared to the control group. However, FAO/WHO also states that the benefits of fish consumption are reduced by MeHg contamination and reducing exposure to of MeHg would result in even greater neurodevelopment (108). In agreement, VKM also acknowledges that high exposure to MeHg may reduce the beneficial effect of fish consumption on neurodevelopment (5). From this perspective, one could argue that the possible beneficial effect of the higher intake of cod in the intervention group, compared to the control group, could be possible larger if THHg levels and estimated MeHg intake were not higher as well. However, the intervention with cod did *not* lead to an increase in number of participants exceeding the reference value of 1000 µg/kg

of THHg levels set by US EPA. Pre-intervention, 10% of the participants exceeded the reference value set by USEPA of 1000 µg/kg, 4 participants in the control group and 10 participants in the intervention group. Post-intervention 8% had THHg levels above 1000 µg/kg, 4 participants in the control group and 6 participants in the intervention group. Of the participants in the intervention group with THHg levels above 1000 µg/kg pre-intervention (n= 10), all participants decreased their THHg levels from pre- to post-intervention (median (IQR) decrease 159 (105-379) µg/kg). Hence, the increased intake of cod during pregnancy did *not* lead to an increase in subjects exceeding the reference value set by US EPA, a level that is considered to be without risk of adverse effects. However, there are also some arguing that the reference levels of Hg in hair should be set at 580 for optimal prevention of MeHg toxicity (110-112), though this is not an established value. If using this approach, the number of participants in the intervention group exceeding THHg levels of 580 µg/kg increased from 41% to 48% from pre- to post-intervention.

The intervention group significantly increased their intake of estimated MeHg from seafood. However, post-intervention, none of the participants in the study exceeded the TWI of MeHg set by EFSA of 1.3 µg/kg per week. Intake below the TWI is considered to be without risking adverse health effects and the TWI of MeHg have been used in the risk-benefits assessments from both VKM and EFSA when evaluating the exposure of MeHg from seafood (5, 28). However, EFSA emphasize that the set TWI of MeHg has uncertainties (28) and several studies published from MoBa expresses that more knowledge is needed in whether exposure of MeHg below the TWI of 1.3 µg/kg during pregnancy may cause adverse neurodevelopmental effects in foetus (13, 87, 88).

5.1.1 Comparing the results with other studies

To my knowledge, there are currently no other dietary RCTs with meals investigating how an increased intake of fish during pregnancy affects THHg levels. Consequently, the results from this thesis are not directly comparable to other studies. However, there have been conducted educational interventions, which mainly have had the aim of lowering Hg exposure from seafood in pregnant women (113-116). In a pilot RCT from the USA, 55 pregnant women with a low fish intake (≤2 servings/month) were randomised to three groups (114). The participants received either advice on general pregnancy health (control group), advice to consume fish low in Hg and high in DHA or advice to consume fish low in Hg and high in DHA and grocery store gift cards ($10/week) to purchase fish. The study concluded that it is

possible to increase consumption of fish that are high in DHA without increasing exposure to Hg in pregnant women that have a low fish intake. The results from the intervention group in this thesis are comparable to this pilot RCT; that an increased fish intake during pregnancy may not increase Hg levels if eating fish with a low content of Hg. However, the participants in the referred study had a much lower fish intake at the beginning of the study and both of the intervention groups had a larger change of fish intake compared to the participants in Mommy's Food.

There are few studies measuring Hg levels of pregnant women in Norway. Hg levels in blood have been investigated in a sub-population of MoBa (gestational week 17, n= 2239) (88). Using a conversion factors of 250 between blood and hair (29), the levels of THHg in MoBa were median (range) 258 (0-3450) µg/kg and thus lower than in this thesis. Hence, the seafood intake and estimated Hg intake from seafood were similarly lower in MoBa. A master thesis from the LiN study measured THHg levels from 2 cm hair samples obtained 6 weeks post-partum and thus these represent Hg exposure from the end of last trimester (117). Data of THHg levels were obtained from participants of the lowest and highest quartile of seafood intake (Q1 and Q4, respectively). Q4 (n= 200) had a mean (SD) intake of 2.6 (0.9) portions of seafood for dinner per week and median THHg levels of 395 (range: 74-2208) µg/kg. The seafood intake in the intervention group post-intervention in Mommy's Food is comparable to the seafood intake of Q4 in LiN. On the contrary, the levels of THHg levels were higher in Mommy's Food compared to LiN. Data of Hg intake from seafood was not available from LiN and the difference in THHg levels may be explained by different types of seafood with different content of Hg consumed.

Compared to reported levels of THHg in Swedish (median: 350 µg/kg, n= 127 and 220 µg/kg, n= 100) (118, 119) and Danish pregnant women (median: 340 µg/kg, n= 146) (113), the levels of THHg (both pre- and post-intervention) were higher in Mommy's Food. However, THHg levels found in this thesis (both pre- and post-intervention) were lower than THHg levels reported in pregnant women in Portugal (median: 716 µg/kg, n= 50 and 1260 µg/kg, n= 343) (120, 121) and Italy (median: 788 µg/kg, n= 604) (104). The study from Italy also assessed neurodevelopment in child at 18 months and found that the level of Hg exposure during pregnancy was not associated with neurodevelopment in child (104).

A study investigating Hg levels in hair of women of reproductive age in Europe revealed data from 17 countries (n= 1.875) involved in the DEMOCOPHES (DEMOnstration of a study to COordinate and Perform Human biomonitoring on a European Scale) project and literature

data from 8 countries (n= 6.820) (110). Including all countries, median THHg levels were 465 µg/kg, however, there were large variations between the countries with highest levels observed in Southern Europe. Comparing the results from this thesis, the levels of THHg were generally higher than most other countries in Europe yet lower than in Spain, Portugal, Italy, Faroe Islands, Croatia, Greece and Malta. The variation of Hg exposure is most likely related to type and quantity of seafood consumed. Southern European and Northern European countries have a higher intake of seafood compared to countries in Central Europe and this may explain the difference in THHg levels compared to the results from this thesis (105). In addition, the pregnant women in Mommy's Food generally consumed seafood species with a relatively low content of Hg. In contrast, some of the countries in DEMOCOPHES showing higher levels of THHg compared to the participants in Mommy's Food are known to consume seafood species with a higher content of Hg (121-124).

In the studies from the Faroe Islands, they found an association between prenatal THHg levels and decreased neurodevelopment in child (80). These findings were not found in the studies from the Seychelles (82). The levels of THHg were considerably lower in Mommy's Food, compared to the epidemiological studies from the Faroe Islands (geometric mean: 4270 µg/kg) (80) and the Seychelles (mean: 6900 µg/kg) (82). This is also highly expected, as the intake of seafood with a high content of Hg is considerably higher at the Faroe Island and the Seychelles compared to in Mommy's Food.

5.2 Methodological considerations

5.2.1 Study design

Choosing an appropriate study design is crucial when testing a relevant hypothesis in studies. In this thesis, the main outcome was THHg levels. However, in Mommy's Food, the main outcome was maternal and infant iodine status. Consequently, the majority of decisions regarding the study design of Mommy's Food have been based on this outcome. In this manner, the study design may not be 100% appropriate for the main aims of this thesis and consequently be a potential limitation. However, when conducting studies, especially RCTs, this demands a large amount of resources and work, from both participants and researchers and one should therefore utilize all relevant data when assessing research.

Observational studies are used to describe relationships and associations between exposure and a measured outcome (125). However, observational studies cannot immediately establish

causality of whether it is the exposure that preceded the outcome (126). This by the reason that observed associations likewise can be due to bias (systematic errors) or confounding factors, such as individual differences in age, sex, ethnicity, habitual diet, sociodemographic factors and other lifestyle factors that influence the measured outcome (127). To avoid the systematic errors and confounding factors often present in epidemiological studies RCTs can be conducted. In a RCT, the participants are randomly allocated into the groups in order to attempt an equal distribution of the confounding factors (128). To my knowledge, there are no RCTs investigating the effect of an increased cod intake during pregnancy on THHg levels. This is a strength in this thesis, as RCT studies are considered the "gold-standard" of clinical research in the hierarchy of research designs (129).

However, in dietary interventions with meals the requirements of a "perfect" RCT are almost impossible to obtain and there are no guidelines on how to conduct these properly (130). The habitual diet of individuals are complex and consists of tremendously many types of chemical components that all may influence the relevant outcome (131). This is difficult to control in a study group and therefore this may influence the result. In addition, when increasing the intake of one food group this may contribute to a decrease in other types of foods groups, which may also influence the results. Optimally, in a RCT the only difference between the groups should be the exposure of the intervention (132). In this study, the exposure is the received cod in the intervention group. Ideally, to assess the research question in this thesis, the control group should have avoided cod and all other seafood that contains Hg during the intervention period. In this manner, the intake of seafood would been controlled for in the control group. Due to ethical considerations of this particularly vulnerable group, this was not possible. The reported seafood intake and dietary MeHg intake estimated from the FFQ showed that the intervention group increased their intake of total fish and total dietary MeHg from seafood from pre- to post-intervention while the control group did not have any changes. Reporting of these data is a strength in this dietary intervention where it is difficult to control for all external factors influencing THHg levels.

5.2.2 Analyses of total hair mercury (THHg)

There are several biological markers used to assess MeHg exposure, however, measurement of Hg levels in blood and hair are most commonly used (64-66). Analyses of total Hg in hair was chosen as method in this study. There are both limitations and strengths of using this as a marker of MeHg exposure. Using hair as a biomarker has been suggested to be the best

measurement of long-term exposure of MeHg (64). In contrast, levels of Hg in blood reflects more recent exposure of Hg (133). In addition, MeHg accumulates in higher concentration in hair and thereby this is an appropriate method when investigating Hg exposure from seafood where most of the Hg are in the form of MeHg (64, 72). Measurement of THHg levels on a group level is considered a well-established method (70). Analysing Hg in blood may be a more exact method for assessing Hg exposure in individuals (133). However, blood levels of Hg reflects Hg intake at the steady state and may not be accurate in populations with an unstable dietary pattern (134). Pregnant women is a study population where it is expected to find physiological and metabolically changes in addition to variations of dietary patterns during pregnancy (135, 136). In addition, because of the RCT *with* cod, it was the intention and an expectation that the participants in the intervention group would change their diet during the intervention period. Based on this, it would have been an advantage to measure both Hg in blood and hair in this thesis. However, this would have demanded more work, been more invasive and expensive. Hence, measuring levels of THHg were considered a valid method to assess Hg exposure from seafood. In addition, THHg levels were measured in infants of the mothers when they were 6 weeks, 6 months and 11 months old. It is more invasive and challenging to obtain blood samples from infants and measuring Hg exposure in hair of infants were considered the most appropriate method. Thus, in order to compare Hg exposure in both mother and infant one had to choose the same method.

2 cm of the hair sample was used for analysis of total Hg. Compared to 1 cm, 2 cm gives an estimate of a longer exposure period of Hg and thus the results are not so influenced by large variations of e.g. seafood intake within a minor period of time. THHg from the samples from post-intervention corresponds to Hg exposure from gestational week 23.6±1.6 to gestational week 30.8±0.8 (95% CI) (97). Optimally, we should have measured Hg exposure at the end of the intervention (until gestational week 36). However, then we would had to collect the hair sample right after birth, which would have been difficult. In addition, it could possibly lead to fewer hair samples obtained, as it would be difficult to reach the participants. One could have instructed the participants to cut the hair samples themselves, although this would giving rise to bias in the sampling process. In this study, the hair samples were collected by the same researchers at all time points, which is a strength in order to reduce inter variability in the collection of hair samples.

5.2.3 Dietary assessment

5.2.3.1 Seafood intake

Intake reported from a FFQ are prone to both over- and underestimation and thus all FFQs developed should be validated (92). The FFQ used in this study is validated in according to capture seafood intake against biochemical markers of omega-3 and vitamin D in Norwegian pregnant women (95). The use of a validated FFQ to report seafood intake in this specific group is therefore a strength in thesis.

