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ORIGINAL ARTICLE

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Dietary fibre intake and lifestyle characteristics in relation to nausea or vomiting during pregnancy—a questionnaire-based cohort study

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ABSTRACT

Nausea or vomiting in pregnancy (NVP) are among the commonest symptoms experienced in early pregnancy. We wanted to evaluate the association of dietary fibre intake, lifestyle characteristics and bowel function with NVP. One hundred and eighty-eight participants completed a self-administered questionnaire concerning bowel function, dietary fibre intake and lifestyle characteristics. Women suffering from NVP ($n = 91$) consumed significantly more fibre derived from cereal products ($p = .026$) and total fibre ($p = .043$) during pre-pregnancy period was compared to women without NVP ($n = 97$). In both groups, intake of total fibre and fibre derived from fruit and vegetables increased significantly during the first trimester. Dietary fibre intake did not protect from NVP. However, women suffering from NVP were able to maintain their fibre intake. Dietary fibre is tolerated well during NVP, and this finding can be used when giving diet counselling to women suffering from NVP.

IMPACT STATEMENT

- **What is already known on this subject?** Nausea or vomiting in pregnancy (NVP) are among the commonest symptoms experienced in early pregnancy. The pathophysiology of NVP remains unknown, but it has been suggested to be multifactorial. Diet during pregnancy may have an impact on NVP. It is generally advised to avoid meat, poultry, fish, eggs and spicy and fatty foods during periods of NVP, but there is limited data on the effects of diet of NVP.
- **What do the results of this study add?** Women suffering from NVP have been shown to eat less meat (and thus protein) compared to women without NVP. Dietary fibre reduces constipation and heartburn and it also keeps blood glucose levels stable. Because of various beneficial effects of fibre on the digestive system, we hypothesised that a high fibre intake may alleviate the symptoms of NVP.
- **What are the implications of these findings for clinical practice and/or further research?** The aim of the present study was to investigate whether the amount or source of dietary fibre are associated with NVP. We wanted to investigate intake of fibre derived from cereal products (mostly representing insoluble fibre) and fibre derived from fruit and vegetables (containing mostly soluble fibre) separately in relationship to NVP, as the mechanisms of action of these fibre groups are different. There are no observational studies including also pre-pregnancy consumption of fibre when focussing on the association between fibre and NVP. The results of this study can be used when giving diet counselling to women suffering from NVP.

KEYWORDS

Hyperemesis gravidarum; nausea or vomiting in pregnancy (NVP); dietary fibre; soluble fibre; insoluble fibre

Introduction

Nausea or vomiting in pregnancy (NVP) are among the commonest symptoms consistently experienced in early pregnancy. The results of surveys indicate that nausea affects up to 85% of pregnant women and vomiting affects approximately 50% (Mitzi 2004; Jewell and Young 2010; McParlin et al. 2016). At its worst, *hyperemesis gravidarum* requiring hospitalisation is estimated to affect 0.5% of pregnancies (Latva-Pukkila et al. 2010). Despite its unpleasantness, NVP has been reported to be associated with decreased risks of miscarriage, preterm delivery, small-for-gestational age infants and perinatal death (Huxley 2000; Furneaux et al. 2001), even though some studies indicate an increased risk for these adverse outcomes (Binu 2003; Temming et al. 2012).

The pathophysiology of NVP remains unknown, but it has been suggested to be multifactorial and to include hormonal changes (Furneaux et al. 2001; Pagona et al. 2003; Mitzi 2004; Jewell and Young 2010; Jarvis and Nelson-Piercy 2011;

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London et al. 2017), maternal characteristics (Louik et al. 2006; Latva-Pukkila et al. 2010; London et al. 2017), gastrointestinal factors, environmental and psychological factors (Baron et al. 1993; London et al. 2017). Since the pathophysiology is poorly understood, treatment is mainly symptomatic and empirical.

