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Original Article

The Fit for Delivery study: rationale for the recommendations and test-retest reliability of a dietary score measuring adherence to 10 specific recommendations for prevention of excessive weight gain during pregnancy

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Abstract

Aiming at preventing excessive weight gain during pregnancy, 10 specific dietary recommendations are given to pregnant women in the intervention arm of the Norwegian Fit for Delivery (FFD) study. This paper presents the rationale and test-retest reliability of the food frequency questionnaire (FFQ) and a dietary score measuring adherence to the recommendations. The study is part of the ongoing FFD study, a randomised, controlled, intervention study in nulliparous pregnant women. A 43-item FFQ was developed for the FFD study. A dietary score was constructed from 10 subscales corresponding to the 10 dietary recommendations. Adding the subscales yielded a score from 0 to 10 with increasing score indicating healthier dietary behaviour. The score was divided into tertiles, grouping participants into low, medium and high adherence to the dietary recommendations. Pregnant women attending ultrasound screening at about week 19 of pregnancy were asked to complete the FFQ twice, 2 weeks apart. Of 154 pregnant women completing the first questionnaire, 106 (69%) completed the form on both occasions and was included in the study. The test-retest correlations of the score and subscales were $r = 0.68$ and $r = 0.56$–0.84, respectively (both $P \leq 0.001$). There was 68% test-retest correct classification of the score and 70–87% of the subscales. In conclusion, acceptable test-retest reliability of the FFQ and the dietary score was found. The score will be used in the FFD study to measure adherence to the dietary recommendations throughout pregnancy and in the following year post-partum.

Keywords: food frequency questionnaire, test-retest reliability, body weight, pregnancy, dietary score, excessive weight gain.

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Introduction

Overweight and obesity have become increasingly prevalent in Norway over the past two decades, also among women of childbearing age (Henriksen 2006). Especially pre-pregnancy body mass index (BMI), but also weight gain during pregnancy, affects gestational as well as long-term health of both mother and child (Thorsdottir *et al*. 2002; Andreasen *et al*. 2004; Nohr *et al*. 2008). Excess gestational weight gain is associated with increased risk of complications both before (Thorsdottir *et al*. 2002) and during delivery (Callaway *et al*. 2006), and further with increased risk of weight retention after delivery (Linné *et al*. 2003; Andreasen *et al*. 2004). Excess gestational weight gain also increases the risk of developing diseases later in

life, such as diabetes and breast cancer (Kinnunen *et al*. 2007; Norman & Reynolds 2011). Excess weight gain in pregnancy is clearly associated with increased birthweight and incidence of large for gestational age babies (Stamnes Koepp *et al*. 2012). High birthweight is further associated with increased risk of obesity and diabetes later in life for the child (Henriksen 2007; Kinnunen *et al*. 2007).

The American Institute of Medicine has published guidelines for weight gain during pregnancy based on a woman's pre-pregnancy BMI (Institute of Medicine 1990). Research suggests that weight gain at or below these recommendations is associated with an optimal delivery outcome for both mother and child (Kinnunen *et al*. 2007). Although studies have shown that weight gain in pregnant women is influenced by health care provider recommendations, it has been reported that 30–60% do not receive weight gain advice in pregnancy (Stotland *et al*. 2005; Tovar *et al*. 2010). The few studies that have investigated specific nutritional factors related to weight gain during pregnancy indicate that diet may play a major role (Olafsdottir *et al*. 2006; Uusitalo *et al*. 2009). A recently published meta-analysis of the effects of randomised dietary interventions in pregnancy confirms that dietary interventions are effective in limiting gestational weight gain, and significant reductions in a range of gestational complications were documented as well (Thangaratinam *et al*. 2012). Excess weight gain during pregnancy has been found to be related to a 'fast food' pattern (Uusitalo *et al*. 2009), 'eating more', drinking more milk and eating more sweets (Olafsdottir *et al*. 2006). There is, however, a paucity of information on what constitutes effective dietary interventions for preventing excessive gestational weight gain (Thangaratinam *et al*. 2012).

Apart from influencing weight gain, dietary factors in pregnancy may also impact directly on the risk of pregnancy complications (Meltzer *et al*. 2011).

Changing dietary habits is difficult to initiate and maintain, and psychological research indicates that only 30–40% of lifestyle change intentions are carried out (Godin & Kok 1996; Allan *et al*. 2008). It is, however, known that first-time pregnant women become more aware of the health aspects of nutrition and seek this kind of information during pregnancy (Szwajcer *et al*. 2005). A study by Crozier *et al*. (2009) showed that pregnant women were able to respond to simple dietary public health messages, such as to reduce the consumption of entrails but that the overall quality of diet was more difficult to improve. Consequently, concise and specific dietary recommendations should be developed and communicated to pregnant women in a simple and comprehensible way.

The Norwegian Fit for Delivery (FFD) study is a prospective randomised, controlled, intervention study carried out among 600 nulliparous pregnant women in the area surrounding Kristiansand in the southern part of Norway. Women in the intervention arm are given dietary advice and access to biweekly exercise groups throughout pregnancy whereas the control group receives routine pregnancy health care. The purpose of the FFD study is to investigate whether a relatively low impact lifestyle intervention during pregnancy can modify gestational weight gain and influence long-term maternal and child nutrition and health. The protocol for the FFD study will be presented elsewhere. The aim of the present paper is to describe the 10 FFD dietary recommendations and their rationale and to report test-retest reliability of the FFQ and the dietary score measuring adherence to the recommendations.

