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RESEARCH ARTICLE

Maternal food-avoidance diets and dietary supplements during breastfeeding

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Abstract

Aims: To identify maternal food-avoidance diets and dietary supplement use during breastfeeding, and to explore factors associated with food avoidance diets.

Design: A prospective mother–child birth cohort study.

Methods: Electronic questionnaires were answered by 1,462 breastfeeding mothers 6 months postpartum in the Preventing Atopic Dermatitis and Allergies in Children (PreventADALL) study from 2014–2016. Demographic and antenatal factors were analysed for associations with food avoidance diets in 1,368 women by multiple logistic regression.

Results: Overall, 289 breastfeeding women (19.8%) avoided at least one food item in their diet, most commonly cow's milk in 99 women (6.8%). Foods were most often avoided due to conditions in the child, maternal factors or lifestyle choice. The odds for food avoidance diets were 2.1 (95% CI: 1.3, 3.4) for food allergy (presumed or

Live S. Nordhagen and Vibeke S. Løfsgaard made equal contribution and shared first authorship.

† indicates Kai-Håkon Carlsen dead.

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diagnosed) and 19.4 (5.4, 70.1) for celiac disease in the mother. Dietary supplements were reported by nearly 80%, most commonly cod liver oil.

KEYWORDS
breastfeeding, diet, dietary supplement, food-avoidance, PreventADALL

1 | INTRODUCTION

Exclusive breastfeeding is recommended for the first 6 months of life (Swedish Food Agency, 2020; The Norwegian Directorate of Health, 2019b; World Health Organization, 2011). Avoidance of specific foods in the maternal diet during breastfeeding may influence the nutritional composition of breastmilk and increase the risk of micronutrient deficiencies in the infant (Dror & Allen, 2018). There is little knowledge of the current prevalence of (Abe et al., 2016) and reasons for maternal food-avoidance diets as well as use of dietary supplements during breastfeeding.

2 | BACKGROUND

During the first months after birth, exclusive breastfeeding is the optimal nutrition for healthy term infants. European recommendations for exclusive breastfeeding are generally 4–6 months (EFSA Panel on Nutrition et al., 2019), with 6 months being recommended in Norway and Sweden (Swedish Food Agency, 2020; The Norwegian Directorate of Health, 2019b). Specific diets in breastfeeding women may influence the nutritional composition of their breastmilk (Bravi et al., 2016; Innis, 2014; Valentine & Wagner, 2013). Avoidance of milk or meat may increase the risk of micronutrient deficiencies in the child (Abe et al., 2016; Kocaoglu et al., 2014; Marangoni et al., 2016); in particular, fatty acids and micronutrients such as fat and water-soluble vitamins, iodine, selenium and folic acid are influenced by maternal diet (Bravi et al., 2016; Innis, 2014; Lutter et al., 2018; Marangoni et al., 2016; Valentine & Wagner, 2013).

In a study from Poland, 29.1% of breastfeeding mothers reported eliminating certain foods (Karcz et al., 2020), while 70% of breastfeeding women in a New Zealand study (Brown et al., 2020) and 100% (145) in a Korean study (Jeong et al., 2017) avoided specific foods or beverages. The types of foods avoided vary, as do the reasons for avoiding them. Prevention of allergies, cultural background, peer pressure and symptoms in the child were reported in Poland (Karcz et al., 2020). In New Zealand, dairy products were avoided due to a belief that dairy causes infant colic, reflux or allergic symptoms (Brown et al., 2020). In Korea, caffeine (90.3%), spicy foods (85.5%) and raw foods (75.2%) were most frequently avoided during breastfeeding, adding to the 12.4% who avoided milk and the 13.1% avoiding wheat without a specified reason (Jeong et al., 2017).

Food avoidance during breastfeeding may negatively impact the nutritional status of both mother and child and may influence motivation for and length of breastfeeding (Jeurink et al., 2019; Karcz et al., 2020). Thus, unwarranted food-avoidance diets should be discouraged for women during breastfeeding (Jeurink et al., 2019; Muraro et al., 2014).

In general, breastfeeding women can follow the same nutritional recommendations as the general population. In Norway, supplementation with vitamin D or cod liver oil is recommended (The Norwegian Directorate of Health, 2019a), while in Sweden, women are advised to choose foods rich in vitamin D, omega-3 fats and folic acid (Swedish Food Agency, 2019). Two recent reports found that 70% of breastfeeding women in the United States used one or more dietary supplements (Jun et al., 2020) while a study from New Zealand found that 26% used folic acid, 63% iodine and 60% alternative supplements during breastfeeding (Brown et al., 2020). Dietary supplements during breastfeeding should be used with care: women should be sure that composition and purity are known (Berlin & van den Anker, 2013; Swedish Food Agency, 2019) and avoid high doses or intake of several supplements containing the same nutrient (The Norwegian Directorate of Health, 2014).