Diet during pregnancy may have an impact on NVP, and its current management includes dietary modification. It is generally advised to avoid meat, poultry, fish, eggs and spicy and fatty foods during periods of NVP (Latva-Pukkila et al. 2010; Peng et al. 2011), but there is limited and conflicting data on the effects of diet of NVP. Women suffering from NVP have been shown to eat less meat (and thus protein) compared to women without NVP (Latva-Pukkila et al. 2010). On the other hand, it has been reported that high-protein meals reduce nausea to a greater degree than carbohydrate- and fat-rich meals (Jednak et al. 1999). In one study, the diet of women with NVP was characterised by high intakes of carbohydrates and added sugar, primarily from sugar-containing soft drinks (Chortatos et al. 2013).

Dietary fibre has various functions in the human digestive tract. Insoluble fibre adds bulk to the stool and speeds the passage of foods through the digestive system alleviating constipation (Finnish Food Composition Database, Finnish Institute for Health and Welfare, 2003–2011; Hasunen et al. 2004; Nordic Council of Ministers 2004; National Nutrition Council, Ministry of Agriculture and Forestry 2005; FINDIET 2007). Bile acids can cause nausea and heartburn. Soluble fibre and bile have a great affinity towards one another. Fibre cannot cross the intestinal barrier and all the bile that has been bound together with the soluble fibre will exit the body through bowel movements. That means the bile will not recycle (enterohepatic cycle) (Carter 1991). Soluble fibre also attenuates the absorption of sugars and reduces the glycemic response after meals keeping blood glucose levels more stable (Raninen et al. 2011). Both alleviating constipation and heartburn and keeping blood glucose levels stable dietary fibre might reduce NVP.

Pregnancy involves changes in the gastrointestinal system such as reduced motility, increased transit time and increased absorptive capacity of the intestine (Jednak et al. 1999; Kock 2002; Jarvis and Nelson-Piercy 2011), and NVP has been shown to be associated with abnormal gastric motility (Jednak et al. 1999). Because of various beneficial effects of fibre on the digestive system, we hypothesised that a high fibre intake may alleviate the symptoms of NVP.

Our secondary aim was to seek association of adherence to a special diet, smoking, alcohol use, being overweight or having vigorous physical activity to the occurrence of NVP, since there have been controversies about their association with NVP (Little and Hook 1979; Weigel and Weigel 1988; Meyer et al. 1994; Källen, et al. 2003; Temming et al. 2014). Physical activity may have beneficial effects on health e.g. by reducing obesity and decreasing constipation (Booth, et al. 2012). Thus, it might prevent also NVP.

The aim of the present study was to investigate whether the amount or source of dietary fibre are associated with NVP. We wanted to investigate intake of fibre derived from cereal products (mostly representing insoluble fibre) and fibre derived from fruit and vegetables (containing mostly soluble fibre) separately in relationship to NVP, as the mechanisms of action of these fibre groups are different. There are some studies (Chortatos et al. 2013) assessing dietary fibre intake at the time of NVP. Since NVP itself may have an impact on fibre consumption, we wanted to relate NVP with pre- pregnancy consumption of fibre, which may better reflect the basic lifestyle of the individual than their fibre intake during the first trimester of pregnancy.

Materials and methods

Ethical issues

The study was approved by the Ethics Committee of Tampere University Hospital in Finland. (Registration code: R05025). Each subject signed an informed consent before participation.

Study population

Participants were recruited from four public maternity outpatient wards in the city of Tampere between January 11 2005 and September 24 2007.

Inclusion and exclusion criteria

Three hundred consecutive healthy pregnant women were asked by a midwife to participate this study at the first visit to maternal outpatient ward at the gestational age of eight weeks. Only singleton pregnancies were accepted. Further exclusion criteria included history of any bowel disease or other chronic diseases which could be directly related to the possible occurrence of gastrointestinal symptoms. Some chronic diseases, which probably have no relationship with NVP; i.e. asthma, mild hypertension or long QT-syndrome, were accepted. After exclusions, two hundred women were eligible. Of these, 12 were dropped because of miscarriage or moving to another district (Figure 1).

Questionnaires

This was a retrospective cohort-study. The first questionnaire included pre-pregnancy period and it was completed immediately after enrolment at gestational age of eight weeks of pregnancy. The questionnaire contained items concerning demographic data, obstetric and medical history, and gastrointestinal symptoms such as constipation or heartburn and food intake.