From the validated FFQ, a developed seafood index was used to calculate seafood intake. In the detailed questions of consumption frequencies regarding seafood, the seafood index are based on the lowest possible weekly intake because recall is prone to overestimate low intakes when asked about several detailed species separately (95). However, when calculating the intake of cod from the FFQ, in the intervention group, during the intervention period, this may have been an incorrect method to use. In total, 91% of the participants in the intervention group reported having cod for dinner 1-2 times/week (data not shown). When calculating the seafood index of this category 1 time/week was used as in accordance with the method (95). In contrast, most of the participants most likely had an intake of cod 2 times/week as in accordance with the protocol and as seen by compliance from the weight registration form (Table 8). The mean (SD) cod intake estimated from the FFQ post-intervention in the intervention group was 1.2 (0.6) portions per week corresponding to 240 (120) g/week (appendix 2). In contrast, data from the weight registration form showed a mean (SD) intake of 306 (62) g cod per week (Table 8). The estimated cod intake from the FFQ are used when summarizing total seafood and fish intake. As a result, the estimated intake of total seafood, total fish and total lean fish in the intervention group post-intervention may be underestimated, as the intake of cod was such a large part of the total intake in these summarized groups.

5.2.3.2 Estimated MeHg intake from seafood and correlation with THHg levels

In accordance to estimate MeHg intake from seafood, the FFQ has not been validated. This would be ideal, as there are several limitations of estimating MeHg intake from seafood. The level of Hg in different types of seafood and fish varies considerably both intra- and interspecies. The level of Hg in the seafood species consumed by the participants in this study may not be corresponding to the Hg levels used for calculation. In addition, Hg content in all seafood species or products have not been measured. In this case, data from another seafood

species were used. E.g. there are no data of Hg content in processed seafood products. In this thesis, Hg content in cod was used for calculations as in accordance with the report from VKM in 2015. There are several commonly used seafood species in processed seafood products and using cod only gives a rough estimate. The summarized intake of processed seafood and intake of MeHg from this was the only group that did not significantly correlated with THHg levels, and thus this may indicate that the estimation of MeHg intake from this category is not properly.

However, the correlation between estimated total MeHg intake from total seafood and THHg levels were acceptable showing a moderate and large correlation. THHg levels are considered a valid biomarker to measure MeHg exposure from seafood (64-67). However, the use of biomarkers to reflect dietary exposure are more expensive and invasive compared to the use of dietary assessment methods such as a FFQ (90). Validation of estimated dietary intake from a FFQ is essential, as the reported intake are prone to both over- and underreporting and relies on memories from the participants (90). Biomarkers are not affected of these biases and can therefore be used to validate a FFQ (93). As we observed a relatively good correlation between THHg levels and estimated MeHg intake from seafood, the results from this thesis can be used to validate the FFQ in according to MeHg intake from seafood in pregnant women. This strengthens the results of reporting a reliable estimated MeHg intake from seafood in this thesis.

In addition to MeHg intake from seafood, there are several other factors affecting THHg levels and this may partly explain why one will not see a perfect correlation between estimated MeHg intake from seafood and THHg levels. This include individual biological differences, intake of other dietary sources of Hg, dental amalgam fillings, cosmetics and other environmental sources (29, 64, 70). Other dietary sources of Hg are not reported in this thesis. In MoBa, dietary sources other than seafood only contributed with 12% of the total dietary Hg intake (13). Other dietary source of Hg may have a small impact on the levels of THHg, however, not expected to be considerable. In addition, the focus in this thesis was on MeHg and seafood. We have not reported dental amalgam fillings of the participants. In some studies, this has been shown to affect THHg levels (137, 138). However, amalgam fillings have been restricted in Norway since 2003 (139) and thus the prevalence of amalgam fillings in this relatively young study population are most likely low.

6 Conclusion

We observed a significant difference in THHg levels between the intervention and the control group post-intervention after adjusting for pre-intervention THHg levels. The change in THHg levels from pre- to post-intervention (ΔTHHg) was significantly different between the groups, even though there was no significant difference in total seafood intake between the groups, and no increase in total seafood intake in the intervention group from pre- to post-intervention. There was no difference between the groups in THHg levels at 6 months postpartum. Pre- and post-intervention, 10% and 8% of the participants exceeded the reference value of THHg levels of 1000 μg/kg set by US EPA, respectively. Median THHg levels were below the reference value of US EPA at all time points and the intervention did not lead to an increase in number of subjects exceeding this reference value. Pre-intervention, one participant exceeded the TWI of MeHg from EFSA, however, none of the participants exceeded this value post-intervention. Consequently, this study shows that pregnant women can increase intake of cod during pregnancy without exceeding current reference values for THHg and TWI of MeHg. However, THHg levels were positively correlated with seafood intake and estimated MeHg intake from seafood, showing that seafood is a major contributor to MeHg exposure. These findings support the dietary recommendations for seafood intake for pregnant women, including limitations in the consumption of seafood known to contain high levels of Hg.

7 Future perspectives

There is a need for future studies investigating how seafood consumption affects Hg exposure in pregnant women. As there are large variations in type and quantity of seafood consumed in different countries, induvial country-specific studies are needed. The study population in Mommy's Food had a relatively high seafood intake compared to the general population in Norway. Future studies should therefore investigate how an increased seafood intake affects Hg levels in pregnant women with low habitual seafood intakes. In addition, future studies should assess how an increased intake of other seafood species (that is considered safe to consume) than cod affects Hg levels in pregnant women. Furthermore, a study including a bigger study population that is more representative for the general population in Norway should be performed.

This study provides new knowledge of MeHg exposure from seafood in pregnant women. However, it does not address which levels of MeHg exposure from seafood that are safe with respect to neurodevelopment of foetus. Studies are not consistent regarding which levels of MeHg exposure from seafood that outweigh the beneficial effects of seafood consumption during pregnancy. This must be studied further using neurodevelopment in offspring as an outcome. The study Mommy's Food measures child development during the first year of life. In this study, we observed a difference in change of THHg levels between the groups. Further results from Mommy's Food will assess if the difference in THHg levels during pregnancy has had an impact on neurodevelopment in child.

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Appendices

Appendix I: Detailed seafood intake from the FFQ pre- and post-intervention

Appendix II: Mercury (Hg) content and estimated portion sizes of seafood and seafood products

Appendix III: Questionnaire (FFQ) pre-intervention

Appendix IV: Questionnaire (FFQ) post-intervention

Appendix I: Detailed seafood intake from the FFQ pre- and post-intervention

Table A1. Detailed seafood intake pre- and post-intervention in Mommy's Food reported from the FFQ and presented as portions per week.

	Pre-intervention					Post-intervention						
Portions per week	**All**		**Control**	**Intervention**		**All**		**Control**	**Intervention**			
Summary questions	**N**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	***P*** [a]	**N**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	***P*** [b]	***P*** [c]	***P*** [d]
Seafood as dinner	127	1.6 (1.0)	1.4 (0.9)	1.8 (1.2)	0.20	107	2.3 (1.4)	1.9 (1.7)	2.6 (0.8)	0.000	0.29	0.000
Seafood as lunch	127	0.4 (0.5)	0.4 (0.6)	0.3 (0.4)	0.96	107	0.5 (1.3)	0.5 (1.7)	0.4 (0.8)	0.33	0.97	0.76
Seafood as spread	127	2.1 (2.9)	2.2 (3.1)	2.0 (2.7)	0.81	106	1.6 (2.3)	1.8 (2.7)	1.3 (1.9)	0.000	0.86	0.000
Detailed questions												
Fatty fish (>5% fat)												
Salmon, trout	122	0.7 (0.5)	0.7 (0.5)	0.6 (0.6)	0.21	105	0.5 (0.5)	0.7 (0.5)	0.3 (0.4)	0.000	0.94	0.000
Mackerel	123	0.1 (0.3)	0.1 (0.2)	0.1 (0.3)	0.08	105	0.1 (0.4)	0.1 (0.3)	0.1 (0.5)	0.59	0.49	0.37
Halibut	127	0.05 (0.07)	0.04 (0.07)	0.06 (0.08)	0.12	107	0.04 (0.07)	0.05 (0.07)	0.03 (0.06)	0.10	0.64	0.05
Herring	125	0.02 (0.1)	0.02 (0.1)	0.02 (0.05)	0.38	106	0.07 (0.4)	0.1 (0.8)	0.01 (0.04)	0.94	0.31	0.41
Lean fish (≤5%)												
Cod	125	0.4 (0.4)	0.4 (0.5)	0.5 (0.5)	0.12	106	0.8 (0.6)	0.4 (0.4)	1.2 (0.6)	0.000	0.57	0.000
Saithe	124	0.09 (0.1)	0.07 (0.09)	0.1 (0.1)	0.29	105	0.09 (0.2)	0.1 (0.2)	0.06 (0.2)	0.025	0.049	0.002
Pollock	124	0.03 (0.06)	0.03 (0.06)	0.03 (0.05)	0.98	106	0.02 (0.05)	0.03 (0.06)	0.01 (0.04)	0.08	0.57	0.10
Ling	126	0.03 (0.3)	0.008 (0.03)	0.05 (0.4)	0.41	107	0.003 (0.02)	0.004 (0.02)	0.003 (0.02)	0.58	0.17	1.000
Wolffish	126	0.05 (0.08)	0.04 (0.07)	0.05 (0.09)	0.39	107	0.03 (0.06)	0.03 (0.06)	0.03 (0.06)	0.64	0.18	0.18
Dried and salted cod	126	0.03 (0.05)	0.02 (0.04)	0.03 (0.06)	0.32	107	0.03 (0.06)	0.01 (0.04)	0.02 (0.04)	0.50	0.66	0.047
Sushi and processed seafood												
Sushi	125	0.07 (0.8)	0.07 (0.06)	0.07 (0.1)	0.28	107	0.04 (0.05)	0.04 (0.05)	0.04 (0.04)	0.89	0.002	0.016
Fish burgers, fish balls, fish pudding	123	0.2 (0.2)	0.2 (0.3)	0.2 (0.2)	0.74	106	0.1 (0.2)	0.2 (0.2)	0.1 (0.1)	0.05	0.87	0.038
Fish au gratin	125	0.1 (0.1)	0.08 (0.06)	0.08 (0.09)	0.69	107	0.08 (0.1)	0.08 (0.1)	0.08 (0.1)	0.99	0.09	0.15
Fish fingers	124	0.03 (0.06)	0.04 (0.05)	0.03 (0.07)	0.37	106	0.03 (0.06)	0.04 (0.05)	0.02 (0.07)	0.007	0.79	0.08
Fish soup	127	0.03 (0.06)	0.03 (0.07)	0.04 (0.08)	0.82	107	0.03 (0.05)	0.03 (0.05)	0.03 (0.04)	0.45	0.73	0.25
Shellfish												
Shrimps unpeeled	125	0.05 (0.07)	0.06 (0.09)	0.04 (0.04)	0.21	107	0.04 (0.04)	0.04 (0.04)	0.03 (0.04)	0.21	0.34	0.66
Browncrab claw meat	126	0.04 (0.07)	0.05 (0.08)	0.03 (0.05)	0.71	107	0.03 (0.06)	0.03 (0.07)	0.03 (0.05)	0.62	0.05	0.62
Browncrab innards	126	0.006 (0.04)	0.009 (0.05)	0.003 (0.02)	0.91	107	0.002 (0.01)	0.002 (0.01)	0.003 (0.01)	0.62	0.11	0.56
Lobster	123	0.008 (0.04)	0.01 (0.04)	0.006 (0.02)	0.45	107	0.005 (0.02)	0.007 (0.03)	0.004 (0.01)	0.84	0.45	0.52