Key messages

- Aiming at preventing excessive weight gain during pregnancy, 10 dietary recommendations are given to pregnant women in the intervention arm of the Fit for Delivery study (FFD).
- A dietary score was constructed from a 43-item food frequency questionnaire and used to evaluate adherence to the recommendations. Acceptable test-retest reliability of the FFQ and the dietary score was found.
- The score will be used in the ongoing FFD study to measure adherence to the dietary recommendations. If positive effects of the dietary intervention are documented, tailored advice on diet and dietary behaviour can be implemented into routine pregnancy and obstetrical care.

Dietary advice in the FFD study

Both national and international dietary guidelines exist for pregnant women (Fowles 2006; The Norwegian Directorate of Health 2010a). In addition, women in the intervention arm of the ongoing FFD study receive dietary advice simplified to 10 easy-to-remember statements specifically targeting prevention of excess weight gain during pregnancy. The following advice is given: (1) eat regular meals; (2) drink water when thirsty; (3) in between meals, choose fruits and vegetables; (4) eat vegetables with dinner every day; (5) eat sweets and snacks only when you really appreciate it; (6) buy small portion sizes of unhealthy foods; (7) limit your intake of added sugar; (8) limit your intake of salt; (9) do not eat beyond satiety; and (10) read nutrition labels on foods before buying. The recommendations are forwarded to study participants in the intervention arm in a pamphlet describing the 10 recommendations and their (simplified) rationale. Soon after inclusion, they receive a telephone call from a skilled adviser and, 4–6 weeks later, a similar call to discuss the practical aspects of the recommendations. Participants in the intervention group are further invited to a lecture focusing on diet and physical activity in pregnancy and a separate cooking lesson aiming at inspiring the participants to cook and make use of healthy foods such as fish, barley and a multitude of vegetables in their cooking.

Rationale for the 10 dietary recommendations

The overall purpose of the FFD study is to prevent excess weight gain and its inherent consequences for mother and child through physical activity and diet modification during pregnancy. The dietary recommendations are tailored for this purpose and aim at making the pregnant women reflect on their food choices. The recommendations have a scientific foundation and are consistent with current Norwegian dietary recommendations.

Eat regular meals

Studies have shown that young people who skip breakfast are more likely to be overweight or obese (Andersen *et al*. 2005; Grøholt *et al*. 2008; Croezen *et al*. 2009) and have a higher BMI than those who eat breakfast regularly (Barton *et al*. 2005; Delva *et al*. 2007). It is also documented that skipping meals leads to an increased number of snacking events and a higher intake of energy-dense foods (Larson *et al*. 2009). In a review of the current US Department and Agriculture (USDA) dietary guidelines for pregnant women, the author lists 'not skipping meals' as important during pregnancy (Fowles 2006).

Drink water when thirsty

Increased consumption of sweetened beverages is a potential contributor to higher energy intake with consequent weight gain (Malik *et al*. 2006). There is also evidence that the satiating effect of beverages is lower than that of solid foods, possibly resulting in poor regulation of energy intake from beverages (Malik *et al*. 2006; Dennis *et al*. 2009). Results from the National Health and Nutrition Examination Survey show that drinking plain water predicts lower energy density of the foods consumed, while drinking beverages predicts higher energy density of foods (Kant *et al*. 2009).

Eat vegetables with dinner every day

Vegetables are low energy-dense foods. The systematic literature review from the World Cancer Research Fund & American Institute for Cancer Research (2007) concludes that 'overall, the epidemiological evidence that low energy-dense foods protect against weight gain, overweight and obesity is substantial and generally consistent'. Studies show that the general Norwegian population has difficulties in including vegetables in the diet (The Norwegian Directorate of Health 2010b). In the traditional Norwegian meal pattern, with only one cooked meal daily, the easiest way to include vegetables is with dinner. In a recent study, only 40% of adolescents and 60% of their parents reported having vegetables with dinner on a random week day (Vejrup *et al*. 2008).

In between meals – choose fruits and vegetables

Because fruits and vegetables are mostly low-energy foods and therefore will not contribute to excessive

weight gain, the pregnant women are recommended to choose fruits and vegetables as in-between-meal snacks. This is in accordance with the USDA guidelines (Fowles 2006). Several studies show that in-between meals or snacks tend to be energy dense and contain much sugar and fat (Fowles 2006; Jaeger *et al*. 2009). Among subjects having many snacking events during a day, the total energy from these meals may exceed the intake from ordinary meals (Sjöberg *et al*. 2003).

Eat sweets and snacks only when you really appreciate it

Sweets and snacks are energy dense and a high intake is related to excessive weight gain in pregnant women (Olafsdottir *et al*. 2006; Uusitalo *et al*. 2009). Studies show that sweets and snacks are frequently eaten unplanned (Wansink *et al*. 2010), often while watching television (Bowman 2006; Chaput *et al*. 2011) or even when bored (Nelson *et al*. 2009). Studies show that snacking is done automatically and that breaking such routines is difficult (Tam *et al*. 2010). An intervention study among undergraduate students showed that both the strategy of telling students to choose healthy instead of unhealthy snacks and that of telling them to limit their intake of unhealthy snacks, actually reduced the number of unhealthy snacking events (Tam *et al*. 2010). The pregnant women are recommended to choose vegetables or fruits as snacks in between meals and eat sweets only when they know they will really enjoy it, aiming at reducing the unplanned and casual intake. The purpose of this recommendation is to challenge participants to reflect on why they want to eat sweets and snacks.