The questionnaire was a frequency type of questionnaire. To estimate the fibre intake, the questionnaire included a section where the participants were asked to report their typical daily frequency (number of portions per day) of consuming of ten different kinds of fibre-containing food items of a given portion size (dl, slice, piece, tablespoon). The questions referred to usual consumption of these food items during the previous year before the current pregnancy. The dietary outcomes included an overall intake of

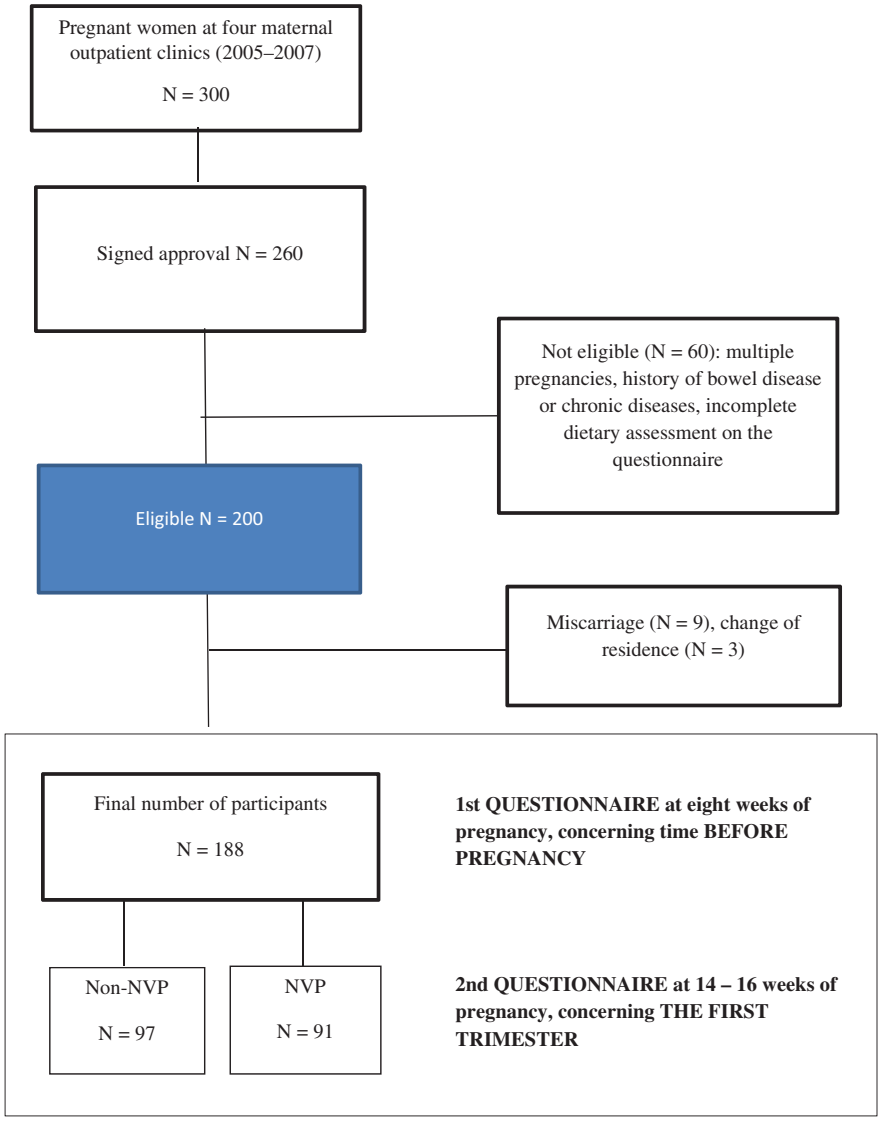

Figure 1. Participant flow.

vegetables, fruit and berries (portions/day), use of high/low fibre bread (portions/day), intake of cereals, muesli and porridge (portions/day) and use of raisins and plums (portion/day). These questions were adapted from a questionnaire used in the study: 'Preventing excessive weight gain during pregnancy-a controlled trial in primary health care (Kinnunen et al. 2007).