Blue mussel	124	0.03 (0.07)	0.03 (0.07)	0.04 (0.06)	0.17	107	0.03 (0.07)	0.04 (0.08)	0.03 (0.06)	0.88	0.32	0.17
Scallop	126	0.02 (0.04)	0.02 (0.03)	0.03 (0.05)	0.66	107	0.02 (0.04)	0.03 (0.04)	0.02 (0.03)	0.25	0.19	0.18
Spread												
Canned mackerel	126	1.1 (2.1)	1.2 (2.1)	1.1 (2.1)	0.82	106	0.6 (1.4)	0.7 (1.6)	0.6 (1.2)	0.84	0.10	0.001
Canned salmon	127	0.02 (0.2)	0.05 (0.3)	0.002 (0.01)	0.14	107	0.009 (0.05)	0.02 (0.08)	0.002 (0.01)	0.14	0.35	1.0
Canned tuna	127	0.2 (0.9)	0.3 (1.2)	0.1 (0.4)	0.45	107	0.2 (0.6)	0.2 (0.9)	0.1 (0.2)	0.98	0.09	0.67
Smoked salmon, trout	127	0.2 (0.4)	0.2 (0.5)	0.2 (0.4)	0.66	107	0.3 (0.7)	0.2 (0.5)	0.3 (0.8)	0.26	0.21	0.45
Cured salmon, trout	127	0.02 (0.08)	0.03 (0.1)	0.02 (0.05)	1.0	107	0.04 (0.2)	0.02 (0.08)	0.05 (0.3)	0.42	0.16	0.34
Pickled herring	126	0.04 (0.1)	0.02 (0.07)	0.06 (0.1)	0.35	107	0.08 (0.6)	0.1 (0.8)	0.04 (0.09)	0.24	0.72	0.29
Caviar	127	0.6 (1.6)	0.9 (2.0)	0.5 (1.2)	0.17	107	0.6 (1.4)	0.8 (1.7)	0.4 (1.0)	0.93	0.55	0.32
Pepper mackerel	127	0.05 (0.3)	0.08 (0.4)	0.02 (0.06)	0.24	107	0.02 (0.08)	0.03 (0.1)	0.01 (0.04)	0.27	0.04	0.08
Shrimps	126	0.2 (0.3)	0.2 (0.4)	0.1 (0.2)	0.27	107	0.1 (0.2)	0.1 (0.2)	0.1 (0.2)	0.86	0.08	0.36
Canned sardines	126	0.01 (0.08)	0.02 (0.1)	0.008 (0.03)	0.55	107	0.01 (0.06)	0.02 (0.09)	0.002 (0.01)	0.26	0.66	0.07
Anchovy	127	0.008 (0.04)	0.009 (0.05)	0.008 (0.04)	0.82	107	0.01 (0.04)	0.002 (0.01)	0.02 (0.06)	0.16	0.18	0.17
Crabsticks	126	0.04 (0.1)	0.04 (0.1)	0.05 (0.2)	0.75	107	0.05 (0.2)	0.05 (0.2)	0.05 (0.1)	0.16	0.95	0.69
Cod roe and liver pate ("Svolværpostei")	126	0.0	0.0	0.0	1.00	107	0.0	0.0	0.0	1.00	1.00	1.00
Cod roe and liver pate ("Lofotpostei")	125	0.0	0.0	0.0	1.00	107	0.0	0.0	0.0	1.00	1.00	1.00
Other												
Other seafood as dinner or warm lunch	120	0.03 (0.1)	0.02 (0.06)	0.04 (0.2)	0.60	99	0.03 (0.1)	0.04 (0.1)	0.02 (0.07)	0.41	0.89	0.29
Other seafood as spread	122	0.08 (0.6)	0.02 (0.06)	0.1 (0.8)	0.76	105	0.03 (0.1)	0.05 (0.2)	0.007 (0.04)	0.19	0.17	0.21
Fish roe	127	0.005 (0.02)	0.059 (0.04)	0.02 (0.0)	0.09	107	0.002 (0.01)	0.003 (0.02)	0.0007 (0.004)	0.56	0.26	0.08
Fish liver	126	0.0002 (0.002)	0.003 (0.008)	0.0	0.30	107	0.0	0.0	0.0	1.00	0.32	1.00

[a] Mann-Whitney U-test for difference between intervention and control group pre-intervention

[b] Mann-Whitney U-test for difference between intervention and control group post-intervention

[c] Wilcoxon signed-rank test for difference between pre- and post-intervention in the control group

[d] Wilcoxon signed-rank test for difference between pre- and post-intervention in the intervention group

Appendix II: Mercury (Hg) content and estimated portion sizes of seafood and seafood products

Table A2. Hg content and estimated portion sizes in seafood species used for estimation of seafood intake and MeHg intake from the FFQ in Mommy's Food.

Seafood species/ seafood product	Seafood species used for calculation of Hg consumption from seafood	mg Hg/kg [a]	Estimated portion size (gram) [b]
Fatty fish (>5% fat)			
Salmon, trout [c]	Atlantic salmon fillet (farmed)	0.017	150
Mackerel	Atlantic mackerel fillet (wild)	0.030	150
Halibut	Atlantic halibut (wild) [d]	0.109	150
Herring	Atlantic herring fillet (wild)	0.052	150
Lean fish (≤5% fat)			
Cod	Atlantic cod fillet (wild)	0.069	200
Saithe	Saithe fillet (wild)	0.059	200
Pollock	Pollock fillet (wild)	0.140	200
Ling	Ling fillet (wild)	0.180	200
Wolffish	Atlantic wolffish fillet (wild)	0.13	200
Dried and salted cod ("klippfisk")	Atlantic cod fillet (wild)	0.069	150
Sushi and processed seafood			
Sushi	Atlantic salmon fillet (farmed)	0.017	300
Fish burgers, fish balls, fish pudding	Atlantic cod fillet (wild)	0.069	150
Fish au gratin	Atlantic cod fillet (wild)	0.069	275
Fish fingers	Atlantic cod fillet (wild)	0.069	150
Fish soup	Atlantic salmon fillet (farmed) [e]	0.017	350
Shellfish			
Shrimps	Shrimp unpeeled (wild)	0.040	250
Browncrab claw meat	Brown crab claw meat (wild)	0.082	150
Browncrab innards	Brown crab innards (wild)	0.075	150
Lobster	Lobster white meat (wild)	0.220	150
Blue mussel	Blue mussel meat (wild)	0.016	115
Scallop	Scallop muscle and roe (wild)	0.018	115

Spread			
Canned mackerel	Mackerel in tomato sauce	0.011 [f]	40
Canned salmon	Atlantic salmon fillet (farmed)	0.017	40
Canned tuna	Canned tuna	0.076 [g]	14
Smoked salmon, trout	Smoked salmon	0.038	25
Cured salmon, trout	Marinated salmon (grawlax)	0.033	25
Pickled herring	Atlantic herring fillet (wild)	0.052	25
Caviar	Atlantic cod roe	0.030 [f]	15
Pepper mackrell	Peppered mackerel	0.030 [f]	40
Shrimps	Shrimp peeled (wild)	0.070	40
Canned sardines	Sardines in oil	0.020	20
Anchovy	European sprat wholefish	0.018	20
Crabsticks	Atlantic cod fillet (wild)	0.069	68
Cod roe and liver pate ("Svolværpostei")	Cod roe and liver pate (Svolværpostei)	0.02 [h]	15
Cod roe and liver pate ("Lofotpostei")	Cod roe and liver pate (Svolværpostei)	0.02 [h]	15
Other			
Fish roe	Atlantic cod roe (wild)	0.03 [f]	45
Fish liver	Atlantic cod liver	0.028	45

[a] Data are retrieved from Seafood Data (https://sjomatdata.nifes.no) (54). Values are given in mean mg/kg from latest analysis year unless otherwise specified

[b] Portion sizes estimated from the report "Weight, measures and portion sizes for foods" from the Norwegian Food Safety Authority. University of Oslo and the Norwegian Directorate of Health. 2015 (96)

[c] Questionnaire of salmon and trout not separated in the FFQ

[d] Hg content of atlantic halibut retrieved from Nilsen et al. 2016 (55) as latest analysis year in Seafood Data had a low sample size (n= 3) and large variations of Hg content. Mean value of median Hg content in weight group 11-20 kg (0.098 mg Hg/kg. n= 154) and 21-40 kg (0.12 mg Hg/kg. n= 85) retrieved as this is most relevant for human consumption.

[e] Hg content in seafood product not available in Seafood Data. Mean value of Hg content in atlantic salmon fillet (farmed) and atlantic cod fillet (wild) used for calculation of Hg content as in accordance with calculations from VKM 2014 (5)

[f] Hg content of atlantic cod roe < LOQ of 0.03 mg/kg

[g] Hg content of canned tuna retrieved from Nilsen and Måge. 2016 (140) as data not available in Seafood Data

[h] Hg content of cod roe and liver pate retrieved from Julshamn and Frantzen. 2008 (141) as data not available in Seafood Data

Appendix III: Questionnaire (FFQ) pre-intervention

Ultralyddato

Hei! Takk for at du har valgt å være med i prosjektet "Mammas mat".

I denne undersøkelsen vil vi spørre deg blant annet om kostholdet ditt og hvordan du har hatt det siden du ble gravid.

Vi setter veldig stor pris på din deltakelse!

Hvilken dato har du ultralyd-termin?

	Dag	Måned	År
	▼	▼	▼

Om deg / demografi

Hvilken svangerskapsuke er du i idag?

▼

Din alder:

▼

Hva er din sivile status?

- Gift
- Samboer

- Enslig
- Skilt
- Separert
- Enke
- Annet

Hvilken utdannelse har du? (Sett ett kryss for den høyeste utdannelsen du har fullført.)

- Grunnskole
- Videregående skole
- Universitets- eller høyskole, inntil fire år
- Universitets- eller høyskole, mer enn fire år

Hva var din arbeidssituasjon før du ble gravid?

Her kan du sette flere kryss.

- Heltidsarbeid (80 - 100%)
- Deltidsarbeid (50 – 79 %)
- Deltidsarbeid (mindre enn 50 %)
- Student på heltid
- Student på deltid
- Hjemmeværende
- Arbeidsledig
- Uføretrygdet
- Sykemeldt

Hva var den samlede inntekten (før skatt) i husholdningen sist år?

- Ingen inntekt
- Under 200 000
- 200 - 349 999
- 350 - 549 999
- 550 - 749 999
- 750 - 999 999
- 1 000 000 -1 249 999
- 1 250 000 - 2 000 000

- Mer enn 2 000 000

Hvordan vil du beskrive familiens økonomi?

Svært god	God	Middels	Dårlig	Svært dårlig
○	○	○	○	○

Sjømat

Sjømat

Her vil vi gjerne få informasjon om deler av kostholdet ditt. Ha den **tiden siden du ble gravid** i bakhodet når du fyller ut skjemaet. Vi er klar over at kostholdet varierer fra dag til dag. Prøv likevel så godt du kan å gi et "gjennomsnitt" av ditt matinntak når det spørres om det.

I de første spørsmålene ønsker vi informasjon om ditt inntak av fisk, fiskeprodukter og annen sjømat.

Hvor ofte har du spist fisk, fiskeprodukter eller annen sjømat som varmt måltid siden du ble gravid (gjelder ikke pålegg)?

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/måned	1 gang/uke	2-3 ganger/uke	4 ganger eller mer/uke
Middag	○	○	○	○	○	○
Lunsj	○	○	○	○	○	○

Hvis du spiser fisk, fiskeprodukter eller annen sjømat til middag/varm lunsj, hvor mye spiser du vanligvis?

1 porsjon tilsvarer 150 gram laks, 200 gram torsk, 12 sushibiter, tre fiskekaker, seks fiskeboller, syv fiskepinner eller 2 dl reker u/skall

Vennligst sett 1 kryss per linje.