Buy small portion sizes of unhealthy foods

The pregnant women are recommended to consider package size and buy small portion sizes of unhealthy food. Studies in young adults show that BMI is strongly related to their selection of large portion sizes of energy-dense, high-carbohydrate foods (Burger *et al*. 2007). These studies suggest that an intervention for preventing weight gain in young adults should focus upon the importance of portion sizes and upon increasing the awareness of eating habits in response to media messages and product packaging (Burger *et al*. 2007). Studies by Rolls *et al*. (2006) show that a reduction in portion size and energy density of foods are additive and lead to sustained decrease in energy intake. Further, studies by Chandon & Wansink (2002) show that people have difficulties regulating their food intake when they are aware of leftovers still available and that the choice therefore must be taken when purchasing and choosing small sizes in order to self-regulate their intake (Chandon & Wansink 2002).

Limit your intake of added sugar

A limitation of sugary foods and drinks is recommended for the general population, as several systematic reviews state an association between liquid sugar and overweight (Norwegian Nutrition Council 2011). Clausen *et al*. (2001) showed that a high intake of sucrose during pregnancy was associated with an increased risk of pre-eclampsia and overweight. Olafsdottir *et al*. (2006) showed that overweight pregnant women who ate more sweets early in pregnancy increased their risk of gaining excessive weight. A recently published Finnish study among pregnant women found similar results; a dietary pattern characterised by junk food, sweets and sugar-sweetened soft drinks was positively associated with weight gain rate (Uusitalo *et al*. 2009).

Limit your intake of salt

A reduced intake of salt is recommended for the general population in order to reduce the risk of hypertension (World Cancer Research Fund & American Institute for Cancer Research 2007; Norwegian Nutrition Council 2011). There is also a quantitative relationship between salt intake and fluid consumption in adults and in children (He *et al*. 2008). Calculations done by He *et al*. (2008) show that a reduction in salt intake by half would result in an average reduction in 2.3 soft drinks per week in children in the UK. A reduction in salt intake could therefore play a role in reducing excess weight gain by reducing intake of energy-containing drinks.

Do not eat beyond satiety

Both the increase in portion size and the availability of food has made it more common to eat beyond satiety. A study among undergraduate females showed that eating beyond satiety was the strongest predictor of BMI when controlled for other eating behaviours (Yanover & Sacco 2008). Another study of African-American and Caucasian women showed that the odds of becoming obese increased sixfold for Caucasian and 15-fold for African-American women who ate beyond satiation every day compared with those who rarely or never ate beyond satiation (Brewer *et al*. 2003).

Read nutritional labels of foods before buying

A study among American adults showed that those who read nutrient labelling had a healthier diet than those who did not read the lists. This association was specifically shown in relation to energy intake (Ollberding *et al*. 2010). The pregnant women in our study are taught how to understand ingredient lists and food labelling, aiming at assisting them in making healthy dietary choices.

Materials and methods

Test-retest of the questionnaire

A 220-item questionnaire was developed for the FFD study to assess demographic and socioeconomic factors at inclusion and aspects of diet and physical activity prospectively and repetitively throughout pregnancy and during the first year post-partum. In the test-retest reliability study, pregnant women from the Kristiansand area in the southern part of Norway were invited to participate by completing the questionnaire regarding pre-pregnant weight and height, marital status, level of education, smoking, alcohol, drugs, diet and physical activity before and during pregnancy on two occasions 2 weeks apart. Participants were recruited while attending ultrasound screening at Sorlandet Hospital HF, usually around 18–20 weeks of gestation. Written information was sent to potential participants 1 week before the scheduled ultrasound appointment. They accepted the invitation by filling in the questionnaire at the hospital (time 1) and received an identical questionnaire by mail 2 weeks later (time 2). The second questionnaire was returned to the hospital in a pre-stamped and addressed envelope. One hundred fifty-four pregnant women agreed to participate in the test-retest study. Of these, 106 (69%) completed the questionnaire on both occasions and were included in the test-retest analysis. The reliability study was carried out between October 2009 and December 2010. In the present paper, the test-retest reliability of the food frequency part of the questionnaire (FFQ) is reported.

Instruments

The FFQ consisted of 43 items concerning dietary behaviour and the consumption of selected foods and drinks. The FFQ was constructed to yield information on the dietary aspects covered in the study and therefore did not cover the diet as a whole. Questions covered meal frequency, drink items, fruits and vegetables, sugary foods, sweets and snacks, fast food, portion sizes of unhealthy foods and drinks, enjoyment of food and familiarity with food labelling. To be able to measure the degree of adherence to the 10 dietary recommendations, a dietary score was constructed from 10 subscales, each subscale referring to one of the corresponding FFD recommendation. The subscales were single variables or sum scores constructed from relevant questions from the FFQ. Each computed subscale was then dichotomised using the median as cut-off, and assigned a value of 0 or 1, with 1 indicating the healthier dietary behaviour. Adding the dichotomised subscales resulted in a dietary score that could take values from 0 (low adherence) to 10 (high adherence). This procedure is in accordance with the method used in assessing adherence to the Mediterranean diet (Bach *et al*. 2006) and adherence to healthy aspects of the Nordic diet (Olsen *et al*. 2011). Methods for summarising diets by means of a single index or score resulting from a function of different dietary components are increasingly being used in epidemiological studies (Bach *et al*. 2006). Score components may be selected by data-driven statistical techniques like factor analysis or cluster analysis, or *a priori* based on knowledge or scientific

evidence within the area of interest (Bach *et al*. 2006). In the present study, the score is constructed on the basis of *a priori* defined aspects of diet and dietary behaviour related to the risk of excess weight gain during pregnancy. Table 1 describes the 10 recommendations, the FFQ questions included in each subscale, resulting cut-off points (median) and the dietary behaviour required for scoring within each subscale. Missing values in the subscales were assigned a value of 0.5 in order to neutralise influence upon the total score. To be able to investigate test-retest agreement of the dietary score, the study population was divided into tertiles according to their computed total score, and grouped into 'low' (0–3.5), 'medium' (4.0–5.5) and 'high' (6.0–10) adherence to the dietary recommendations.

