Dietary changes during first trimester pregnancy for women with nausea and vomiting in the Norwegian Mother and Child Cohort Study

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ABSTRACT

Objective: Examine responses given to questions addressing whether pregnancy had caused women with nausea and vomiting (NVP) or symptom-free (SF) to alter their food habits in the first trimester in order to better understand the dietary changes taking place in women with NVP.
Method: Using questions featured in the Norwegian Mother and Child Cohort Study (MoBa) specifically asking participants about alterations in diet and episodes of nausea and vomiting. The final sample used included 30,072 women.
Results: We found 46% with no symptoms of nausea and/or vomiting in pregnancy, whilst 54% reported both nausea and vomiting. The NVP group of women were the group most affected with changes in food consumption, having the lowest proportion reporting to eat as before pregnancy, as well as the highest proportion reporting 'eating more' and 'reduced eating'. The SF group reported eating more than NVP group in one instance, that being for chocolate (SF 17.7% vs NVP 16.3%).
Conclusion: We have shown a higher degree of dietary change in women with NVP compared to SF women. We also found chocolate as the only exception, with a higher proportion of SF women eating more of this food item.

INTRODUCTION

Over half of all pregnancies involve episodes of nausea and vomiting (NVP), usually experienced during the first trimester (1,2). It is common during pregnancy for women to change the composition and quantity of their ordinary diet, usually as a result of food cravings and aversions (3,4). These dietary changes have been reported to be more pronounced when NVP was present, yet little is understood about how dietary intake during pregnancy is actually affected by NVP (5).

In a study exploring the association between NVP symptoms and dietary preferences, cravings, and aversions, it was reported that women with moderate to severe NVP had more cravings both before and during their pregnancy, although food aversions also tended to increase (6,7).

Previously reported cravings for foods include sweets (especially chocolate), fruits and fruit juices, ice cream, milk, and other dairy products (8), whereas the most commonly reported aversions were for drinks containing caffeine, strong tasting and smelling foods, and fatty/greasy foods (4).

We recently assessed the dietary intake of NVP women included in the Norwegian Mother and Child Cohort study (MoBa) and found a higher total energy intake for them compared to symptom-free (SF) women (9). In the present study we examined in more detail the responses given to specific questions addressing whether women enrolled in MoBa had altered their food habits in the first trimester. Furthermore, we investigated which food items, if any, the NVP group of women had altered their eating habits the most for in order to better understand the dietary changes taking place in women with first trimester NVP.

MATERIAL AND METHODS

The core data of this study is based on the Norwegian Mother and Child Cohort Study (MoBa) (10). Data regarding age (year), height (cm), weight (kg), education (seven categories collapsed into: ≤12 years, 13-16 years, ≥17 years of education, other education or missing), and maternal smoking (no, occasionally, daily) were obtained from data found in MoBa questionnaire 1 (Q1), answered approximately in week 15 of gestation. Maternal body mass index (BMI, kg/m^2) was calculated at the start of pregnancy. The Medical Birth Registry of Norway (MBRN) is linked to MoBa (11) and parity data from the MBRN and questions detailing previously occurring pregnancies from Q1 were combined in order to minimise missing values. We used three categories for parity (nulliparous, para 1, para ≥2). Within version 1 of questionnaire 2 (Q2),

answered between weeks 15 to 22 of gestation, was a validated food frequency questionnaire (FFQ), and in version 2 of Q2, additional questions regarding dietary behaviour and episodes of nausea and vomiting. The FFQ allowed us to calculate energy intake (kJ), macronutrient intake (g), and micronutrient intake (mg/µg). Energy percent (E%) of macronutrients were calculated using overall energy intake and specific macronutrient intake values. In question 31 (q31) within Q2, women were asked to indicate which food items they had started to eat more of, less of, as before, never eaten before, or else stopped eating completely due to the pregnancy, ticking boxes in a list provided. Questionnaire three (Q3) provided data enabling us to determine cases diagnosed as Hyperemesis Gravidarum (HG), defined as prolonged nausea and vomiting during pregnancy that required hospitalisation before week 25 of pregnancy. Gestational weight gain (GWG) was calculated as weight at end of pregnancy (from questionnaire four (Q4) minus maternal weight at start of pregnancy (from Q1). Q4, answered postpartum, had a lower response rate compared with Q1 or Q2. Owing to this, there are data missing for 5112 women (17% of sample) regarding GWG. In the analysis of GWG, only women with gestational weight changes between –30 kg and +50 kg were included. The present study used the quality-assured data files released for research in 2009 (version four).