3 | RESEARCH QUESTION

The primary aim of our study was to determine the prevalence of maternal food-avoidance diets and dietary supplement use during breastfeeding, and subsequently to identify factors associated with the use of food-avoidance diets during breastfeeding.

4 | THE STUDY

4.1 | Design

This study has a cross-sectional design and uses antenatal and demographic data collected in the Preventing Atopic Dermatitis and Allergies in children (PreventADALL) study, a population-based, prospective mother–child birth cohort, described in detail elsewhere (Lødrup Carlsen et al., 2018). Pregnant women scheduled for routine ultrasound examination at 18 weeks of pregnancy from December 2014–October 2016 were invited to participate in the study at Oslo University Hospital and Østfold Hospital Trust in Norway, and at Karolinska University Hospital, Sweden. Briefly, 2,697 women with 2,701 singleton or twin pregnancies (four women were enrolled with two separate pregnancies) were enrolled with the inclusion criteria of no severe maternal or foetal illness and sufficient, and Scandinavian language skills. Exclusion criteria were severe maternal

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or foetal disease and plans to move from the catchment area of any of the participating hospitals within the first year of the child's life. The women signed a written informed consent during the enrolment visit in connection with the ultrasound examination. Their healthy infants born with a gestational age (GA) of at least 35.0 weeks were included at birth, resulting in 2,395 mother–child pairs. At birth, both guardians signed the informed consent for their child. Twins were excluded from this study, as shown in Figure 1.

We identified 1,462 mothers who reported breastfeeding at 6 months postpartum (Figure 1) as eligible participants for this study. As antenatal data at 18 weeks GA were not available for 95 women, 1,368 women were included for analysis of factors associated with food-avoidance diets 6 months postpartum.

5 | METHOD

Details on the use of avoidance diets or dietary supplements during breastfeeding were recorded in electronic questionnaires distributed 6 months after the child was born, with a reminder 2 weeks later in the absence of response. Women who reported that they were still breastfeeding at 6 months were asked whether they had avoided certain foods or been on a specific diet for the previous 3 months and the reason(s) for their food-avoidance diets. Multiple responses to pre-specified food categories were possible: no or yes due to own disease or ailment, due to suspected intolerance/allergy in the child, due to ailment in the child (not disease), due to disease in the child, to prevent disease in the child or lifestyle choice. The women were subsequently asked to record which food(s) they excluded completely from their diet: cow's milk, lactose, gluten, egg, peanut, nuts (other than peanuts), meat, fish, dairy products or others, described in free text. Regarding dietary supplements, the women were asked whether they had used any of the following supplements: folic acid, multivitamins, cod liver oil, omega fatty acids, fish oils, iron, or other dietary supplements.

The antenatal questionnaire, completed at the time of enrolment, included information on age, education, marital status, country and area of residence, family income, and relevant medical and allergy history.

The electronic questionnaires included information on health status and disease in the mother, child and family; lifestyle; environment; stress; quality of life; and type of diet. The questionnaire was developed by the study team, which consisted of highly skilled paediatricians, healthcare professionals and PhD fellows. Wherever possible, questions from collaborative studies including the MeDALL questionnaire, the Isle of Wight 3rd-generation study, Barrier Enhancement for Eczema Prevention (BEEP; Lødrup Carlsen et al., 2018), the Norwegian Mother, Father and Child Cohort Study, and Environment and Childhood Asthma study (ECA) were used, giving the questionnaire good content validity. A pilot survey of the questionnaire was conducted before dispatch to ensure that the questions and answer alternatives were understood. To assess possible selection bias, we compared distributions of variables among those who answered the 6-month questionnaire versus those who did not.

The main outcome was the prevalence of food avoidance diets in the previous 3 months, reported 6 months postpartum. Further outcomes were exclusion of specific foods, including cow's milk, dairy products, lactose, gluten, eggs, peanuts, nuts, meat, fish, and other.