	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner eller mer
Middag	○	○	○	○	○
Lunsj	○	○	○	○	○

Hvor ofte har du spist følgende sjømat som middag og som varm lunsj siden du ble gravid?

NB Sushi og fiskemat (fiskekaker, fiskeboller o.l.) er egne spørsmål og kommer senere.

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Laks, ørret - middag	○	○	○	○	○
Laks, ørret – lunsj	○	○	○	○	○
Torsk - middag	○	○	○	○	○
Torsk - lunsj	○	○	○	○	○
Sei - middag	○	○	○	○	○
Sei - lunsj	○	○	○	○	○
Makrell – middag	○	○	○	○	○
Makrell - lunsj	○	○	○	○	○
Sild - middag	○	○	○	○	○
Sild - lunsj	○	○	○	○	○
Lyr - middag	○	○	○	○	○
Lyr – lunsj	○	○	○	○	○

Du har svart at du spiser laks/ørret til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser laks/ørret til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser torsk til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser torsk til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sei til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sei til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser makrell til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser makrell til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sild til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sild til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lyr til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lyr til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Lange - middag					
Lange - lunsj					
Kveite - middag					
Kveite - lunsj					
Steinbit - middag					
Steinbit - lunsj					

Du har svart at du spiser lange til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner

- 3 porsjoner

Du har svart at du spiser lange til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kveite til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kveite til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser steinbit til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon

- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser steinbit til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Sushi og fiskemat (fiskekaker, fiskeboller o.l.)

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Sushi - middag					
Sushi - lunsj					
Fiskekaker/-boller/-pudding - middag					
Fiskekaker/-boller/-pudding - lunsj					
Fiskegrateng					
Fiskepinner					
Fiskesuppe					
Klippfisk					

Du har svart at du spiser sushi til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 12 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sushi til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 12 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskekaker/-boller/-pudding til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 3 fiskekaker, 6 fiskeboller eller 3 skiver fiskepudding.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskekaker/-boller/-pudding til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 3 fiskekaker, 6 fiskeboller eller 3 skiver fiskepudding.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskegrateng. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 275 gram**.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskepinner. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 7 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskesuppe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 350 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser klippfisk. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Reker	○	○	○	○	○
Krabbe, klokjøtt	○	○	○	○	○
Krabbe, brunmat	○	○	○	○	○
Hummer	○	○	○	○	○
Blåskjell	○	○	○	○	○
Kamskjell	○	○	○	○	○

Du har svart at du spiser reker. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 250 gram reker med skall.**

- ½ porsjon eller mindre

- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser klokjøtt av krabbe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser brunmat av krabbe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser hummer. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser blåskjell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 115 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon

- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kamskjell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 115 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Har du spist annen sjømat som middag eller varm lunsj siden du ble gravid?

- Nei
- Ja

Vennligst oppgi hva slags fisk du har spist som middag og som varm lunsj siden du ble gravid

1 porsjon tilsvarer 150 gram laks, 200 gram torsk, 12 sushibiter, tre fiskekaker, seks fiskeboller, syv fiskepinner eller 2 dl reker u/skall

	Sjeldnere enn 1 gang/måned	1-3 ganger/måned	1-2 ganger/uke	3 ganger eller mer/uke	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
1.									
2.									
3.									

Hvor ofte bruker du fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende?

- Aldri
- Sjelden
- 1-3 ganger/måned
- 1-2 ganger/uke

- 3-5 ganger/uke
- Mer enn 5 ganger/uke

Hvis du bruker fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende, hvor mye spiser du vanligvis?

1 porsjon tilsvarer for eksempel èn skive røkelaks, makrell i tomat til èn skive, kaviar til èn skive, èn fiskekake eller 2 dl reker u/skall

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Hvor ofte har du spist følgende fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende siden du ble gravid?

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Makrell på boks (alle typer)					
Laks på boks					
Tunfisk på boks					
Røkt laks, ørret					
Gravet laks, ørret					
Sild (sursild, rømmesild, kryddersild el.lign.)					
Kaviar					
Peppermakrell					
Reker (ikke rekesalat)					
Sardin på boks					
Ansjos					
Crabsticks					
Svolværpostei					
Lofotpostei					

Du har svart at du spiser makrell på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = makrell på boks til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser laks på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = laks på boks til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser tunfisk på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én spiseskje tunfisk.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser røkt laks/ørret. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én oppskåret skive laks/ørret.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser gravet laks/ørret. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én skive gravet laks/ørret.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sild. Hvor stor porsjon spiser du vanligvis? **Én porsjon = sild til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kaviar. Hvor stor porsjon spiser du vanligvis? **Én porsjon = kaviar til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser peppermakrell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = pepper-/kaldrøkt/varmrøkt makrell til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser reker som pålegg. Hvor stor porsjon spiser du vanligvis? **Én porsjon = reker til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sardiner på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon brisling = brisling til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser ansjos. Hvor stor porsjon spiser du vanligvis? **Én porsjon ansjos = ansjos til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser crabsticks. Hvor stor porsjon spiser du vanligvis? **Én porsjon crabsticks = 4 stk crabsticks.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner

- 3 porsjoner

Du har svart at du spiser svolværpostei. Hvor stor porsjon spiser du vanligvis? **Én porsjon = postei til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lofotpostei. Hvor stor porsjon spiser du vanligvis? **Én porsjon = postei til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Er det andre typer fisk, fiskeprodukter eller sjømat som du har spist som pålegg, i salat, mellommåltid, snacks eller lignende siden du ble gravid?

- Nei
- Ja

Vennligst spesifiser hvilke typer fisk du har spist hvor ofte og hvor mye

1 Porsjon tilsvarer for eksempel èn skive røkelaks, makrell i tomat til èn skive, kaviar til èn skive, èn fiskekake

	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
1.									

	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
2.									
3.									

Spiser du fiskerogn eller fiskelever?

- Nei
- Ja

Hvor mange ganger per år spiser du fiskeinnmat?

Vennligst sett 1 kryss per linje.

	Aldri	1-3 ganger/år	4-6 ganger/år	7-9 ganger/år	≥ 10 ganger/år
Fiskerogn					
Fiskelever					

Eventuelle kommentarer til spørsmålene om fisk, fiskeprodukter og sjømat

Melk og Meieriprodukter

Melk og meieriprodukter
I de neste spørsmålene ønsker vi informasjon om ditt inntak av melk og meieriprodukter. Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene.

Hvor ofte har du spist og/eller drukket meieriprodukter (melk, yoghurt, ost e.l.) siden du ble gravid? Ikke ta med melk du eventuelt bruker i kaffe/te.

- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang hver dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

Hvor mange ganger har du drukket følgende melke- og meieriprodukter og/eller brukt det i frokostblandinger/grøt siden du ble gravid?

Ta med laktosefri og laktosereduserte produkter.

NB Ikke ta med bruk av melk i kaffedrikker (kommer som eget spørsmål).

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag
Helmelk							
Lettmelk							
Ekstra lett melk							
Skummet melk							
Melk med smak (f.eks sjokomelk, jordbærmelk)							
Syrnet melk naturell							
Syrnet melk med smak							
Yoghurt (alle typer)							
Drikkeyoghurt							
Smoothie med melk							
Geitemelk							

Du har krysset av for at du har drukket helmelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer f.eks. 1,5 dl (lite glass) eller et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner

- 3 porsjoner

Du har krysset av for at du har drukket lettmelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket ekstra lett melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket skummet melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket melk med smak. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket syrnet melk naturell. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket syrnet melk med smak. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist yoghurt. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket drikkeyoghurt. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket smoothie med melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket geitemelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Har du drukket eller brukt andre typer melke- og meieriprodukter i frokostblandingen/grøt siden du ble gravid (f.eks. melk fra ris, havre, soya)?

- Nei
- Ja

Vennligst spesifiser

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt. Ta med laktosefri og laktosereduserte produkter.

NB Ikke ta med bruk av melk i kaffedrikker (kommer som eget spørsmål).

	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
1.											
2.											
3.											

Hvor ofte har du vanligvis drukket kaffe siden du ble gravid?

- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang/dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

Hvor ofte har du vanligvis drukket te siden du ble gravid?

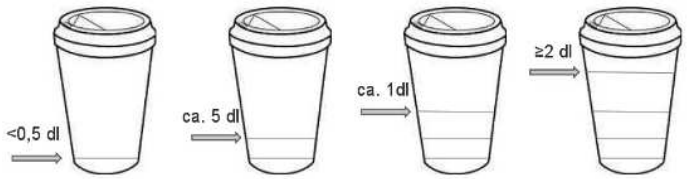
- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang/dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

Bruker du melk i kaffe/te (gjelder kun kumelk)?

- Nei
- Ja

Hvor mye melk bruker du vanligvis i hver kopp kaffe/te?

	Drikker ikke	< 0,5dl	ca 0,5dl	ca 1dl	≥ 2dl
Kaffe					
Te					



Hvor ofte spiser du følgende meieriprodukter? Gjelder også økologiske og laktosefri og/eller – reduserte varianter. Ta med det du bruker i taco, i lasagne, på pizza og i annen matlaging.

Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene.

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag
Hvitost (f.eks. Jarlsberg, Norvegia, Synnøve Finden gulost)							
Hvit geitost (f.eks Chevre, Ekte hvit geitost, Snøfrisk)							
Brunost (f.eks Gudbrandsdals-, Fløtemys-, Millom, Heidalsost)							
Brun geitost (Ekte Geitost)							
Myke oster (f.eks Brie, Camberbert)							

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag
Smøreoster (f.eks Kremost, Tubeost, Philadelphia)							
Osteprodukter på boks (f.eks Cottage cheese, Kesam/Kvarg)							
Meieriprodukter på boks (rømme, crème fraiche)							
Melkebasert mat som saus, suppe, gryte el.							
Melkebasert mat som pannekaker, vafler, sveler el.							
Is, vaniljesaus e.l (fløte/yoghurt/melkebasert)							

Du har krysset av for at du har spist hvitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist hvit geitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist brunost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist brun geitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist myke oster. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive, smøreost til én brødskive, én mozerella.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist smøreoster. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist osteprodukter på boks. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl cottage cheese/kesam.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist meieriprodukter på boks. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én spiseskje rømme / crème fraiche.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist melkebasert mat som saus, suppe, gryte el.. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl melkebasert saus/suppe/gryte.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist melkebasert mat som pannekaker, vafler, sveler el.. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én pannekake eller én vaffel.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist is, vaniljesaus e.l (fløte/yoghurt/melkebasert). Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl melkebasert saus/suppe/gryte eller én kule is.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Eventuelle kommentarer til spørsmålene om melke- og meieriprodukter

Økologiske alternativer

Økologiske alternativer
Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene.

Hvis det finnes økologiske alternativer, velger du disse?

Vennligst sett 1 kryss per linje.

	Aldri/sjelden	Noen ganger	Ofte	For det meste
Melk, melkeprodukter og ost				
Brød og kornprodukter (f.eks mel, müsli)				
Egg				

	Aldri/sjelden	Noen ganger	Ofte	For det meste
Grønnsaker				
Frukt				
Kjøtt				

Andre deler kosthold

Andre deler av kostholdet ditt

Vi minner om at du skal ha tiden **fra du ble gravid** i tankene når du svarer på spørsmålene.

Hvor ofte har du spist retter med rødt kjøtt (pølser, kjøttdeig, biff, koteletter fra svin, storfe, vilt og lam) som middagsmat?

- Aldri
- Sjeldnere enn 1 gang/måned
- 1-3 ganger/ måned
- 1 gang/uke
- 2-3 ganger/uke
- 4 ganger eller mer/uke

Hvor ofte har du spist retter med hvitt kjøtt (kylling, kalkun, annen fjærkre) som middagsmat?