Study sample

The MoBa cohort featured in the version four data file used here consists of 108,842 children. The present study excluded women with multiple births, those not answering Q1 or only version one of Q2 (n=17,995). Further exclusions were made for women failing to answer version 2 of Q2 (n=5390). Women not answering questions relating to episodes of nausea and vomiting, or reporting only nausea or only vomiting, HG, a duration of nausea and vomiting >26 weeks, or a dietary intake ≤4500 or ≥20,000 kJ were also excluded (n=25,769). Reports of NVP were cross-checked from answers provided in both Q1 and Q2, with exclusions made for inconsistent or contradicting answers between the two questionnaires, or with contradicting answers such as simultaneously answering both 'yes' and 'no' to nausea and vomiting (n=15,791). Women enrolled in MoBa more than once due to additional pregnancies had all but their first participation excluded (n=9699). Women with a gestational length outside weeks 28-42, women without a successful pregnancy (i.e. non-living births), and those with missing weight and height at the start of pregnancy were excluded (n=2894). Finally, women not answering q31 of Q2 were excluded (n=1232). In total, 30,072 women were included in the final study sample.

Statistical analysis

The study sample was divided into two groups, reflecting answers concerning experiences of nausea and vomiting: having both nausea and vomiting (NVP) or symptom-free (SF). Results are presented as means (standard deviations; SDs) or frequencies (%). Independent samples t-test was used to compare means between the two groups. Chi-squared tests were performed for categorical variables. Logistic regression analysis was used to analyse binary outcomes (eating more, reduced intake) in relation to group (SF, NVP). We adjusted for energy intake (continuous). The results are presented as crude odds ratios (cORs) and adjusted odds ratios (aORs) with 95% confidence intervals (95% CIs). In order to effectively explore which foods the women had begun to actually eat less of, we combined data for foods reported as 'eating less of' as well as 'stopped completely' in pregnancy, to create a category showing overall reduced intake in the logistic regression analyses. A significance level of 0.05 was used. All analyses were performed using SPSS 20.0 (IBM Corp, Armonk, NY, USA).

RESULTS

In this study sample, 46% reported no symptoms of nausea and vomiting in pregnancy (SF group, n=13,371), whilst 54% reported both nausea and vomiting (NVP group, n=16,341). The NVP group had the lowest mean maternal age at delivery, highest mean weight and BMI at the start of pregnancy, lowest mean gestational weight gain (GWG) at end of pregnancy, lowest proportion nulliparous, highest proportions with education ≤12 years, highest proportions being non-smokers before and during pregnancy, highest mean energy intake and micronutrient intake, highest mean energy percent (E%) intakes of carbohydrates and added sugar, and lowest mean E% intakes of protein and fat (Table 1).

The NVP group was the group most affected by overall changes in food consumption when compared to the SF group, portrayed by their representing the lowest proportion reporting to eat 'as before pregnancy' (Table 2). Moreover, the NVP group had the highest proportions eating 'more of' and the highest proportions eating 'less of' and 'stopped'. The only exception was chocolate, where the proportion eating 'more of' was lower for NVP than SF women. When exploring foods eaten 'more of', significant differences between the NVP group and SF group were found for all foods except sweets (Table 3). The largest differences were found for biscuits (aOR 2.69, 95% CI 2.48-2.91), eggs (aOR 1.59, 95% CI 1.47-1.72), and sugared soft-drinks (aOR 1.92, 95% CI 1.75-2.11). Significantly less NVP women reported eating more chocolate (aOR 0.88, 95% CI 0.83-0.94). Significantly increased odds were found for all foods when comparing NVP women to SF women as regards reduced intakes (Table 4). The largest differences between the two groups were for milk and cheese (aOR 4.70, 95% CI 4.14-5.13), bread and cereals (aOR 6.69, 95% CI 5.63-7.94), vegetables (aOR 5.70, 95% CI 4.69-6.92), fruit (aOR 5.15, 95% CI 4.03-6.59), and meat (aOR 3.48, 95% CI 3.19-3.81).