Procedures and statistical analysis

The data was analysed using the computer program SPSS statistical software package version 19.0 (IBM Corporation, Armonk, NY, USA). Test-retest reproducibility of the selected FFQ questions or sum scores (subscales) was assessed using bivariate correlations. As 7 of the 10 subscales were not normally distributed, rank order correlation was estimated with Spearman's correlation coefficient. The final score was normally distributed and is therefore presented with Pearson's correlation coefficient. Cross tabulations and Cohen's kappa coefficients were used to investigate the test-retest agreement of classification into the three adherence categories. The same method was used to investigate the test-retest classification of the subscale scoring. For the test-retest cross tabulation of the individual dichotomised subscales, participants with the assigned missing value of 0.5 were excluded, yielding different number of participants in the various analyses (Table 2).

Ethical considerations

The test-retest study was included in the protocol for the FFD study that was approved by the Norwegian Regional Committee for Medical Research Ethics.

Results

A total of 106 pregnant women completed the questionnaire on both occasions and were included in the analyses. Mean age was 29 years (range 20–42), and median gestational week at the time of completing the first questionnaire was 19 (range 16–31). Table 2 presents details for the test-retest comparison. The correlation coefficient between test and retest of the dietary score was $r = 0.68$, $P \leq 0.001$ (Pearson) and between the test and retest subscales $r = 0.56$–0.84, $P \leq 0.001$ (Spearman's rank correlation coefficient). Regarding the test-retest agreement of the dietary scoring, 68% was correctly classified into low, medium or high adherence on both occasions (kappa measure of agreement 0.51). Four per cent was grossly misclassified, moving either from high to low adherence or the opposite way. For the dichotomised subscales, 70–87% were correctly classified on both occasions. The kappa measure of agreement between test and retest subscale scoring ranged from 0.39 to 0.74 (Table 2).

Discussion

Ten dietary recommendations are given to pregnant women in the intervention arm of the ongoing Norwegian FFD study. We hypothesise that adherence to the recommendations will contribute to the prevention of excess weight gain during pregnancy without sacrificing normal eating or the enjoyment of food in general. To be able to rank participants according to degree of adherence to the 10 recommendations, a dietary score was constructed based on relevant subscales constructed from the FFQ.

The test-retest Spearman correlation coefficients from 0.59 to 0.74 for the subscales were good considering that correlation coefficients on the order of 0.5–0.7 are typical for the reproducibility of nutrient intakes and comparable with that of many biological measurements made among free-living subjects (Willett 1998). Erkkola *et al*. (2001) conducted a reproducibility study of a 181-item FFQ in 111 pregnant women who completed the FFQ twice at a 1-month interval (Erkkola *et al*. 2001). The intraclass correlation coefficients for nutrients ranged from 0.44

Table 1. The FFD study. The components underlying the construction of 10 subscales that constitutes the FFD dietary score based on the 10 dietary recommendations for preventing excess weight gain during pregnancy and forwarded to the intervention group in the FFD study ($n = 106$)

Dietary recommendations	Related FFQ question(s)	Response alternatives and coding	Calculations	Possible range of each subscale	Median = cut-off	Dietary behaviour associated with scoring
1. Eat regular meals	How often do you eat – breakfast – lunch – dinner – evening meal/supper	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three times a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7	Sum of answers to the four questions	0–28 meals a week	Test: 26 Retest: 25	Test: ≤25 meals week^{-1} = 0 ≥26 meals week^{-1} = 1 Retest: ≤24 meals week^{-1} = 0 ≥25 meals week^{-1} = 1
2. Drink water when thirsty	How often do you drink – tap water – bottled water – carbonised water – whole-fat milk – low-fat milk – skimmed milk – juice – fruit drinks or nectar – sugar-containing beverages – artificially sweetened beverages – alcohol-containing beverages	Never = 0 Less than once a week = 0.5 Once a week = 1 Twice a week = 2 Three a week = 3 Four times a week = 4 Five times a week = 5 Six times a week = 6 Every day = 7 Several times a day = 10	Sum of water intake events (frequency) divided by sum of all other drink intake events (frequency) multiplied by 100	0–100%	Test: 40% Retest: 38%	Test: <40% of drinking events is water = 0 ≥40% of drinking events is water = 1 Retest: <38% of drinking events is water = 0 ≥38% of drinking events is water = 1
3. Eat vegetables with dinner every day	How often do you eat vegetables with dinner?	Never to daily (0–7)	No calculation	0–7	Test: 5 Retest: 4	Test: <5 times week^{-1} = 0 ≥5 times week^{-1} = 1 Retest: <4 times week^{-1} = 0 ≥4 times week^{-1} = 1
4. In between meals – choose fruits or vegetables	How often do you eat fruits or vegetables as an in-between meal? How often do you eat in-between meals?	Never to several times a day (0–10)	Frequency of eating fruits or vegetables in between meals divided by frequency of having in-between meals multiplied by 100	0–100%	Test: 80% Retest: 86%	Test: Fruits/vegetables <80% of in-between meals = 0 Fruits/vegetables ≥80% of in-between meals = 1 Retest: Fruits/vegetables <86% of in-between meals Fruits/vegetables ≥86% of in-between meals
5. Eat sweets and snacks only when you really appreciate it	How often do you eat sweets or unhealthy foods without really appreciating it?	Never to several times a day (0–10)	No calculation	0–10	Test: 0.5 Retest: 0.5	Test and retest: Never eating sweets without appreciation = 1 Sometimes eating sweets without appreciation = 0