- Aldri
- Sjeldnere enn 1 gang/måned
- 1-3 ganger/ måned
- 1 gang/uke
- 2-3 ganger/uke
- 4 ganger eller mer/uke

Hvilken brød/knekkebrød type spiser du vanligvis?

- Jeg spiser ikke brød eller knekkebrød
- Fint (0 -25% sammalt/hele korn)
- Halvgrovt (25-50% sammalt/hele korn)
- Grovt (50-75% sammalt/hele korn)
- Ekstra grovt (75-100% sammalt/hele korn)

Hvor mange porsjoner grønnsaker eller frukt/bær spiser du vanligvis?

1 porsjon kan for eksempel være én middels stor frukt (eple, pære, banan eller annet), eller en håndfull druer, eller ett glass juice. 1 porsjon grønnsaker kan for eksempel være én gulrot eller tre buketter brokkoli eller én porsjonsbolle med salat.

Poteter regnes ikke med.

Vennligst sett 1 kryss per linje.

	Mindre enn 1-3 porsjoner/uke	1-3 porsjoner/uke	4-6 porsjoner/uke	1 porsjon/dag	2 porsjoner/dag	3 porsjoner/dag	4 porsjoner eller mer/dag
Frukt og bær (ikke juice og smoothie)	○	○	○	○	○	○	○
Grønnsaker	○	○	○	○	○	○	○
Juice (eks. eple, appelsin)	○	○	○	○	○	○	○
Smoothie	○	○	○	○	○	○	○

Hvor mange egg spiser du per uke? (Stekt, kokt, eggerøre, omelett)

Egg i bakverk skal ikke tas med.

- ○ Mindre enn 1 egg/uke
- ○ 1 egg/uke
- ○ 2-3 egg/uke
- ○ 4-5 egg /uke
- ○ 6-7 egg/uke
- ○ 8 eller flere egg/uke

Hvor ofte spiser du sjokolade, kaker, kjeks, snop eller lignende?

- ○ Aldri/sjelden
- ○ 1-2 ganger/uke
- ○ 3-4 gang/uke

- ○ Hver dag

Hvor ofte drikker du følgende drikker?

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger/dag	5 ganger eller mer/dag
Brus/iste/energidrikk (med sukker)	○	○	○	○	○	○	○	○
Sukkerfri/lettbrus	○	○	○	○	○	○	○	○
Vann	○	○	○	○	○	○	○	○

Hvis du bruker salt som tilsetning i mat og matlaging, velger du vanligvis salt tilsatt jod?

- ○ Aldri/sjelden
- ○ Noen ganger
- ○ For det meste
- ○ Vet ikke

Spisevaner

Spisevaner

De neste spørsmål handler om spisevanene dine. Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene.

Er det matvarer (mat, drikke, annet) du har spist/drukket spesielt mye av i svangerskapet ("cravings")?

- ○ Nei
- ○ Ja, men bare deler av svangerskapet
- ○ Ja, i hele svangerskapet

Vennligst spesifiser:

Er det matvarer du har unngått å spise i svangerskapet på grunn av aversjon?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet

Vennligst spesifiser:

Er det matvarer du har unngått å spise i svangerskapet av frykt for å skade barnet?

- Nei
- Ja

Vennligst spesifiser:

Er det matvarer du har begynt å spise fordi det kan være gunstig for barnet?

- Nei
- Ja

Vennligst spesifiser:

Har du vært plaget med svangerskapskvalme?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet hittil

Hvilken svangerskapsuke opphørte svangerskapsrelatert kvalme?

▼

Har du kastet opp grunnet svangerskapskvalme?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet hittil

Hvilken svangerskapsuke opphørte svangerskapsrelatert oppkast?

▼

Kosttilskudd

Kosttilskudd

I den siste delen av spørsmål om kostholdet ønsker vi informasjon om eventuelle kosttilskudd. Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene.

Tar du et komplett tilskudd for gravide (med omega-3, vitaminer og mineraler)**?**

- Nei
- Ja

Hvor ofte tar du kosttilskudd for gravide?

	Bruker ikke	1-3 ganger/uke	4-6 ganger/uke	Daglig	Når du tar tilskudd, hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken? Bruker ikke	Mindre enn anbefalt mengde	Anbefalt mengde	Mer enn anbefalt mengde
Lifeline Care Gravid	○	○	○	○	○	○	○	○
Nycoplus Care Gravid	○	○	○	○	○	○	○	○
Annet, spesifiser:	○	○	○	○	○	○	○	○

Bruker du annet kosttilskudd?

Kryss av på aktuelle alternativer (maks. 1 kryss per linje)

	Bruker ikke	1-3 ganger/måned	1-3 ganger/uke	4-6 ganger/uke	Daglig
Tran/flytende fiskeolje	○	○	○	○	○
Omega-3-kapsler	○	○	○	○	○
Jern (tilskudd med kun jern)	○	○	○	○	○
B-vitaminer (inkl. folsyre)	○	○	○	○	○
Multivitamin og mineral	○	○	○	○	○

Du har svart at du tar tran/flytende fiskeolje. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- ○ Mindre enn anbefalt mengde
- ○ Anbefalt mengde
- ○ Mer enn anbefalt mengde

Du har svart at du tar Omega-3-kapsler. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- ○ Mindre enn anbefalt mengde
- ○ Anbefalt mengde
- ○ Mer enn anbefalt mengde

Du har svart at du tar jern. Hvor mye tar du per gang ift. anbefalt mengde på flasken/pakken?

- ○ Mindre enn anbefalt mengde

- ○ Anbefalt mengde
- ○ Mer enn anbefalt mengde

Du har svart at du tar B-vitaminer. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- ○ Mindre enn anbefalt mengde
- ○ Anbefalt mengde
- ○ Mer enn anbefalt mengde

Du har svart at du tar multivitamin og mineraler. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- ○ Mindre enn anbefalt mengde
- ○ Anbefalt mengde
- ○ Mer enn anbefalt mengde

Bruker du annet kosttilskudd som ikke ble nevnt?

- ○ Nei
- ○ Ja

Vennligst spesifiser:

	1-3 ganger/måned	1-3 ganger/uke	4-6 ganger/uke	Daglig	Når du tar tilskudd, hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken? Mindre enn anbefalt mengde	Anbefalt mengde	Mer enn anbefalt mengde
1.	○	○	○	○	○	○	○
2.	○	○	○	○	○	○	○
3.	○	○	○	○	○	○	○

Kryss av for feltene under som eventuelt gjelder for deg:

	Nei	Ja
Har melkeallergi	○	○
Har melkeintoleranse	○	○
Har cøliaki/glutenallergi	○	○
Spiser ikke meieriprodukter	○	○
Spiser ikke egg	○	○

SCOFF

Nå kommer noen spørsmål om dine holdninger og vaner knyttet til mat og vekt.

Brekker du deg fordi du føler deg ubehagelig full i magen?

- ○ Nei
- ○ Ja

Er du bekymret fordi du mister kontroll over hvor mye du spiser?

- ○ Nei
- ○ Ja

Har du nylig gått ned med mer enn 6 kilo i vekt over en tremånedersperiode?

- ○ Nei
- ○ Ja

Synes du at du er tykk selv om andre sier at du er for tynn?

- ○ Nei
- ○ Ja

Vil du si at mat har en dominerende plass i livet ditt?

- ○ Nei
- ○ Ja

EPDS

Hvordan føler du deg?

Her vil vi gjerne få vite hvordan du føler deg. Vennligst velg svaret som passer best med **hvordan du har følt deg de siste 7 dagene**, ikke bare slik du har det i dag. Ikke tenk for lenge på svaret - de spontane svarene er best.

I de siste syv dagene...

Vennligst sett 1 kryss per linje.

	Ikke i det hele tatt	Mye mindre enn vanlig	Noe mindre enn vanlig	Like mye som vanlig
Jeg har kunnet se lyst på tilværelsen og le	○	○	○	○
Jeg har gledet meg til ting som skulle skje	○	○	○	○

I de siste syv dagene...

Vennligst sett 1 kryss per linje.

	Nei, aldri	Nei, sjelden	Ja, ganske ofte	Ja, svært ofte
Jeg har bebreidet meg selv unødvendig når ting gikk galt	○	○	○	○
Jeg har følt meg bekymret og engstelig uten grunn	○	○	○	○
Jeg har følt meg redd og fått panikk uten god grunn	○	○	○	○
Det har blitt for mye for meg og jeg mestrer situasjonen dårlig	○	○	○	○
Jeg har vært så ulykkelig at jeg har hatt vansker med søvnen	○	○	○	○
Jeg har følt meg lei eller nedfor	○	○	○	○
Jeg har vært så ulykkelig at jeg har grått	○	○	○	○
Jeg har hatt tanker om å skade meg selv	○	○	○	○

HADS

Nå ber vi deg om å ha tiden fra du ble gravid i tankene:

Jeg føler meg nervøs og urolig

- ○ Ikke i det hele tatt

- Fra tid til annen
- Mye av tiden
- Mesteparten av tiden

Jeg gleder meg fortsatt over tingene slik jeg pleide før

- Avgjort like mye
- Ikke fullt så mye
- Bare lite grann
- Ikke i det hele tatt

Jeg har en urofølelse som om noe forferdelig vil skje

- Ikke i det hele tatt
- Litt, bekymrer meg lite
- Ja, ikke så veldig ille
- Ja, og noe svært ille

Jeg kan le og se det morsomme i situasjoner

- Like mye nå som før
- Ikke like mye nå som før
- Avgjort ikke som før
- Ikke i det hele tatt

Jeg har hodet fullt av bekymringer

- En gang i blant
- Av og til
- Ganske ofte
- Veldig ofte

Jeg er i godt humør

- For det meste

- Ganske ofte
- Noen ganger
- Aldri

Jeg kan sitte i fred og ro og kjenne meg avslappet

- Ja, helt klart
- Vanligvis
- Ikke så ofte
- Ikke i det hele tatt

Jeg føler meg som om alt går langsommere

- Ja, helt klart
- Vanligvis
- Ikke så ofte
- Ikke i det hele tatt

Jeg føler meg urolig som om jeg har sommerfugler i magen

- Ikke i det hele tatt
- Fra tid til annen
- Ganske ofte
- Svært ofte

Jeg bryr meg ikke lenger om hvordan jeg ser ut

- Bryr meg som før
- Kan hende ikke nok
- Ikke som jeg burde
- Ja, jeg har sluttet å bry meg

Jeg er rastløs som om jeg stadig må være aktiv

- Ikke i det hele tatt

- Ikke så veldig mye
- Ganske mye
- Uten tvil svært mye

Jeg ser med glede frem til hendelser og ting

- Like mye som før
- Heller mindre enn før
- Avgjort mindre enn før
- Nesten ikke i det hele tatt

Jeg kan plutselig få en følelse av panikk

- Ikke i det hele tatt
- Ikke så veldig ofte
- Ganske ofte
- Uten tvil svært ofte

Jeg kan glede meg over gode bøker, radio og TV

- Ofte
- Fra tid til annen
- Ikke så ofte
- Svært sjelden

Sosial støtte

Om sosial støtte

Er du i et parforhold?

- Nei
- Ja

Hvor enig er du i disse beskrivelsene av ditt parforhold?

Vennligst sett 1 kryss per linje.

	Svært enig	Enig	Litt enig	Litt uenig	Uenig	Svært uenig
Det er et nært samhold mellom meg og min ektefelle/samboer/partner						
Min partner og jeg har problemer i parforholdet						
Jeg er svært lykkelig i mitt parforhold						
Min partner er generelt forståelsesfull						
Jeg tenker ofte på å avslutte vårt parforhold						
Jeg er fornøyd med forholdet til min partner						
Vi er ofte uenige om viktige avgjørelser						
Jeg har vært heldig med valg av partner						
Vi er enige om hvordan barn bør oppdras						
Jeg tror min partner er fornøyd med forholdet						

Har du noen utenom din ektefelle/samboer/partner som du kan søke råd hos i en vanskelig situasjon?