Table 1 includes fibre content for each food item in the questionnaire. These contents were determined by applying information from the website of the Finnish Bread Information (Finish Bread Information 1961) and the Finnish Food Composition Database (Finnish Food Composition Database, National Institute for Health and Welfare, 2003–2011) (Fineli-Database, http://www.fineli.fi/ Fineli®). The total intake of dietary fibre (g/day) was estimated by (1) multiplying the number of portions/day of each food item by the respective fibre content and then (2) summing up the results of each food item. We also calculated separately the fibre intake derived from cereal products (food items on rows 1–7) and from fruits and vegetables (food items on rows 8–10).

The second questionnaire was completed at 14–16 weeks of gestation and all questions referred to the period of the first 13 weeks of gestation. Questions related to the consumption of fibre-containing food items were similar with those in the first questionnaire.

Questions on nausea or vomiting were translated and modified from the Rome III criteria. Constipation was defined by defaecation, a maximum twice of a week. If heartburn occurred at least once a week, women were considered to suffer from heartburn. Body weight, height, body mass index and change of body weight during pregnancy were measured routinely, as a part of the maternity health care program. BMI $\geq$25 kg/m^2 was used as a cut-off for being overweight based on WHO definition.

We divided the women into two groups, according to NVP during the first trimester. Those women who had nausea or vomiting at least once a day constituted NVP group. Those who had nausea or vomiting less than once a day belonged to non-NVP group. We also divided participants into two groups according to total fibre intake before pregnancy: those who consumed fibre at least 25 g/day (n=33)

Table 1. Assessment table for daily intake of cereal- derived and fruit/vegetable-derived fibre.

Fibre-containing food items	Portion	Number of portions per day	Fibre coefficient for each food item
Cereal-derived fibre			
Rye bread/ crisp bread/ multigrain bread with grains	1 slice/ piece		× 3
Other multigrain bread/ oat bread/ barley bread/ graham bread/ rolls	1 slice/ piece		× 2
French bread, baquette or other white bread	1 slice/ piece		× 1
Breakfast cereals, what?	1 dl		× 6 (All- Bran PLUS) × 3 (All- Bran REG) × 0.5 (regular)
Muesli or piece of Weetabix	1 dl/ piece		× 0.5
Flake porridge	1 dl		× 4
Brans	1 tablespoon		× 1
Fruit/vegetable-derived fibre			
Plums or raisins	1 piece of plums/ 1 tablespoon of raisins		× 0.5
Fruits or berries	1 piece of fruits/ 1 dl of berries		× 2
Fresh or cooked vegetables	1 dl		× 2

In the questionnaire, the patients estimated their typical daily consumption of ten different kinds of fibre-containing food items. Daily fibre intake was calculated by multiplying the amount of the special food item by its fibre coefficient.

Table 2. Characteristics of mothers before pregnancy according to nausea or vomiting (NVP) during the first trimester ($N = 188$).

	NVP during I trimester			Univariable		
	No ($n = 97$)	Yes ($n = 91$)	p	N	OR	(95% CI)
Age (y), mean (Sd)	28.8 (5.1)	29.2 (4.9)	.604	188	1.02	(0.96–1.08)
BMI (kg/m^2), Md (range)	23.1 (18.4–39.1) n = 95	22.4 (18.7–33.3)	.064	186	**0.91**	**(0.84–0.99)**
BMI, *n* (%)			.007			
Normal <25	57 (59)	71 (78)		128	**2.37**	**(1.24–4.51)**
≥25	38 (39)	20 (22)		58	1.00	
Parity, *n* (%)			.073			
Nulliparas	63 (65)	49 (54)		112	1.00	
Multiparas	34 (35)	42 (46)		76	1.59	(0.88–2.86)
Chronic disease, *n* (%)			.202			
No	88 (91)	77 (85)		165	1.00	
Yes	9 (9)	14 (15)		23	1.78	(0.73–4.34)
Smoking, *n* (%)			.315			
No	73 (75)	74 (81)		147	1.00	
Yes	24 (25)	17 (19)		41	0.70	(0.35–1.41)
Alcohol use, *n* (%)			.062			
No	9 (9)	17 (19)		26	1.00	
Yes	88 (91)	74 (81)		162	0.45	(0.19–1.06)
Special diet, *n* (%)			.069			
No	81 (84)	66 (73)		147	1.00	
Yes	16 (16)	25 (27)		41	1.92	(0.95–3.89)
Vigorous physical activity, *n* (%)			.142			
No	29 (30)	17 (19)		46	1.00	
Yes	66 (68)	73 (80)		139	1.89	(0.95–3.74)
Constipation, *n* (%)			.859			
No	76 (78)	70 (77)		146	1.00	
Yes	20 (21)	21 (23)		41	1.14	(0.57–2.28)
Heartburn, *n* (%)			.514			
No	74 (76)	73 (80)		147	1.00	
Yes	23 (24)	18 (20)		41	0.79	(0.39–1.59)