Table 1. Continued

Dietary recommendations	Related FFQ question(s)	Response alternatives and coding	Calculations	Possible range of each subscale	Median = cut-off	Dietary behaviour associated with scoring
6. Buy small portion sizes of unhealthy foods	Which size of the following three items do you usually buy? – crisps – chocolate – soda	Small = 0 Big = 1	Sum of three answers	0–3	Test: 3 Retest: 3	Test and retest: Buying small portion size of at least one of the three items = 1 Buying big size of all three items = 0
7. Limit your intake of added sugar	How often do you have – sugar-sweetened fruit drinks – soda – cookies/crackers – sweet breads – cake/muffins – sugar-containing cereals – sugar-containing fruit yoghurt – chocolate/sweets How often do you add sugar to your food?	Never to several times a day (0–10)	Sum of answers to the nine questions	0–90	Test: 10 Retest: 10	Test and retest: <10 (approximately equivalent to eating food with added sugar once a day or less) = 1 ≥10 (approximately equivalent to eating food with added sugar more than once a day) = 0
8. Limit your intake of salt	How often do you eat – salted crackers – noodles – crisps or other salted snacks – hot dogs from kiosk/gas station – fried potato chips from fast-food restaurants – canned or freeze-dried food How often do you add salt to your food?	Never to several times a day (0–10)	Sum of answers to the seven questions	0–70	Test: 7.5 Retest: 7.5	Test and retest: <7.5 (fast-foods, snacks or salting of food no more than once a day) = 1 ≥7.5 (fat-foods, snacks or salting of foods more than once a day = 0
9. Do not eat beyond satiety	How often do you eat beyond satiety?	Never to several times a day (0–10)	No calculation	0–10	Test: 1 Retest: 1	Test and retest: Less than once a week = 1 Once a week or more = 0
10. Read nutrition labels on foods before buying		Never = 1 Sometimes = 2 Usually = 3 Always = 4	No calculation	1–4	Test: 2 Retest: 2	Test and retest: Never reading labels = 0 sometimes or often reading labels = 1
Total FFD score			Sum of the 10 dichotomised subscales	0–10	Test: 5 Retest: 5	Adherence test and retest: ≤3.5 = low 4–5.5 = medium ≥6 = high

FFD, fit for delivery; FFQ, food frequency questionnaire.

Table 2. The FFD study. Test-retest reliability of the 10 subscales that constitute the FFD dietary score and for the trichotomised score

The 10 subscales related to the corresponding FFD dietary recommendations	Spearman's rank order correlation	*P*-value	Kappa measure of agreement (dichotomised subscales)	Percent agreement between test and retest (dichotomised subscales)
Meal frequency ($n = 103$)	0.84	≤0.001	0.71	85
Choosing water when thirsty ($n = 98$)	0.70	≤0.001	0.55	78
Vegetables for dinner ($n = 103$)	0.76	≤0.001	0.45	73
Fruits and vegetables as in-between-meal snack ($n = 92$)	0.56	≤0.001	0.39	70
Eating sweets and snacks without appreciation ($n = 100$)	0.68	≤0.001	0.63	82
Portion size of sweets and snacks ($n = 93$)	0.77	≤0.001	0.74	87
Frequency of eating foods and drinks with added sugar ($n = 100$)	0.78	≤0.001	0.62	81
Frequency of eating foods and snacks with added salt ($n = 99$)	0.77	≤0.001	0.61	81
Frequency of overeating ($n = 102$)	0.81	≤0.001	0.65	83
Frequency of reading food labels before buying ($n = 101$)	0.73	≤0.001	0.58	82
FFD dietary score ($n = 106$)	0.68*	≤0.001	0.51†	68†

FFD, fit for delivery. *Pearson correlation coefficient is used for the FFD score. †Trichotomised score.

(ice cream) to 0.91 (coffee), and the authors conclude that the FFQ has an acceptable reproducibility and represents a useful tool for categorising pregnant women according to their dietary intake. Bosco *et al.* (2010) investigated reproducibility of self-reported dietary intake during an earlier pregnancy, 3 months apart, reporting mean intraclass correlations of energy-adjusted nutrients of 0.59 (range 0.41–0.69) and good agreement of reporting multivitamin use during pregnancy (kappa = 0.66–0.85) (Bosco *et al.* 2010). Shu *et al.* (2004) investigated reproducibility of an FFQ used in the Shanghai Women's Health study with 191 participants completing the questionnaire twice, 2 years apart. They report correlation coefficients from 0.41 to 0.66 for daily intake of food groups such as rice, poultry, red meat, fish, soy foods, vegetables and fruits. Hu *et al.* (1999) assessed reproducibility of an FFQ completed 1 year apart in a subsample of men from the Health Professionals Follow-Up Study in 1986, comparing two dietary patterns (so called 'prudent' and 'Western' pattern) on two occasions 1 year apart, reporting correlation coefficients ranging from 0.36 to 0.92 for individual foods, 0.70 for the prudent pattern and 0.67 for the Western pattern (Hu *et al.* 1999), comparable with the ones presented in our study.