Table 1. Maternal characteristics, n=30,072*.

	Total n=30,072	Symptom-free (SF) n=13,731	Nausea and vomiting (NVP) n=16,341		*P* value**
	n	Mean (SD)	Mean (SD)		
Maternal age at delivery (y)	30,072	30.3 (4.5)	29.2 (4.6)		<0.001
Maternal weight at pregnancy start (kg)	30,072	67.5 (12.2)	68.6 (13.6)		<0.001
BMI at pregnancy start (kg/m²)	30,072	23.8 (4.1)	24.3 (4.6)		<0.001
Gestational weight gain (kg)	24,960	15.1 (5.7)	14.3 (6.4)		<0.001
		n (%)	n (%)		
Parity					
Nulliparous	17,346	8644 (63.0)	8702 (53.3)		
Para 1	8381	3262 (23.8)	5119 (31.3)		<0.001
Para ≥2	4327	1816 (13.2)	2511 (15.4)		
Maternal education (y)					
≤12 y	9404	3987 (29.7)	5417 (33.9)		
13-16 y	12,541	5761 (42.9)	6780 (42.4)		<0.001
≥17 y	7470	3673 (27.4)	3797 (23.7)		
Smoking 3 months prior to pregnancy					
No	21,154	9254 (68.0)	11,900 (73.5)		
Occasionally	3072	1494 (11.0)	1578 (9.7)		<0.001
Daily	5588	2868 (21.0)	2720 (16.8)		
Smoking during pregnancy					
No	27,361	12,259 (89.9)	15,102 (93.1)		
Occasionally	840	483 (3.5)	357 (2.2)		<0.001
Daily	1663	899 (6.6)	764 (4.7)		
	Mean (SD)	E%	Mean (SD)	E%	
Energy (kJ)	9540.7 (2523.0)	-	9828.4 (2713.7)	-	-
Carbohydrates (g)	301.9 (90.5)	53.5 (4.7)	315.3 (97.6)	54.3 (5.0)	<0.001***
Added sugar (g)	60.0 (37.1)	10.4 (4.8)	65.7 (42.5)	11.0 (5.4)	<0.001***
Protein (g)	86.2 (20.8)	15.6 (2.1)	87.2 (22.4)	15.3 (2.2)	<0.001***
Fat (g)	79.0 (23.6)	30.7 (4.5)	80.2 (25.3)	30.2 (4.6)	<0.001***
Retinol (μg)	833.8 (619.4)	-	860.8 (679.8)	-	<0.001
Folate (μg)	271.9 (94.4)	-	279.4 (101.8)	-	<0.001
Vitamin D (μg)	3.4 (2.3)	-	3.5 (2.5)	-	0.02
Iron (mg)	11.2 (3.4)	-	11.4 (3.6)	-	<0.001

* Detailed characteristics from main sample can be found in our previous publication (9)
** T-test for continuous variables and chi-squared test for categorical variables
*** T-test for E%

DISCUSSION

The results presented in this article add new knowledge about dietary habits for women experiencing NVP in the first trimester of pregnancy. We found that NVP women had the greater dietary change compared to the SF women, representing the lowest proportion 'eating as before' for all food items, as well as representing the highest proportion both 'eating more' and with 'reduced eating' for most food items.