Differences between groups were tested by independent samples *t*-test, Mann–Whitney *U* test or by Pearson Chi-square test or Fisher's exact test with *p* values (*p*). Missing values were not shown, but they were included into the analyses. Results of univariable logistic regression models NVP during the first trimester were shown by odds ratios (OR) with 95 % confidence intervals (CI). Md: median; y: year; kg: kilograms.
Bold value signifies BMI $p = .007$.

and those who used less than 25 g/day (n=155). This is based to national recommendation of daily use of total fibre at least 25 g/day (FINDIET 2007).

We asked how often women had vigorous physical activity at least 20 minutes at a time. Then we divided women into two groups; those who were physically active before pregnancy or during the first trimester and to those who were not. In the active group, the women had vigorous physical activity at least twice a week. Questions concerning physical activity were based on national recommendation (UKK, Institute, Fitness Institute Foundation).

Statistical analyses

Characteristics of the mothers were expressed as the means with standard deviations, when continuous variables were normally distributed. In the cases of skewed distributions, medians with ranges were used. Categorical variables were shown as frequencies with percentages. Missing values were categorised as a group of unknowns and those unknown missing value groups were included in the analyses. The effect of baseline characteristics for NVP in the first trimester was analysed by the Pearson Chi-square test, Fisher's exact

Table 3. Intake of fibre g/day (N=188) before pregnancy and during the first trimester according to nausea or vomiting (NVP) during the first trimester.

		NVP		
		No (n = 97)	Yes (n = 91)	p
Intake of fibre derived from cereal products (g/day)				
Before pregnancy	***n***	**97**	**91**	**.026**
	Md (IQR)	10.4 (7.6–15.0)	12.9 (9.7–16.3)	
During the first trimester	***n***	**97**	**91**	.559
	Md (IQR)	12.0 (8.0–16.0)	12.6 (8.4–16.3)	
		NVP		
		No (n = 97)	Yes (n = 91)	
Intake of fibre derived from fruit and vegetables (g/day)				
Before pregnancy	***n***	**97**	**91**	.160
	Md (IQR)	4.6 (2.4–8.0)	5.1 (4.0–8.0)	
During the first trimester	***n***	**97**	**91**	.099
	Md (IQR)	6.0 (3.1–10.0)	8.0 (5.0–10.0)	
		NVP		
		No (n = 97)	Yes (n = 91)	
Intake of total fibre (g/day)				
Before pregnancy	*n*	**97**	**91**	**.043**
	Md (IQR)	16.0 (11.1–22.0)	19.1 (14.6–23.9)	
During the first trimester	*n*	**97**	**91**	.253
	Md (IQR)	19.0 (13.4–24.8)	20.6 (15.4–25.7)	

IQR: interquartile range. Differences between nausea groups were tested by Mann–Whitney U test and change in time were tested by related samples' Wilcoxon Signed rank test. Md: median; NVP: nausea or vomiting during pregnancy; g/day: grams/day.
Bold value signifies p values under .05.

Table 4. Risk factors for nausea or vomiting (NVP) during the first trimester (***N*=188**).