In this study, a combination of methods is used to evaluate the test-retest reliability of the FFQ and the resulting dietary score. The kappa statistic was used together with observed percent agreement as a measure of chance-corrected proportional agreement (Altman 1991). According to Altman (1991), values of kappa above 0.80 indicate very good agreement, 0.61–0.80 good agreement, 0.41–0.60 indicates moderate agreement, 0.21–0.40 fair agreement and <0.20 poor agreement. The test-retest subscale correlation in this study of $r = 0.56$–0.84 combined with 70–87% correct classification of the dichotomised subscales and kappa values ranging from 0.39 to 0.74, indicate at least acceptable test-retest reliability of the FFQ. The test-retest dietary score correlation of $r = 0.68$ combined with 68% correct classification, only 4% grossly misclassified and a kappa value of 0.51, also indicate acceptable test-retest reliability of the trichotomised score (Masson *et al.* 2003).

The measuring of adherence to a dietary behaviour with a single score has its limitations. Five of the 10 subscales were based on one FFQ question only,

yielding few response alternatives and a skewed distribution. Hence, for some subscales, the dichotomising by the median resulted in differently sized groups. For the purpose of this study, however, and by inspecting the resulting cut-off points, we feel confident that the sample was acceptably divided. The identical weighting or contribution of each subscale to the final dietary score may be questioned. It is probably not possible to predict the specific impact of adherence to any one of the 10 dietary recommendations in the complicated picture of preventing excess weight gain in pregnancy.

Neither the dietary score, nor the 43-item FFQ, has been validated. Several of the FFQ questions are inquiring dietary behaviour rather than food or drink intake, rendering validation more challenging. A 24-h recall on selected food and drink items was included in the questionnaire, but was not sufficiently detailed for the purpose of validation. The score will be used as an instrument to rank study participants according to degree of adherence to this *a priori* defined dietary behaviour, hypothesised to be protective against excessive weight gain during pregnancy. This relative ranking of adherence will be the measure of a potential effect of the dietary intervention in the FFD study. The score will further be used to investigate differences in dietary behaviour related to demographic and socioeconomic factors and to explore longitudinal dietary changes during pregnancy and the following years related to aspects of mother and child health.

Conclusion

Ten specific and simplified dietary recommendations are given to pregnant women in the intervention arm of the FFD study in order to prevent excessive weight gain during pregnancy and its inherent risks and potential complications. A dietary score was constructed to evaluate adherence to the recommendations. Acceptable test-retest reliability of the FFQ and the dietary score was found. The score will be used in the ongoing FFD study as a measure of adherence to the dietary recommendations. If positive effects of the dietary intervention are documented through the FFD study, tailored advice on diet and dietary behaviour can be implemented into routine pregnancy and obstetrical care.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

LRS, IV and EB conceived the FFD study. NCØ and EB designed the present study and developed the dietary recommendations. NCØ drafted the rationale. LRS was responsible for the data collection. ERH constructed the dietary score in cooperation with NCØ and EB, carried out statistical procedures and drafted the methods and discussion section. The other authors revised the paper critically.

References

Allan J.L., Johnston M. & Campbell N. (2008) Why do people fail to turn good intentions into action? The role of executive control processes in the translation of healthy eating intentions into action in young Scottish adults. *BMC Public Health* **8**, 123.

Altman D.G. (1991) *Practical Statistics for Medical Research*. Chapman & Hall: London.

Andersen L.F., Lillegaard I.T.L., Øverby N., Lytle L., Klepp K. & Johansson L. (2005) Overweight and obesity among Norwegian schoolchildren: changes from 1993 to 2000. *Scandinavian Journal of Public Health* **33**, 99–106.

Andreasen K.R., Andersen M.L. & Schantz A.L. (2004) Obesity and pregnancy. *Acta Obstetricia et Gynecologica Scandinavica* **83**, 1022–1029.

Bach A., Serra-Majem L., Carrasco J.L., Roman B., Ngo J., Bertomeu I. *et al*. (2006) The use of indexes evaluating

the adherence to the Mediterranean diet in epidemiological studies: a review. *Public Health Nutrition* **9**, 132–146.

Barton B.A., Eldridge A.L., Thompson D., Affenito S.G., Striegel-Moore R.H., Franko D.L. *et al*. (2005) The relationship of breakfast and cereal consumption to nutrient intake and body mass index: the National Heart, Lung, and Blood Institute Growth and Health Study. *Journal of the American Dietetic Association* **105**, 1383–1389.

Bosco J.L.F., Tseng M., Spector L.G., Olshan A.F. & Bunin G.R. (2010) Reproducibility of reported nutrient intake and supplement use during a past pregnancy: a report from the Children's Oncology Group. *Paediatric and Perinatal Epidemiology* **24**, 93–101.

Bowman S.A. (2006) Television-viewing characteristics of adults: correlations to eating practices and overweight and health status. *Preventing Chronic Disease* **3**, A38.

Brewer E.A., Kolotkin R.L. & Baird D.D. (2003) The relationship between eating behaviors and obesity in African American and Caucasian women. *Eating Behaviors* **4**, 159–171.

Burger K.S., Kern M. & Coleman K.J. (2007) Characteristics of self-selected portion size in young adults. *Journal of the American Dietetic Association* **107**, 611–618.

Callaway L.K., Prins J.B., Chang A.M. & McIntyre H.D. (2006) The prevalence and impact of overweight and obesity in an Australian obstetric population. *The Medical Journal of Australia* **184**, 56–59.