- Nei
- Ja, 1-2 personer
- Ja, flere enn to personer

Hvor ofte treffer du eller snakker i telefonen med familie (utenom husholdningen) eller nære venner?

- 1 gang i måneden eller sjeldnere
- 2-8 ganger i måneden
- Mer enn 2 ganger i uken

Føler du deg ofte ensom?

- Nesten aldri

- Sjelden
- Av og til
- Som regel
- Nesten alltid

Fysisk aktivitet, medikamenter, røyk

Hvor mange timer er du fysisk aktiv totalt i løpet av en uke?
(Moderat til høy intensitet, som rask gåing, løping, ballsport, svømming, gruppetrening i sal og lignende)

Vi minner om at du skal ha **tiden fra du ble gravid** i tankene når du svarer på spørsmålene

- 0-30 min
- > 30 min – 1 time
- > 1 time – 2 timer
- > 2 timer – 3 timer
- > 3 timer

Hva var din vekt før du ble gravid (kg)?

▼

Hva er din vekt nå (kg)?

▼

Hvor høy er du?

▼

Har du brukt foreskrevne medikamenter de siste 6 ukene?

- Nei
- Ja

Vennligst beskriv medikament og hvor ofte du bruker det:

	Månedlig eller sjeldnere	2-4 ganger i måneden	2-3 dager i uken	4-6 dager i uken	Daglig

Røyker og/eller snuser du nå mens du er gravid?

- Nei
- Ja

Hvor mye snus eller røyk bruker du per dag?

Sigaretter per uke

Snusporsjonser/-poser per uke

Har du røyket og/eller snust mens du var gravid? Ta også med «festrøyk» / «festsnus».

- Nei
- Ja

I hvilken svangerskapsuke sluttet du?

▼

Sigaretter per uke før du sluttet

Snusporsjonser/-poser per uke før du sluttet

Søvn

Søvn

Hvor mange dager per uke...

	0	1	2	3	4	5	6	7
...bruker du mer enn 30 minutter for å sovne etter at lysene ble slukt?								
...er du våken mer enn 30 minutter innimellom søvnen?								
...våkner du mer enn 30 minutter tidligere enn du ønsker uten å få sove igjen?								
...føler du deg for lite uthvilt etter å ha sovet?								
...er du så søvnig/trett at det går ut over skole/jobb eller privatlivet?								
...er du misfornøyd med søvnen din?								

Om du har søvnplager, hvor lenge har de vart?

Når legger du deg vanligvis?

Hverdager

Helger

Når står du vanligvis opp?

Hverdager

Helger

Hvor lang tid går det vanligvis fra du legger deg til du sovner?

Timer

Minutter

Appendix IV: Questionnaire (FFQ) post-intervention

Ultralyddato

Hei! Takk for at du har **deltatt i første del** av prosjektet "Mammas mat".

I denne undersøkelsen vil vi spørre deg blant annet om kostholdet ditt og hvordan du har hatt det de siste 16 ukene siden vårt forrige møte.

Vi setter veldig stor pris på din deltakelse!

Hvilken dato har du ultralyd-termin?

	Dag	Måned	År
	▼	▼	▼

Om deg / demografi

Hvilken svangerskapsuke er du i idag?

▼

Hvor fikk du først informasjon om studien "Mammas mat"?

- [ ] Brosjyre i posten
- [ ] Facebook
- [ ] Babyverden.no
- [ ] Via bekjente
- [ ] Via KK
- [ ] Nifes.no
- [ ] Annet, beskriv:

Din alder (år):

Hva er din sivilstatus?

- ( ) Gift
- ( ) Samboer
- ( ) Enslig
- ( ) Skilt
- ( ) Separert
- ( ) Enke
- ( ) Annet

Hvilken utdannelse har du? (Sett ett kryss for den høyeste utdannelsen du har fullført.)

- ( ) Ni- eller tiårig grunnskole
- ( ) Videregående skole
- ( ) Universitet/høyskole/fagskole, inntil fire år
- ( ) Universitets/høyskole, fire år eller mer

Hva var din arbeidssituasjon før du ble gravid?

Her kan du sette flere kryss.

- [ ] Heltidsarbeid (80 - 100%)
- [ ] Deltidsarbeid (50 – 79 %)
- [ ] Deltidsarbeid (mindre enn 50 %)
- [ ] Student på heltid
- [ ] Student på deltid
- [ ] Hjemmeværende
- [ ] Arbeidsledig
- [ ] Uføretrygdet
- [ ] Sykemeldt

Hva er din arbeidssituasjon nå?

Her kan du sette flere kryss.

- Heltidsarbeid (80-100%)
- Deltidsarbeid (50-79%)
- Deltidsarbeid (mindre enn 50%)
- Student på heltid
- Student på deltid
- Hjemmeværende
- Arbeidsledig
- Uføretrygdet
- Sykemeldt

Hva var den samlede inntekten (før skatt) i husholdningen sist år?

- Ingen inntekt
- Under 200 000
- 200 - 349 999
- 350 - 549 999
- 550 - 749 999
- 750 - 999 999
- 1 000 000 -1 249 999
- 1 250 000 - 2 000 000
- Mer enn 2 000 000

Hvordan vil du beskrive familiens økonomi?

Svært god	God	Middels	Dårlig	Svært dårlig
○	○	○	○	○

Sjømat

Sjømat

Her vil vi gjerne få informasjon om deler av kostholdet ditt. Ha **de siste 16 ukene** i bakhodet når du fyller ut skjemaet. Vi er klar over at kostholdet varierer fra dag til dag. Prøv likevel så godt du kan å gi et "gjennomsnitt" av ditt matinntak når det spørres om det.

I de første spørsmålene ønsker vi informasjon om ditt inntak av fisk, fiskeprodukter og annen sjømat de siste 16 ukene.

Hvor ofte har du spist fisk, fiskeprodukter eller annen sjømat som varmt måltid de siste 16 ukene (gjelder ikke pålegg)? Inkluder torsken du eventuelt fikk utlevert av oss.

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/måned	1 gang/uke	2-3 ganger/uke	4 ganger eller mer/uke
Middag	○	○	○	○	○	○
Lunsj	○	○	○	○	○	○

Hvis du har spist fisk, fiskeprodukter eller annen sjømat til middag/varm lunsj, hvor mye har du vanligvis spist de siste 16 ukene? Inkluder torsken de eventuelt fikk utlevert av oss.

1 porsjon tilsvarer 150 gram laks, 200 gram torsk, 12 sushibiter, tre fiskekaker, seks fiskeboller, syv fiskepinner eller 2 dl reker u/skall

Vennligst sett 1 kryss per linje.

	Aldri	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner eller mer
Middag	○	○	○	○	○	○
Lunsj	○	○	○	○	○	○

Hvor ofte og hvor mye har du vanligvis spist av følgende sjømat som middag og/eller varm lunsj de siste 16 ukene? Inkluder torsken du eventuelt fikk utlevert av oss.

NB Sushi og fiskemat (fiskekaker, fiskeboller o.l.) er egne spørsmål og kommer senere.

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Laks, ørret - middag	○	○	○	○	○
Laks, ørret – lunsj	○	○	○	○	○
Torsk - middag	○	○	○	○	○
Torsk - lunsj	○	○	○	○	○
Sei - middag	○	○	○	○	○
Sei - lunsj	○	○	○	○	○
Makrell – middag	○	○	○	○	○
Makrell - lunsj	○	○	○	○	○

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Sild - middag					
Sild - lunsj					
Lyr - middag					
Lyr – lunsj					

Du har svart at du spiser laks/ørret til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser laks/ørret til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser torsk til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser torsk til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sei til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sei til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser makrell til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser makrell til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sild til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sild til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lyr til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lyr til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Lange - middag					
Lange - lunsj					
Kveite - middag					
Kveite - lunsj					
Steinbit - middag					
Steinbit - lunsj					

Du har svart at du spiser lange til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser lange til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kveite til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kveite til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser steinbit til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser steinbit til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 200 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Sushi og fiskemat (fiskekaker, fiskeboller o.l.)

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Sushi - middag					
Sushi - lunsj					
Fiskekaker/-boller/-pudding - middag					
Fiskekaker/-boller/-pudding - lunsj					
Fiskegrateng					
Fiskepinner					
Fiskesuppe					
Klippfisk					

Du har svart at du spiser sushi til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 12 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sushi til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 12 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskekaker/-boller/-pudding til middag. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 3 fiskekaker, 6 fiskeboller eller 3 skiver fiskepudding.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskekaker/-boller/-pudding til lunsj. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 3 fiskekaker, 6 fiskeboller eller 3 skiver fiskepudding.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskegrateng. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 275 gram**.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskepinner. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 7 biter.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser fiskesuppe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 350 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon

- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser klippfisk. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Reker					
Krabbe, klokjøtt					
Krabbe, brunmat					
Hummer					
Blåskjell					
Kamskjell					

Du har svart at du spiser reker. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 250 gram reker med skall.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser klokjøtt av krabbe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon

- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser brunmat av krabbe. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser hummer. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 150 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser blåskjell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 115 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kamskjell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = 115 gram.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Har du spist annen sjømat som middag eller varm lunsj siden du ble gravid?

- Nei
- Ja

Vennligst oppgi hva slags fisk du har spist som middag og som varm lunsj siden du ble gravid

1 porsjon tilsvarer 150 gram laks, 200 gram torsk, 12 sushibiter, tre fiskekaker, seks fiskeboller, syv fiskepinner eller 2 dl reker u/skall

	Sjeldnere enn 1 gang/måned	1-3 ganger/måned	1-2 ganger/uke	3 ganger eller mer/uke	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
1.									
2.									
3.									

Hvor ofte har du brukt fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende de siste 16 ukene?

- Aldri
- Sjelden
- 1-3 ganger/måned
- 1-2 ganger/uke
- 3-5 ganger/uke
- Mer enn 5 ganger/uke

Hvis du bruker fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende, hvor mye har du vanligvis spist?

1 porsjon tilsvarer for eksempel èn skive røkelaks, makrell i tomat til èn skive, kaviar til èn skive, èn fiskekake eller 2 dl reker u/skall

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon

2 porsjoner

3 porsjoner

Hvor ofte og hvor mye har du vanligvis spist av følgende fisk, fiskeprodukter eller annen sjømat som pålegg, i salat, mellommåltid, snacks eller lignende de siste 16 ukene?

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke
Makrell på boks (alle typer)					
Laks på boks					
Tunfisk på boks					
Røkt laks, ørret					
Gravet laks, ørret					
Sild (sursild, rømmesild, krydddersild el.lign.)					
Kaviar					
Peppermakrell					
Reker (ikke rekesalat)					
Sardin på boks					
Ansjos					
Crabsticks					
Svolværpostei					
Lofotpostei					

Du har svart at du spiser makrell på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = makrell på boks til én brødskive.**

½ porsjon eller mindre

1 porsjon

1 ½ porsjon

2 porsjoner

3 porsjoner

Du har svart at du spiser laks på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = laks på boks til én brødskive.**

½ porsjon eller mindre

1 porsjon

1 ½ porsjon

2 porsjoner

3 porsjoner

Du har svart at du spiser tunfisk på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én spiseskje tunfisk.**

½ porsjon eller mindre

1 porsjon

1 ½ porsjon

2 porsjoner

3 porsjoner

Du har svart at du spiser røkt laks/ørret. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én oppskåret skive laks/ørret.**

½ porsjon eller mindre

1 porsjon

1 ½ porsjon

2 porsjoner

3 porsjoner

Du har svart at du spiser gravet laks/ørret. Hvor stor porsjon spiser du vanligvis? **Én porsjon = én skive gravet laks/ørret.**

½ porsjon eller mindre

1 porsjon

1 ½ porsjon

2 porsjoner

3 porsjoner

Du har svart at du spiser sild. Hvor stor porsjon spiser du vanligvis? **Én porsjon = sild til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser kaviar. Hvor stor porsjon spiser du vanligvis? **Én porsjon = kaviar til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser peppermakrell. Hvor stor porsjon spiser du vanligvis? **Én porsjon = pepper-/kaldrøkt/varmrøkt makrell til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser reker som pålegg. Hvor stor porsjon spiser du vanligvis? **Én porsjon = reker til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser sardiner på boks. Hvor stor porsjon spiser du vanligvis? **Én porsjon brisling = brisling til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser ansjos. Hvor stor porsjon spiser du vanligvis? **Én porsjon ansjos = ansjos til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser crabsticks. Hvor stor porsjon spiser du vanligvis? **Én porsjon crabsticks = 4 stk crabsticks.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har svart at du spiser svolværpostei. Hvor stor porsjon spiser du vanligvis? **Én porsjon = postei til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner

- 3 porsjoner

Du har svart at du spiser lofotpostei. Hvor stor porsjon spiser du vanligvis? **Én porsjon = postei til én brødskive.**

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Er det andre typer fisk, fiskeprodukter eller sjømat som du har spist som pålegg, i salat, mellommåltid, snacks eller lignende siden du ble gravid?