	NVP			Univariable		
	No (n = 97)	Yes (n = 91)	p	N	OR	(95% CI)
Special diet during the first trimester, n (%)			.257			
No	81 (84)	70 (77)		151	1.00	
Yes	16 (16)	21 (23)		37	1.52	(0.74–3.14)
Vigorous physical activity during the first trimester, n (%)			.243			
No	46 (47)	52 (57)		98	1.00	
Yes	50 (52)	39 (43)		89	0.69	(0.39–1.23)
Constipation during the first trimester, n (%)			.011			
No	78 (80)	57 (63)		135	1.00	
Yes	19 (20)	33 (36)		52	**2.38**	**(1.23–4.60)**
Heartburn during the first trimester, n (%)			.108			
No	49 (51)	39 (43)		88	1.00	
Yes	45 (46)	52 (57)		97	1.45	(0.81–2.59)

Differences between groups were tested by independent samples t-test, Mann–Whitney U test or by Pearson Chi-square test or Fisher's exact test with p values (p). Missing values were not shown, but they included into the analyses. Results of univariable logistic regression models for nausea or vomiting during the first trimester were shown by odds ratios (OR) with 95 % confidence intervals (CI).
Bold value signifies p = .011.

test or by Mann–Whitney U test between the NVP groups. Finally, univariable incidence odds ratios (OR) with 95% confidence intervals for nausea and vomiting were calculated for positive NVP.

The differences in fibre intake between NVP groups were tested by using the Mann-Whitney U test before pregnancy and during the first trimester. Changes in intake of fibre derived from cereal products and fibre from fruit and vegetables from pre-pregnancy period until the first trimester were analysed by using related samples' Wilcoxon Signed rank test. Differences in special diet, physical activity, constipation and heartburn before pregnancy between NVP or non-NVP groups or during the first trimester were tested by using the Pearson Chi-square test or Fisher's exact test.

The associations of predictive variables during the first trimester and NVP were tested by Pearson Chi-square or Fisher's exact test, and prevalence odds ratios (OR) with 95% confidence intervals were calculated. Changes in the risk factors from before pregnancy to the first trimester between NVP groups were tested by Pearson Chi-square test, Fisher's exact test or by the Mann–Whitney U test and by OR with 95% CI. A multivariable logistic regression analysis was adjusted by risk factors before pregnancy, age, BMI, smoking, use of alcohol and primiparity. Missing values in predictive variables were included in the analyses. Statistical analyses were performed by using PASW Statistics Release 18.0.0. Values of p under .05 were considered as being statistically significant.

Results

Demographic data and lifestyle characteristics before pregnancy are presented in Table 2. Thirty-five participants had some special diet, i.e. a lactose-free diet (n=9), low-lactose diet (n=10), gluten-free diet (n=3), vegetarian diet (n=5), fishless diet (n=2) and no red meat (n=6). Women with normal weight based on BMI <25 kg/m^2 had significantly more

Table 5. Change of risk factors from before pregnancy to the first trimester for nausea or vomiting (NVP) during the first trimester (*N*=188).

	NVP			Univariable			Multivariable	
	No (*n* = 97)	Yes (*n* = 91)	*p*	*N*	OR	(95% CI)	OR	(95% CI)
Special diet, *n* (%)			.029					
None	81 (84)	66 (73)		147	1.00		1.00	
Continue to follow during pregnancy	16 (16)	20 (22)		36	1.53	(0.74–3.19)	1.26	(0.54–2.92)
Gave up	0 (0)	5 (5)		5	*		*	
Change of physical activity, *n* (%)			.004					
About same level	84 (87)	63 (69)		147	1.00		1.00	
Much less during pregnancy	13 (13)	28 (31)		41	**2.87**	**(1.38–5.99)**	**2.50**	**(1.03–6.03)**
Change of constipation, *n* (%)			.027					
Same	80 (83)	62 (68)		142	1.00		1.00	
Less during pregnancy	9 (9)	9 (10)		18	1.29	(0.48–3.44)	1.11	(0.31–4.06)
More during pregnancy	8 (8)	20 (22)		28	**3.23**	**(1.33–7.81)**	2.57	(0.94–7.03)
Change of heartburn, *n* (%)			.113					
About same level	76 (78)	62 (68)		138	1.00		1.00	
Much more during pregnancy	21 (22)	29 (32)		50	1.69	(0.88–3.26)	1.39	(0.62–3.08)
Change of total fibre consumption, *n* (%)			.736					
Same	34 (35)	31 (34)		65	1.00		1.00	
Less (over 2 g/day) during pregnancy	16 (16)	19 (21)		35	1.30	(0.57–2.97)	0.90	(0.33–2.44)
More (over 2 g/day) during pregnancy	47 (49)	41 (45)		88	0.96	(0.50–1.82)	1.06	(0.49–2.27)
Change of total fibre consumption g/day, Md (IQR)	1.7 (−0.9–5.8)	1.4 (−1.3–5.0)	.575	188	0.99	(0.94–1.03)	–	