Chandon P. & Wansink B. (2002) When are stockpiled products consumed faster? A convenience – salience framework of postpurchase consumption incidence and quantity. *JMR, Journal of Marketing Research* **39**, 321–335.

Chaput J.P., Klingenberg L., Astrup A. & Sjödin A.M. (2011) Modern sedentary activities promote overconsumption of food in our current obesogenic environment. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity* **12**, e12–e20.

Clausen T., Slott M., Solvoll K., Drevon C.A., Vollset S.E. & Henriksen T. (2001) High intake of energy, sucrose, and polyunsaturated fatty acids is associated with increased risk of preeclampsia. *American Journal of Obstetrics and Gynecology* **185**, 451–458.

Croezen S., Visscher T.L., Ter Bogt N.C., Veling M.L. & Haveman-Nies A. (2009) Skipping breakfast, alcohol consumption and physical inactivity as risk factors for overweight and obesity in adolescents: results of the E-MOVO project. *European Journal of Clinical Nutrition* **63**, 405–412.

Crozier S.R., Robinson S.M., Godfrey K.M., Cooper C. & Inskip H.M. (2009) Women's dietary patterns change little from before to during pregnancy. *Journal of Nutrition* **139**, 1956–1963.

Delva J., Johnston L.D. & O'Malley P.M. (2007) The epidemiology of overweight and related lifestyle behaviors: racial/ethnic and socioeconomic status differences among American youth. *American Journal of Preventive Medicine* **33**, S178–S186.

Dennis E.A., Flack K.D. & Davy B.M. (2009) Beverage consumption and adult weight management: a review. *Eating Behaviors* **10**, 237–246.

Erkkola M., Karppinen M., Javanainen J., Räsänen L., Knip M. & Virtanen S.M. (2001) Validity and reproducibility of a food frequency questionnaire for pregnant Finnish women. *American Journal of Epidemiology* **154**, 466–476.

Fowles E.R. (2006) What's a pregnant woman to eat? A review of current USDA dietary guidelines and MyPyramid. *Journal of Perinatal Education* **15**, 28–33.

Godin G. & Kok G. (1996) The theory of planned behavior: a review of its applications to health-related behaviors. *American Journal of Health Promotion* **11**, 87–98.

Grøholt E., Stigum H. & Nordhagen R. (2008) Overweight and obesity among adolescents in Norway: cultural and socio-economic differences. *Journal of Public Health* **30**, 258–265.

He F.J., Marrero N.M. & MaCGregor G.A. (2008) Salt intake is related to soft drink consumption in children and adolescents: a link to obesity? *Hypertension* **51**, 629–634.

Henriksen T. (2006) Nutrition and pregnancy outcome. *Nutrition Reviews* **64**, S19–S23.

Henriksen T. (2007) Nutrition, weight and pregnancy. *Tidsskrift for Den Norske Lægeforening: Tidsskrift for Praktisk Medicin, Ny Række* **127**, 2399–2401.

Hu F.B., Rimm E., Smith-Warner S.A., Feskanich D., Stampfer M.J., Ascherio A. *et al*. (1999) Reproducibility and validity of dietary patterns assessed with a food-frequency questionnaire. *The American Journal Of Clinical Nutrition* **69**, 243–249.

Institute of Medicine (1990) Nutritional status and weight gain. In: *Nutrition during Pregnancy* (ed Institute of Medicine), pp 9–12. National Academies Press: Washington, DC.

Jaeger S.R., Marshall D.W. & Dawson J. (2009) A quantitative characterisation of meals and their contexts in a sample of 25 to 49-year-old Spanish people. *Appetite* **52**, 318–327.

Kant A.K., Graubard B.I. & Atchison E.A. (2009) Intakes of plain water, moisture in foods and beverages, and total water in the adult US population – nutritional, meal pattern, and body weight correlates: National Health and Nutrition Examination Surveys 1999–2006. *The American Journal of Clinical Nutrition* **90**, 655–663.

Kinnunen T.I., Pasanen M., Aittasalo M., Fogelholm M., Hilakivi-Clarke L., Weiderpass E. *et al*. (2007) Preventing excessive weight gain during pregnancy – a controlled trial in primary health care. *European Journal of Clinical Nutrition* **61**, 884–891.

Larson N.I., Nelson M.C., Neumark-Sztainer D., Story M. & Hannan P.J. (2009) Making time for meals: meal structure and associations with dietary intake in young adults. *Journal of the American Dietetic Association* **109**, 72–79.

Linné Y., Dye L., Barkeling B. & Rössner S. (2003) Weight development over time in parous women – the SPAWN study – 15 years follow-up. *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* **27**, 1516–1522.

Malik V.S., Schulze M.B. & Hu F.B. (2006) Intake of sugar-sweetened beverages and weight gain: a systematic review. *The American Journal of Clinical Nutrition* **84**, 274–288.

Masson L.F., McNeill G., Tomany J.O., Simpson J.A., Peace H.S., Wei L. *et al*. (2003) Statistical approaches for assessing the relative validity of a food-frequency questionnaire: use of correlation coefficients and the kappa statistic. *Public Health Nutrition* **6**, 313–321.

Meltzer H.M., Brantsæter A.L., Nilsen R.M., Magnus P., Alexander J. & Haugen M. (2011) Effect of dietary factors in pregnancy on risk of pregnancy complications: results from the Norwegian Mother and Child Cohort Study. *The American Journal of Clinical Nutrition* **94**, 1970S–1974S.

Nelson M.C., Kocos R., Lytle L.A. & Perry C.L. (2009) Understanding the perceived determinants of weight-related behaviors in late adolescence: a qualitative analysis among college youth. *Journal of Nutrition Education & Behavior* **41**, 287–292.