- Nei
- Ja

Vennligst spesifiser hvilke typer fisk du har spist hvor ofte og hvor mye

1 Porsjon tilsvarer for eksempel èn skive røkelaks, makrell i tomat til èn skive, kaviar til èn skive, èn fiskekake

	Sjeldnere enn 1 gang/måned	1-3 ganger/ måned	1-2 ganger/uke	3 ganger eller mer/uke	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner
1.									
2.									
3.									

Har du spist fiskerogn eller fiskelever?

- Nei
- Ja

Hvor mange ganger per år spiser du fiskeinnmat?

Vennligst sett 1 kryss per linje.

	Aldri	1-3 ganger/år	4-6 ganger/år	7-9 ganger/år	≥ 10 ganger/år
Fiskerogn					
Fiskelever					

Eventuelle kommentarer til spørsmålene om fisk, fiskeprodukter og sjømat

Melk og Meieriprodukter

Melk og meieriprodukter

I de neste spørsmålene ønsker vi informasjon om ditt inntak av melk og meieriprodukter de siste 16 ukene siden vårt forrige møte.

Hvor ofte har du spist og/eller drukket meieriprodukter (melk, yoghurt, ost e.l.) de siste 16 ukene? Ta med alternative melkedrikker som ikke er kumelk.

- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang hver dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

Hvor ofte og hvor mye har du drukket av følgende melke- og meieriprodukter, og/eller brukt det i frokostblandinger/grøt de siste 16 ukene?

Ta med laktosefri og laktosereduserte produkter.

NB Ikke ta med bruk av melk i kaffedrikker (kommer som eget spørsmål).

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag
Helmelk	○	○	○	○	○	○	○
Lettmelk	○	○	○	○	○	○	○
Ekstra lett melk	○	○	○	○	○	○	○
Skummet melk	○	○	○	○	○	○	○
Melk med smak (f.eks sjokomelk, jordbærmelk)	○	○	○	○	○	○	○
Syrnet melk naturell	○	○	○	○	○	○	○
Syrnet melk med smak	○	○	○	○	○	○	○
Yoghurt (alle typer)	○	○	○	○	○	○	○
Drikkeyoghurt	○	○	○	○	○	○	○
Smoothie med melk	○	○	○	○	○	○	○
Geitemelk	○	○	○	○	○	○	○

Du har krysset av for at du har drukket helmelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer f.eks. 1,5 dl (lite glass) eller et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon
- ○ 1 ½ porsjon
- ○ 2 porsjoner
- ○ 3 porsjoner

Du har krysset av for at du har drukket lettmelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon
- ○ 1 ½ porsjon
- ○ 2 porsjoner
- ○ 3 porsjoner

Du har krysset av for at du har drukket ekstra lett melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon
- ○ 1 ½ porsjon
- ○ 2 porsjoner
- ○ 3 porsjoner

Du har krysset av for at du har drukket skummet melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon
- ○ 1 ½ porsjon
- ○ 2 porsjoner
- ○ 3 porsjoner

Du har krysset av for at du har drukket melk med smak. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon
- ○ 1 ½ porsjon
- ○ 2 porsjoner
- ○ 3 porsjoner

Du har krysset av for at du har drukket syrnet melk naturell. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ○ ½ porsjon eller mindre
- ○ 1 porsjon

- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket syrnet melk med smak. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist yoghurt. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket drikkeyoghurt. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket smoothie med melk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har drukket geitemelk. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Har du drukket eller brukt andre typer melke- og meieriprodukter i frokostblandingen/grøt de siste 16 ukene (f.eks. melk fra ris, havre, soya)?

NB Ikke ta med bruk av melk i kaffedrikker (kommer som eget spørsmål).

- Nei
- Ja

Vennligst spesifiser

1 porsjon tilsvarer 1,5 dl (lite glass), et lite beger yoghurt. Ta med laktosefri og laktosereduserte produkter.

NB Ikke ta med bruk av melk i kaffedrikker (kommer som eget spørsmål).

	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag	½ porsjon eller mindre	1 porsjon	1 ½ porsjon	2 porsjoner	3 porsjoner

1.											
2.											
3.											

Hvor ofte har du drukket kaffe de siste 16 ukene?

- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang/dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

Hvor ofte har du drukket te de siste 16 ukene?

- Aldri
- Sjeldnere enn 1 gang/uke
- 1-3 ganger/uke
- 4-6 ganger/uke
- 1 gang/dag
- 2 ganger/dag
- 3-4 ganger eller mer/dag

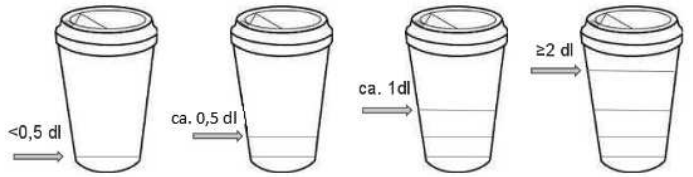
Bruker du melk i kaffe/te (gjelder kun kumelk)?

- Nei
- Ja

Hvor mye melk har du vanligvis brukt i hver kopp kaffe/te?

	Drikker ikke	< 0,5dl	ca 0,5dl	ca 1dl	≥ 2dl
Kaffe					

	Drikker ikke	< 0,5dl	ca 0,5dl	ca 1dl	≥ 2dl
Te					



Hvor ofte spiser du følgende meieriprodukter? Gjelder også økologiske og laktosefri og/eller – reduserte varianter. Ta med det du bruker i taco, i lasagne, på pizza og i annen matlaging.

Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene.

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger eller mer/dag
Hvitost (f.eks. Jarlsberg, Norvegia, Synnøve Finden gulost)							
Hvit geitost (f.eks Chevre, Ekte hvit geitost, Snøfrisk)							
Brunost (f.eks Gudbrandsdals-, Fløtemys-, Millom, Heidalsost)							
Brun geitost (Ekte Geitost)							
Myke oster (f.eks Brie, Camembert)							
Smøreoster (f.eks Kremost, Tubeost, Philadelphia)							
Osteprodukter på boks (f.eks Cottage cheese, Kesam/Kvarg)							
Meieriprodukter på boks (rømme, crème fraiche)							
Melkebasert mat som saus, suppe, gryte el.							
Melkebasert mat som pannekaker, vafler, sveler el.							
Is, vaniljesaus e.l (fløte/yoghurt/melkebasert)							

Du har krysset av for at du har spist hvitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist hvit geitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist brunost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist brun geitost. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive eller smøreost til én brødskive.

- ½ porsjon eller mindre

- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist myke oster. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer skivet ost til én brødskive, smøreost til én brødskive, én mozerella.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist smøreoster. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer smøreost til én brødskive.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist osteprodukter på boks. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl cottage cheese/kesam.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist meieriprodukter på boks. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én spiseskje rømme / crème fraiche.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist melkebasert mat som saus, suppe, gryte el.. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl melkebasert saus/suppe/gryte.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist melkebasert mat som pannekaker, vafler, sveler el.. Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én pannekake eller én vaffel.

- ½ porsjon eller mindre
- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Du har krysset av for at du har spist is, vaniljesaus e.l (fløte/yoghurt/melkebasert). Hvor stor er porsjonen vanligvis?

1 porsjon tilsvarer én dl melkebasert saus/suppe/gryte eller én kule is.

- ½ porsjon eller mindre

- 1 porsjon
- 1 ½ porsjon
- 2 porsjoner
- 3 porsjoner

Eventuelle kommentarer til spørsmålene om melke- og meieriprodukter

Økologiske alternativer

Økologiske alternativer
Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene.

Dersom det finnes økologiske alternativer, velger du disse?

Vennligst sett 1 kryss per linje.

	Aldri/sjelden	Noen ganger	Ofte	For det meste
Melk, melkeprodukter og ost				
Brød og kornprodukter (f.eks mel, müsli)				
Egg				
Grønnsaker				
Frukt				
Kjøtt				

Andre deler kosthold

Andre deler av kostholdet ditt

Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene.

Hvor ofte har du spist retter med rødt kjøtt (pølser, kjøttdeig, biff, koteletter fra svin, storfe, vilt og lam) som middagsmat?

- Aldri

- Sjeldnere enn 1 gang/måned
- 1-3 ganger/ måned
- 1 gang/uke
- 2-3 ganger/uke
- 4 ganger eller mer/uke

Hvor ofte har du spist retter med hvitt kjøtt (kylling, kalkun, annen fjærkre) som middagsmat?

- Aldri
- Sjeldnere enn 1 gang/måned
- 1-3 ganger/ måned
- 1 gang/uke
- 2-3 ganger/uke
- 4 ganger eller mer/uke

Hvilke brød/knekkebrødtype har du vanligvis spist de siste 16 ukene?

- Jeg spiser ikke brød eller knekkebrød
- Fint (0 -25% sammalt/hele korn)
- Halvgrovt (25-50% sammalt/hele korn)
- Grovt (50-75% sammalt/hele korn)
- Ekstra grovt (75-100% sammalt/hele korn)

Hvor mange porsjoner grønnsaker eller frukt/bær har du vanligvis spist de siste 16 ukene?

1 porsjon kan for eksempel være én middels stor frukt (eple, pære, banan eller annet), eller en håndfull druer, eller ett glass juice. 1 porsjon grønnsaker kan for eksempel være én gulrot eller tre buketter brokkoli eller én porsjonsbolle med salat.

Poteter regnes ikke med.

Vennligst sett 1 kryss per linje.

	Mindre enn 1-3 porsjoner/uke	1-3 porsjoner/uke	4-6 porsjoner/uke	1 porsjon/dag	2 porsjoner/dag	3 porsjoner/dag	4 porsjoner eller mer/dag
Frukt og bær (ikke juice og smoothie)							
Grønnsaker							
Juice (eks. eple, appelsin)							
Smoothie							

Hvor mange egg har du spist per uke de siste 16 ukene? (Stekt, kokt, eggerøre, omelett)

NB Egg i bakverk skal ikke tas med.

- Mindre enn 1 egg/uke
- 1 egg/uke
- 2-3 egg/uke
- 4-5 egg /uke
- 6-7 egg/uke
- 8 eller flere egg/uke

Hvor ofte har du spist sjokolade, kaker, kjeks, snop eller lignende de siste 16 ukene?

- Aldri/sjelden
- 1-2 ganger/uke
- 3-4 gang/uke
- Hver dag

Hvor ofte har du drukket følgende drikker de siste 16 ukene?

Vennligst sett 1 kryss per linje.