Md: median; IQR: inter quartile range. Differences between groups were tested by Mann–Whitney *U* test, Pearson Chi-square test or Fisher's exact test with *p* values (*p*). Missing values were not shown, but they included into the analyses. Results of univariable logistic regression models for nausea or vomiting during the first trimester were shown by odds ratios (OR) with 95% confidence intervals (CI). g: grams; *cannot be computed due to the zero frequency. Multivariable: adjusted by risk factors before pregnancy, age, BMI, smoking, use of alcohol and primiparity.
Bold value signifies special diet, change in physical activity, changes in constipation.

NVP compared to the overweight women (BMI ≥25 kg/m2) (p=.007).

The median consumption of total fibre in the NVP group was 19.1 g/day during pre-pregnancy period and it increased significantly to 20.6 g/day during the first trimester (p=.004). In the non-NVP group, the median consumption of total fibre increased significantly from pre-pregnancy period 16.0 g/day to the first trimester 19.0 g/day, p<.001 (Table 3). Women in NVP group consumed significantly more total fibre at pre- pregnancy period than women in the non-NVP group (p=.043). In both groups, the total fibre intake increased, but still the median intake remained below guideline levels during the whole study period. During the first trimester, there were no significant differences in the intake of total fibre, fibre derived from cereal products and fibre from fruit and vegetables between groups.

When the women were divided into two groups according to fibre consumption before pregnancy (≥25 g/day and <25 g/day), there was no difference in the incidence of NVP between these two groups.

There was no significant difference between constipation and heartburn incidence before pregnancy in respect of NVP during the first trimester (Table 2), but during the first trimester women suffering from NVP had more constipation compared to the non-NVP group (Table 4).

The changes in diet, physical activity and gastrointestinal symptoms from pre-pregnancy period to the first trimester in the groups are shown in Table 5. Women with NVP had vigorous physical activity less frequently than before pregnancy. Increase in the occurrence of constipation was more common in women with NVP.

Discussion

Our findings were contrary to our hypothesis. A higher fibre intake did not protect from NVP and seemed even to predispose to NVP. Furthermore, obesity and consuming less fibre were associated with lower frequency of NVP. According to our present study, healthy lifestyle factors were not protective against NVP, but more studies are needed to strengthen any connections between NVP and lifestyle factors.

Insoluble fibre has beneficial effects on the function of the digestive system. Dietary fibre supplementation has been found to relieve symptoms of constipation significantly in a non-pregnant population (Raninen et al. 2011). However, this might not be linked to alleviation of nausea and vomiting during pregnancy, as in our study suffering from NVP was associated with higher intake of total or cereal product-derived fibre.

Even though a high fibre intake did not seem to prevent from NVP, our results indicate that soluble and insoluble forms of fibre are relatively well-tolerated food items during NVP, as women suffering from NVP were able to maintain fibre intake. In earlier studies, Latva-Pukkila et al. reported that women with NVP reduced their intake of protein, and consumed proportionally more carbohydrate. There was no difference in fibre intake between women with or without NVP (Latva-Pukkila et al. 2010). Furthermore, it is also known that a high intake of fatty foods carries a risk of *hyperemesis gravidarum* (Jarvis and Nelson-Piercy 2011). Food items which are rich in fibre contain relatively small amounts of protein and fat compared to carbohydrates, which could make fibre more tolerable during periods of NVP. Another reason for relatively high intake of fibre could be that women attempt to maintain healthy nutrition regardless of NVP. Dietary fibre-soluble and insoluble-are generally considered as healthy food products. Our finding of similar total fibre intake in women with and without NVP is consistent with the results of a previous study (Latva-Pukkila et al. 2010). However, Chortatos et al. found that dietary fibre intake was