Nohr E.A., Vaeth M., Baker J.L., Sørensen T.I.A., Olsen J. & Rasmussen K.M. (2008) Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. *The American Journal of Clinical Nutrition* **87**, 1750–1759.

Norman J.E. & Reynolds R.M. (2011) The consequences of obesity and excess weight gain in pregnancy. *The Proceedings of the Nutrition Society* **70**, 450–456.

Norwegian Nutrition Council (2011) *Dietary Recommendations for Health Promotion and the Prevention of Chronic Diseases in Norway* (in Norwegian). Report. The Norwegian Directorate of Health: Oslo.

Olafsdottir A.S., Skuladottir G.V., Thorsdottir I., Hauksson A. & Steingrimsdottir L. (2006) Maternal diet in early and late pregnancy in relation to weight gain. *International Journal of Obesity (2005)* **30**, 492–499.

Ollberding N.J., Wolf R.L. & Contento I. (2010) Food label use and its relation to dietary intake among US adults. *Journal of the American Dietetic Association* **110**, 1233–1237.

Olsen A., Egeberg R., Halkjær J., Christensen J., Overvad K. & Tjønneland A. (2011) Healthy aspects of the Nordic diet are related to lower total mortality. *The Journal of Nutrition* **141**, 639–644.

Rolls B.J., Roe L.S. & Meengs J.S. (2006) Reductions in portion size and energy density of foods are additive and lead to sustained decreases in energy intake. *American Journal of Clinical Nutrition* **83**, 11–17.

Shu X.O., Yang G., Jin F., Liu D., Kushi L., Wen W. *et al*. (2004) Validity and reproducibility of the food frequency questionnaire used in the Shanghai Women's Health Study. *European Journal of Clinical Nutrition* **58**, 17–23.

Sjöberg A., Hallberg L., Höglund D. & Hulthén L. (2003) Meal pattern, food choice, nutrient intake and lifestyle factors in The Göteborg Adolescence Study. *European Journal of Clinical Nutrition* **57**, 1569–1578.

Stamnes Koepp U.M., Frost Andersen L., Dahl-Joergensen K., Stigum H., Nass O. & Nystad W. (2012) Maternal pre-pregnant body mass index, maternal weight change and offspring birthweight. *Acta Obstetricia et Gynecologica Scandinavica* **91**, 243–249.

Stotland N.E., Haas J.S., Brawarsky P., Jackson R.A., Fuentes-Afflick E. & Escobar G.J. (2005) Body mass index, provider advice, and target gestational weight gain. *Obstetrics and Gynecology* **105**, 633–638.

Szwajcer E.M., Hiddink G.J., Koelen M.A. & Van Woerkum C.M.J. (2005) Nutrition-related information-seeking behaviours before and throughout the course of pregnancy: consequences for nutrition communication. *European Journal of Clinical Nutrition* **59** (Suppl. 1), S57–S65.

Tam L., Bagozzi R.P. & Spanjol J. (2010) When planning is not enough: the self-regulatory effect of implementation intentions on changing snacking habits. *Health Psychology* **29**, 284–292.

Thangaratinam S., Rogozińska E., Jolly K., Glinkowski S., Roseboom T., Tomlinson J.W. *et al*. (2012) Effects of interventions in pregnancy on maternal weight and obstetric outcomes: meta-analysis of randomized evidence. *BMJ* **344**, e2088. doi: 10.1136/bmj.e2088.

The Norwegian Directorate of Health (2010a) *Pregnant*. Helsedirektoratet. Available at: http://www.helsedirektoratet.no/publikasjoner/gravid/Sider/default.aspx

The Norwegian Directorate of Health (2010b) *Trends in Norwegian Diet 2009* (in Norwegian). Helsedirektoratet: Oslo.

Thorsdottir I., Torfadottir J.E., Birgisdottir B.E. & Geirsson R.T. (2002) Weight gain in women of normal weight before pregnancy: complications in pregnancy or delivery and birth outcome. *Obstetrics and Gynecology* **99**, 799–806.

Tovar A., Chasan-Taber L., Bermudez O.I., Hyatt R.R. & Must A. (2010) Knowledge, attitudes, and beliefs regarding weight gain during pregnancy among Hispanic women. *Maternal & Child Health Journal* **14**, 938–949.

Uusitalo U., Arkkola T., Ovaskainen M.-L., Kronberg-Kippilä C., Kenward M.G., Veijola R. *et al*. (2009) Unhealthy dietary patterns are associated with weight gain during pregnancy among Finnish women. *Public Health Nutrition* **12**, 2392–2399.

Vejrup K., Lien N., Klepp K.-I. & Bere E. (2008) Consumption of vegetables at dinner in a cohort of Norwegian adolescents. *Appetite* **51**, 90–96.

Wansink B., Payne C.R. & Shimizu M. (2010) 'Is this a meal or snack?' Situational cues that drive perceptions. *Appetite* **54**, 214–216.

Willett W.C. (ed) (1998) Reproducibility and validity of food-frequency questionnaires. In: *Nutritional Epidemiology*, 2nd edn, pp 105–110. Oxford University Press: New York.

World Cancer Research Fund & American Institute for Cancer Research (2007) *Food, Nutrition, Physical Activity and the Prevention of Cancer: A Global Perspective*, 1st edn, AICR: Washington, DC.

Yanover T. & Sacco W.P. (2008) Eating beyond satiety and body mass index. *Eating and Weight Disorders: EWD* **13**, 119–128.