	Aldri	Sjeldnere enn 1 gang/uke	1-3 ganger/uke	4-6 ganger/uke	1 gang/dag	2 ganger/dag	3-4 ganger/dag	5 ganger eller mer/dag
Brus/iste/energidrikk (med sukker)								
Sukkerfri/lettbrus								
Vann								

Dersom du bruker salt som tilsetning i mat og matlaging, velger du vanligvis salt tilsatt jod?

- Aldri/sjelden
- Noen ganger
- For det meste
- Vet ikke

Spisevaner

Spisevaner

De neste spørsmål handler om spisevanene dine. Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene.

Er det matvarer (mat, drikke, annet) du har spist/drukket spesielt mye av i svangerskapet (”cravings”)?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet

Vennligst spesifiser:

Er det matvarer du har unngått å spise i svangerskapet på grunn av aversjon?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet

Vennligst spesifiser:

Er det matvarer du har unngått å spise i svangerskapet av frykt for å skade barnet?

- Nei
- Ja

Vennligst spesifiser:

Er det matvarer du har begynt å spise fordi det kan være gunstig for barnet?

- Nei
- Ja

Vennligst spesifiser:

Har du vært plaget med svangerskapskvalme?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet hittil

Hvilken svangerskapsuke opphørte svangerskapsrelatert kvalme?

▼

Har du kastet opp grunnet svangerskapskvalme?

- Nei
- Ja, men bare deler av svangerskapet
- Ja, i hele svangerskapet hittil

Hvilken svangerskapsuke opphørte svangerskapsrelatert oppkast?

▼

Kosttilskudd

Kosttilskudd

I den siste delen av spørsmål om kostholdet ønsker vi informasjon om eventuelle kosttilskudd. Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene.

Tar du et komplett tilskudd for gravide (med omega-3, vitaminer og mineraler)**?**

- Nei
- Ja

Hvor ofte tar du kosttilskudd for gravide?

	Bruker ikke	1-3 ganger/uke	4-6 ganger/uke	Daglig	**Når du tar tilskudd, hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?** Bruker ikke	Mindre enn anbefalt mengde	Anbefalt mengde	Mer enn anbefalt mengde
Lifeline Care Gravid								
Nycoplus Care Gravid								
Annet, spesifiser:								

Bruker du annet kosttilskudd?

Kryss av på aktuelle alternativer (maks. 1 kryss per linje)

	Bruker ikke	1-3 ganger/måned	1-3 ganger/uke	4-6 ganger/uke	Daglig
Tran/flytende fiskeolje					

	Bruker ikke	1-3 ganger/måned	1-3 ganger/uke	4-6 ganger/uke	Daglig
Omega-3-kapsler					
Jern (tilskudd med kun jern)					
B-vitaminer (inkl. folsyre)					
Multivitamin og mineral					

Du har svart at du tar tran/flytende fiskeolje. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- Mindre enn anbefalt mengde
- Anbefalt mengde
- Mer enn anbefalt mengde

Du har svart at du tar Omega-3-kapsler. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- Mindre enn anbefalt mengde
- Anbefalt mengde
- Mer enn anbefalt mengde

Du har svart at du tar jern. Hvor mye tar du per gang ift. anbefalt mengde på flasken/pakken?

- Mindre enn anbefalt mengde
- Anbefalt mengde
- Mer enn anbefalt mengde

Du har svart at du tar B-vitaminer. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- Mindre enn anbefalt mengde
- Anbefalt mengde
- Mer enn anbefalt mengde

Du har svart at du tar multivitamin og mineraler. Hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?

- Mindre enn anbefalt mengde

- Anbefalt mengde
- Mer enn anbefalt mengde

Bruker du annet kosttilskudd som ikke ble nevnt?

- Nei
- Ja

Vennligst spesifiser:

					Når du tar tilskudd, hvor mye tar du vanligvis ift. anbefalt mengde på flasken/pakken?		
	1-3 ganger/måned	1-3 ganger/uke	4-6 ganger/uke	Daglig	Mindre enn anbefalt mengde	Anbefalt mengde	Mer enn anbefalt mengde
1.							
2.							
3.							

Kryss av for feltene under som eventuelt gjelder for deg:

	Nei	Ja
Har melkeallergi		
Har melkeintoleranse		
Har cøliaki/glutenallergi		
Spiser ikke meieriprodukter		
Spiser ikke egg		

SCOFF

Nå kommer noen spørsmål om dine holdninger og vaner knyttet til mat og vekt.

Er du bekymret fordi du mister kontroll over hvor mye du spiser?

- Nei
- Ja

Synes du at du er tykk selv om andre sier at du er for tynn?

- Nei
- Ja

Vil du si at mat har en dominerende plass i livet ditt?

- Nei
- Ja

EPDS

Hvordan føler du deg?

Her vil vi gjerne få vite hvordan du føler deg. Vennligst velg svaret som passer best med **hvordan du har følt deg de siste 7 dagene**, ikke bare slik du har det i dag. Ikke tenk for lenge på svaret - de spontane svarene er best.

I de siste syv dagene...

Vennligst sett 1 kryss per linje.

	Ikke i det hele tatt	Mye mindre enn vanlig	Noe mindre enn vanlig	Like mye som vanlig
Jeg har kunnet se lyst på tilværelsen og le				
Jeg har gledet meg til ting som skulle skje				

I de siste syv dagene...

Vennligst sett 1 kryss per linje.

	Nei, aldri	Nei, sjelden	Ja, ganske ofte	Ja, svært ofte
Jeg har bebreidet meg selv unødvendig når ting gikk galt				
Jeg har følt meg bekymret og engstelig uten grunn				

	Nei, aldri	Nei, sjelden	Ja, ganske ofte	Ja, svært ofte
Jeg har følt meg redd og fått panikk uten god grunn				
Det har blitt for mye for meg og jeg mestrer situasjonen dårlig				
Jeg har vært så ulykkelig at jeg har hatt vansker med søvnen				
Jeg har følt meg lei eller nedfor				
Jeg har vært så ulykkelig at jeg har grått				
Jeg har hatt tanker om å skade meg selv				

HADS

På de neste spørsmålene ber vi deg vennligst om å velge svaret som passer best med hvordan du har følt deg **de siste 7 dagene**:

Jeg føler meg nervøs og urolig

- Ikke i det hele tatt
- Fra tid til annen
- Mye av tiden
- Mesteparten av tiden

Jeg gleder meg fortsatt over tingene slik jeg pleide før

- Avgjort like mye
- Ikke fullt så mye
- Bare lite grann
- Ikke i det hele tatt

Jeg har en urofølelse som om noe forferdelig vil skje

- Ikke i det hele tatt
- Litt, bekymrer meg lite
- Ja, ikke så veldig ille
- Ja, og noe svært ille

Jeg kan le og se det morsomme i situasjoner

- Like mye nå som før
- Ikke like mye nå som før
- Avgjort ikke som før
- Ikke i det hele tatt

Jeg har hodet fullt av bekymringer

- En gang i blant
- Av og til
- Ganske ofte
- Veldig ofte

Jeg er i godt humør

- For det meste
- Ganske ofte
- Noen ganger
- Aldri

Jeg kan sitte i fred og ro og kjenne meg avslappet

- Ja, helt klart
- Vanligvis
- Ikke så ofte
- Ikke i det hele tatt

Jeg føler meg som om alt går langsommere

- Ja, helt klart
- Vanligvis
- Ikke så ofte
- Ikke i det hele tatt

Jeg føler meg urolig som om jeg har sommerfugler i magen

- Ikke i det hele tatt
- Fra tid til annen
- Ganske ofte
- Svært ofte

Jeg bryr meg ikke lenger om hvordan jeg ser ut

- Bryr meg som før
- Kan hende ikke nok
- Ikke som jeg burde
- Ja, jeg har sluttet å bry meg

Jeg er rastløs som om jeg stadig må være aktiv

- Ikke i det hele tatt
- Ikke så veldig mye
- Ganske mye
- Uten tvil svært mye

Jeg ser med glede frem til hendelser og ting

- Like mye som før
- Heller mindre enn før
- Avgjort mindre enn før
- Nesten ikke i det hele tatt

Jeg kan plutselig få en følelse av panikk

- Ikke i det hele tatt
- Ikke så veldig ofte
- Ganske ofte
- Uten tvil svært ofte

Jeg kan glede meg over gode bøker, radio og TV

- Ofte
- Fra tid til annen
- Ikke så ofte
- Svært sjelden

Sosial støtte

Om sosial støtte

Er du i et parforhold?

- Nei
- Ja

Hvor enig er du i disse beskrivelsene av ditt parforhold?

Vennligst sett 1 kryss per linje.

	Svært enig	Enig	Litt enig	Litt uenig	Uenig	Svært uenig
Det er et nært samhold mellom meg og min ektefelle/samboer/partner						
Min partner og jeg har problemer i parforholdet						
Jeg er svært lykkelig i mitt parforhold						
Min partner er generelt forståelsesfull						
Jeg tenker ofte på å avslutte vårt parforhold						
Jeg er fornøyd med forholdet til min partner						
Vi er ofte uenige om viktige avgjørelser						
Jeg har vært heldig med valg av partner						
Vi er enige om hvordan barn bør oppdras						
Jeg tror min partner er fornøyd med forholdet						

Har du noen utenom din ektefelle/samboer/partner som du kan søke råd hos i en vanskelig situasjon?

- Nei
- Ja, 1-2 personer
- Ja, flere enn to personer

Hvor ofte treffer du eller snakker i telefonen med familie (utenom husholdningen) eller nære venner?

- 1 gang i måneden eller sjeldnere
- 2-8 ganger i måneden
- Mer enn 2 ganger i uken

Føler du deg ofte ensom?

- Nesten aldri
- Sjelden
- Av og til
- Som regel
- Nesten alltid

Fysisk aktivitet, medikamenter, røyk

Hvor mange timer er du fysisk aktiv totalt i løpet av en uke?
(Moderat til høy intensitet, som rask gåing, løping, ballsport, svømming, gruppetrening i sal og lignende)

Vi minner om at du skal ha **de siste 16 ukene** i tankene når du svarer på spørsmålene

- 0-30 min
- > 30 min – 1 time
- > 1 time – 2 timer
- > 2 timer – 3 timer
- > 3 timer

Hva var din vekt før du ble gravid (kg)?

▼

Hva er din vekt nå (kg)?

▼

Hvor høy er du?

▼

Har du brukt foreskrevne medikamenter de siste 6 ukene?

- Nei
- Ja

Vennligst beskriv medikament og hvor ofte du bruker det:

	Månedlig eller sjeldnere	2-4 ganger i måneden	2-3 dager i uken	4-6 dager i uken	Daglig

Røyker og/eller snuser du nå mens du er gravid?

- Nei
- Ja

Hvor mye snus eller røyk bruker du?

Sigaretter per uke

Snusporsjoner/-poser per uke

Har du røyket og/eller snust mens du var gravid? Ta også med «festrøyk» / «festsnus».

- Nei
- Ja

I hvilken svangerskapsuke sluttet du?

Sigaretter per uke før du sluttet

Snusporsjoner/-poser per uke før du sluttet

Søvn

Søvn

Her ber vi deg om å ha **de siste 7 dagene** i tankene når du svarer:

Hvor mange dager per uke ....

	0	1	2	3	4	5	6	7
...bruker du mer enn 30 minutter for å sovne etter at lysene ble slukt?								
...er du våken mer enn 30 minutter innimellom søvnen?								
...våkner du mer enn 30 minutter tidligere enn du ønsker uten å få sove igjen?								
...føler du deg for lite uthvilt etter å ha sovet?								
...er du så søvnig/trett at det går ut over skole/jobb eller privatlivet?								
...er du misfornøyd med søvnen din?								

Om du har søvnplager, hvor lenge har de vart?

Når legger du deg vanligvis?

Hverdager

Helger

Når står du vanligvis opp?

Hverdager

Helger

Hvor lang tid går det vanligvis fra du legger deg til du sovner?

Timer

Minutter