In the MoBa questionnaires there were no specific questions to help us determine whether an increase of any particular food or food item could be interpreted as a craving, likewise, a reduced intake interpreted as an aversion. However, since it has been reported that approximately 50% of pregnant women experience cravings and 70% experience aversions (7,12), and that women with food cravings are more likely to experience NVP (12), we can speculate with a degree of caution that these food changes are related to cravings and aversions. It should nevertheless be noted that there are an abundance of other reasons why a woman may alter her diet during gestation, such as compliance with health service recommendations, fears for the wellbeing of the developing foetus, beliefs in folklore related to food combinations, and other socio-cultural determinants (13-15).

It has been suggested previously that women with symptoms of NVP may be turning to particular foods in an attempt to alleviate symptoms related to the unpleasantness of the condition (2,12,13,16). This is supported by research proposing foods, in particular carbohydrates, are often used to self-medicate in order to reduce unpleasant states of being, primarily via serotonin increases after consumption (17). We have previously reported that NVP women in MoBa have higher intakes of carbohydrates and added sugar than SF women (9). In the present study we found that carbohydrate-rich foods such as breads and cereals, sugared soft-drinks, and biscuits were foods the NVP women had high odds of eating more of. That women suffering from NVP increase their intake of bread, biscuits, and sweet sugar-containing foods during pregnancy, as well as total carbohydrates, has been

Table 2. Overall food changes in the SF and NVP groups, n=30,072.

	Group	Not eat before %	As before %	More of %	Less of %	Stopped %
Milk, cheese	SF	1.9	57.9	38.0	2.1	0.1
	NVP	2.6	46.4	41.7	8.9	0.4
Bread, Cereals	SF	0.1	66.6	32.1	1.1	0
	NVP	0.2	55.9	37.3	6.6	0
Biscuits	SF	11.8	67.0	6.4	13.8	0.9
	NVP	10.0	53.6	15.8	18.5	2.1
Fat	SF	4.7	77.3	3.6	14.2	0.2
	NVP	4.7	64.9	4.7	24.9	0.7
Meat	SF	0.8	90.6	3.7	4.8	0
	NVP	1.2	78.5	5.5	14.6	0.3
Fish	SF	2.0	78.7	16.0	3.1	0.2
	NVP	2.6	70.0	17.1	9.8	0.6
Eggs	SF	1.7	84.2	7.5	6.3	0.2
	NVP	1.7	71.8	11.6	13.9	1.0
Vegetables	SF	0.2	66.6	32.3	0.9	0
	NVP	0.3	59.9	35.1	4.6	0.1
Fruit	SF	0.3	40.3	58.8	0.5	0
	NVP	0.3	33.4	63.7	2.6	0.1
Chocolate	SF	1.2	55.1	17.7	25.3	0.7
	NVP	1.2	41.5	16.3	38.4	2.6
Sweets	SF	2.6	57.3	13.3	25.7	1.0
	NVP	2.7	44.2	14.1	36.6	2.4
Juice	SF	2.9	60.4	29.7	6.1	0.5
	NVP	2.5	49.0	33.2	13.5	1.5
Sugared soft-drink	SF	18.6	41.6	4.7	30.7	4.0
	NVP	14.4	34.6	8.8	35.6	6.2

Table 3. Women eating 'more of' a food item, n=30,072.