significantly greater in the nausea group compared to symptom-free women or those who had vomiting (Chortatos et al. 2013). An increased intake of fibre could also be associated with changes in energy intake during pregnancy (Chortatos et al. 2013).

The American Dietetic Association (ADA) recommends a fibre intake of 20−35 grams per day. In Finland, the recommended daily fibre intake is 25−35 grams. According to FINDIET 2007, the daily fibre intake in adult Finnish women is only 21 grams (FINDIET 2007). We found that the median self-estimated intake of fibre was below guideline levels during the whole study period. However, the consumption of fibre increased during pregnancy. One reason for that could be that women begin to eat healthily after learning they are pregnant. Nurses and midwives also give advice on healthy lifestyle and diet during pregnancy when women visit maternal welfare clinics.

Obese women had less NVP. Maybe obese women have a greater tendency to good appetite than women with normal weight, and this tendency may prevail even during early pregnancy, when most of women have disgust on eating (Mitzi 2004; Jewell and Young 2010). Although the mechanism of appetite during pregnancy remains to be elucidated, it is possible that sex hormones, and, in particular, progesterone are involved (Linden-Hirschberg 2012).

In earlier studies, there have been contrary results concerning lifestyle and NVP. Temming et al. noticed that women reporting NVP were more likely to be younger, obese, single and smokers (Temming et al. 2014). However, other studies have suggested that women who smoke may have significantly less NVP than non-smokers (Little and Hook 1979; Weigel and Weigel 1988; Meyer et al. 1994; Källen et al. 2003). Also, in our study there was a tendency for less NVP among smokers. Alcohol consumption prior to conception has been associated with a decreased risk of NVP (Weigel and Weigel 1988), we had similar tendency in our study. Furthermore, NVP in smokers was negatively associated with alcohol consumption before and during pregnancy (Little and Hook 1979). NVP associated with pre-pregnancy drinking was not related to any change in alcohol consumption after conception (Little and Hook 1979). However, smoking and alcohol use should be strongly discouraged when planning pregnancy based on the many health risks related to them.

In the multivariable analyses, there was no significant difference in pre-pregnancy physical activity between groups, but the NVP group had less vigorous physical activity during the first trimester compared to pre-pregnancy period. Probably, this reduction of physical activity was a consequence of the fact that they did not feel well. Furthermore, increased constipation was also associated with NVP. It is possible that limited physical activity increased constipation in this group.

Overall, in the NVP group there was a tendency to a healthier lifestyle (more vigorous physical activity, less alcohol consumption, less smoking) before pregnancy; even if these differences between groups were not statistically significant.

Our study has some strengths and limitations. This was the first study to relate fibre intake to the occurrence of NVP including also pre-pregnancy estimation of fibre intake. All women had regular documented visits to the midwife, and thus the accuracy of most of the background factors could be ascertained. Fibre intake was based on self-assessed consumption of typical fibre-containing food items. No direct measurements of food fibre contents could be performed, and due to the retrospective nature of describing the women's pre-pregnancy nourishment some inaccuracies cannot be excluded. Since some analyses were univariable, there might also be some confounding factors. As a total of 188 of 300 invited women participated, some selection bias may be present. However, most of the exclusions were based on medical reasons, and only 40 women refused to fill in the questionnaires. It is possible that due to the small samples size some existing associations did not appear statistically significant.

The aetiology of NVP remains unknown. Our results indicated that dietary fibre and healthy lifestyle did not protect from NVP. However, we found that despite NVP, affected women were able to consume as much fibre as women without NVP. This implies that dietary fibre is tolerated well during NVP, and this finding can be used when giving diet counselling to women suffering from NVP.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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