Foods – more of	Group	n (%)*	cOR (95% CI)	aOR (95% CI)**
Milk, cheese	SF	5214 (38.0)	1.00	1.00
	NVP	6816 (41.7)	1.17 (1.12-1.22)	1.15 (1.10-1.21)
Bread, cereals	SF	4411 (32.1)	1.00	1.00
	NVP	6094 (37.3)	1.26 (1.20-1.32)	1.23 (1.17-1.29)
Biscuits	SF	884 (6.4)	1.00	1.00
	NVP	2587 (15.8)	2.73 (2.52-2.96)	2.69 (2.48-2.91)
Fat	SF	499 (3.6)	1.00	1.00
	NVP	768 (4.7)	1.31 (1.17-1.47)	1.28 (1.14-1.43)
Meat	SF	513 (3.7)	1.00	1.00
	NVP	897 (5.5)	1.50 (1.34-1.67)	1.46 (1.31-1.63)
Fish	SF	2200 (16.0)	1.00	1.00
	NVP	2793 (17.1)	1.08 (1.02-1.15)	1.07 (1.01-1.14)
Eggs	SF	1035 (7.5)	1.00	1.00
	NVP	1895 (11.6)	1.61 (1.49-1.74)	1.59 (1.47-1.72)
Vegetables	SF	4430 (32.3)	1.00	1.00
	NVP	5729 (35.1)	1.13 (1.08-1.19)	1.12 (1.07-1.18)
Fruit	SF	8074 (58.8)	1.00	1.00
	NVP	10,407 (63.7)	1.23 (1.17-1.29)	1.21 (1.16-1.27)
Chocolate	SF	2428 (17.7)	1.00	1.00
	NVP	2663 (16.3)	0.91 (0.85-0.96)	0.88 (0.83-0.94)
Sweets	SF	1830 (13.3)	1.00	1.00
	NVP	2304 (14.1)	1.07 (0.99-1.14)	1.04 (0.97-1.11)
Juice	SF	4084 (29.7)	1.00	1.00
	NVP	5419 (33.2)	1.17 (1.12-1.23)	1.16 (1.10-1.22)
Sugared soft-drink	SF	651 (4.7)	1.00	1.00
	NVP	1438 (8.8)	1.94 (1.76-2.13)	1.92 (1.75-2.11)

* Number (%) of women with outcome
** Adjusted for total energy intake

Table 4. Women with 'reduced intake' of a food item, n=30,072.

Foods – reduced	Group	*n* (%)*	cOR (95% CI)	aOR (95% CI)**
Milk, cheese	SF	301 (2.2)	1.00	1.00
	NVP	1518 (9.3)	4.57 (4.03-5.18)	4.70 (4.14-5.33)
Bread, cereals	SF	152 (1.1)	1.00	1.00
	NVP	1090 (6.7)	6.39 (5.38-7.58)	6.69 (5.63-7.94)
Biscuits	SF	2022 (14.7)	1.00	1.00
	NVP	3362 (20.6)	1.50 (1.41-1.59)	1.50 (1.41-1.59)
Fat	SF	1974 (14.4)	1.00	1.00
	NVP	4188 (25.6)	2.05 (1.93-2.18)	2.06 (1.94-2.18)
Meat	SF	665 (4.8)	1.00	1.00
	NVP	2433 (14.9)	3.44 (3.14-3.76)	3.48 (3.19-3.81)
Fish	SF	448 (3.3)	1.00	1.00
	NVP	1696 (10.4)	3.43 (3.09-3.82)	3.46 (3.11-3.85)
Eggs	SF	899 (6.5)	1.00	1.00
	NVP	2444 (15.0)	2.51 (2.32-2.72)	2.53 (2.33-2.74)
Vegetables	SF	120 (0.9)	1.00	1.00
	NVP	768 (4.7)	5.59 (4.61-6.79)	5.70 (4.69-6.92)
Fruit	SF	75 (0.5)	1.00	1.00
	NVP	438 (2.7)	5.02 (3.92-6.41)	5.15 (4.03-6.59)
Chocolate	SF	3573 (26.0)	1.00	1.00
	NVP	6693 (41.0)	1.97 (1.88-2.07)	2.00 (1.91-2.11)
Sweets	SF	3671 (26.7)	1.00	1.00
	NVP	6371 (39.0)	1.75 (1.67-1.84)	1.77 (1.69-1.86)
Juice	SF	906 (6.6)	1.00	1.00
	NVP	2446 (15.0)	2.49 (2.30-2.70)	2.53 (2.33-2.74)
Sugared soft-drink	SF	4761 (34.7)	1.00	1.00
	NVP	6830 (41.8)	1.35 (1.29-1.42)	1.34 (1.28-1.41)

* Number (%) of women with outcome
** Adjusted for total energy intake

observed by others (2,5,12,18). Elsewhere it has been found that a diet high in carbohydrates may aggravate gastric dysrhythmias when compared to high protein diets, which can lead to nausea, suggesting that women suffering NVP may potentially be exasperating their condition by virtue of their dietary choices (19).

Popularly craved carbohydrate foods among pregnant women in general tend to include biscuits, sweet foods, and soft drinks (12,20,21), yet the list also includes protein-rich foods such as meat, milk, cheese, and eggs (2,7,18,21). Meat is a food item found to be both 'eaten more' of and 'eaten less' of by the NVP women in this study. This peculiarity has also been reported in other studies (7,21,22). When comparing the results for 'eat more' and 'reduced eating', it is evident that a higher proportion of NVP women reported they reduced their intake of protein-rich foods such as meat, fish, and eggs. This finding supports other studies reporting on NVP and diet (7,20,23,24).

That the only exception in the 'eating more' category regarding NVP women should be chocolate is somewhat surprising, especially considering the NVP group's prevailingly higher proportions in the other food items. We previously found that women with no symptoms of nausea and vomiting consumed the most chocolate, both in response to a FFQ, and as a response to new foods begun since pregnancy (9). Regular chocolate consumption has been linked to favorable effects upon cardiovascular health, blood pressure, and the intestinal immune system (25-27). These benefits are attributed to the flavanols and procyanidins, as well as other micronutrients found in cocoa. A recent study also found cocoa derived flavanols to have a prebiotic effect on human gut microflora, whereby the cocoa flavanols modulated a significant growth of select gut microflora such as *Bifidobacterium* and *Lactobacillus* species without significant differences in the total number of bacteria (28). Supporting this participation of intestinal microflora in pregnancy wellbeing, the only other food item women without symptoms began to consume the most of in our previous study was dairy-based probiotic foods (9). This suggests a possible connection between gut microflora and NVP conditions, especially relevant when we consider that *Helicobacter pylori* has previously been suggested as causative in symptoms of NVP, as well as HG (29). Studies outlining probiotics' role in preventing or controlling *Helicobacter pylori* are growing (30). The role of probiotics in the immune system is also noteworthy, as symptoms of NVP have been previously suggested as being triggered by immunological changes following conception (31). Probiotics effect upon anti- and pro- inflammatory cytokines by modulating the skewness in the balance of T helper cells Th1 and Th2, thereby inducing the development of a population of T cells producing anti-inflammatory

cytokines, has been previously outlined (31). In vitro studies demonstrate cocoa derived flavanols and procyanidins modulating the release of pro-inflammatory cytokines that affect immune system activation (32), and recent animal studies have shown cocoa flavonoids modulate the immune system via reductions in intestinal immunoglobulin A (IgA) concentrations (25).

Although speculative, the findings here relating to chocolate, when taken in regard with our previous findings on chocolate and probiotics, tend to suggest a higher intake of these foods may create a more favorable immune response for women with a developing conceptus, resulting in an alleviation of NVP symptoms. As our findings are based upon a cross-sectional study, it is impossible to determine whether these dietary patterns for the two groups relating to these particular food items are providing a protective effect against NVP, although future research would allow a more robust hypothesis to be generated.

The strengths of this study are the large population-based cohort the sample has been derived from, and the validated FFQ used. A possible weakness of this study is the large reliance upon self-reported food habits. Bias in recall amongst women with nausea and vomiting has also been observed previously and may affect some of the results seen here (33). Additionally, the responses in the questionnaires do not allow for assessing the severity of NVP symptoms. Since many of the cited studies have taken place in different continents, a degree of cultural or traditional diversity may distort the data when compared to a Norwegian sample. This is especially relevant in possible reasons for changing diet in pregnancy, whether NVP is present or not.

In conclusion, we have found that the NVP group of women experienced a higher degree of dietary change compared to the SF group as a result of pregnancy. Of the two groups, the NVP women had the lowest proportion 'eating as before pregnancy', and highest proportion 'eating more' and 'eating less' since becoming pregnant. The only exception amongst all food items surveyed was chocolate, where the SF women had the highest proportion 'eating more', possibly obtaining some protection from NVP symptoms through this food.

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