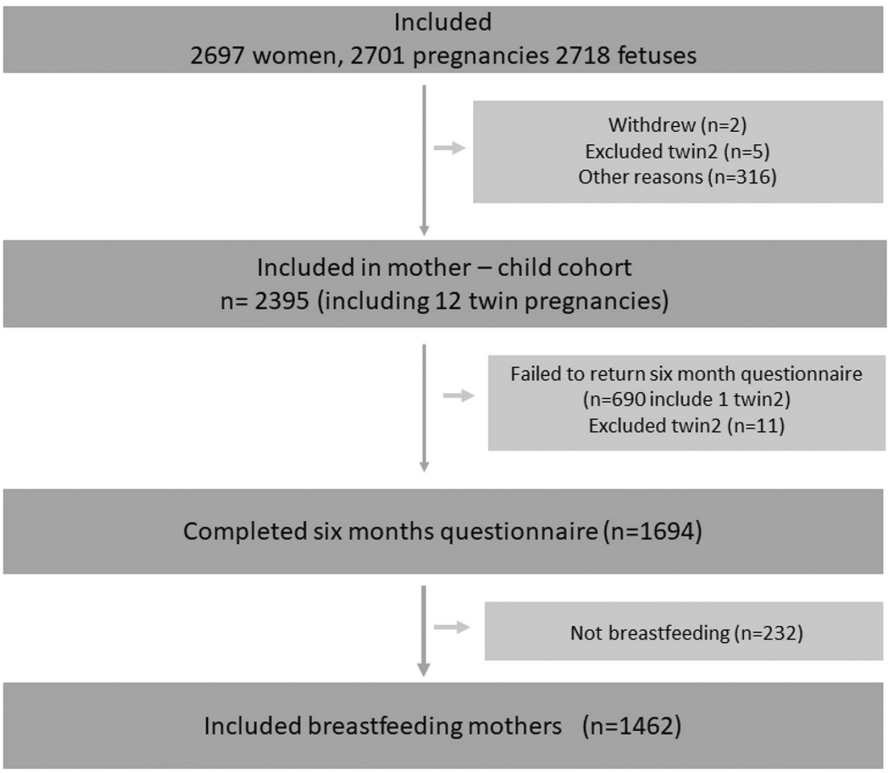

FIGURE 1 Flowchart showing the present study population

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Reasons for food-avoidance diets were categorized into conditions in the child (including suspected intolerance/allergy, ailment or disease), maternal causes (disease or ailment), primary prevention or lifestyle choice. Dietary supplement use was recoded based on the following frequency categories reported for the previous 3 months: regularly (several times per week), occasionally, for a specific period, or not at all. Supplements were divided into the following categories: folate, cod liver oil, fish oils/omega fatty acids, iron, multivitamins or other dietary supplements.

Explanatory variables or possible confounders that were adjusted for in the multivariate analysis were maternal age, education level, marital status, previous pregnancies, country of origin, family income, living environment, doctor-diagnosed asthma, doctor-diagnosed atopic dermatitis, presumed or doctor-diagnosed food allergy and celiac disease.

5.1 | Analysis

Categorical variables are presented as counts and percentages. Possible associations between pairs of explanatory categorical variables were analysed using the Chi-squared test. The variables selected to be examined for possible association with food-avoidance diets were those known from the literature and our own clinical experience. Variables were first tested for possible association in univariate binary logistic regression analyses and those that reached *p*-value <.05 were included in the multivariate model. The results are expressed as odds ratios (OR) with 95% confidence interval (CI). Significance level was set to 0.05. All analyses were performed by IBM© SPSS© statistics version 25.

5.2 | Ethical considerations

The PreventADALL study was approved by the Regional Committee for Medical and Health Research Ethics in South- Eastern Norway (2014/518) and the relevant Swedish authorities (2014/2242–31/4), in addition to being registered at clinicaltrials.gov (number NCT02449850).

6 | RESULTS

Of the 1,694 women returning the 6 months postpartum questionnaire, 1,462 (86.3%) reported breastfeeding. The group of women who were currently breastfeeding had a higher educational level and/or higher income, were older, and more often lived in a city centre compared to non-breastfeeding women (Table 1). The included participants were somewhat older, with a higher educational level, more often of Nordic ethnic origin and primiparous compared to those who did not return the 6-month questionnaire (Table S1).

6.1 | Food-avoidance diets

The prevalence of food-avoidance diets 6 months postpartum was 19.8% (n = 289) in breastfeeding women. The most commonly avoided foods were cow's milk in 99 (6.8%) women and dairy products in 46 (3.1%) women, followed by lactose in 33 (2.3%) women and gluten in 36 (2.5%) women with further details in Table 2. Among the 289 women who reported being on a food-avoidance diets, 203 (70.2%) avoided one type of food, 49 (17%) avoided two and 37 (12.8%) avoided three or more types of food.

The reported reasons for maternal food-avoidance diets were related to conditions in the child in 169 (58.5%) cases, maternal causes in 87 (30.1%), both child and maternal causes in 11 (3.8%) and lifestyle choice in 45 (15.6%) cases while 5 women (1.7%) avoided foods to prevent disease development in their child. Most women (247 of 289) reported only one reason for following a food-avoidance diet, while 40 (13.8%) reported two reasons and two (0.7%) reported more than two reasons. Maternal food-avoidance diets related to conditions in the child included suspected intolerance/food allergy in 96 cases (33.2%), ailment or discomfort in 92 cases (31.8%), other diseases not specified in 8 cases (2.8%) and both suspected intolerance/food allergy and ailment/other disease in 25 cases (8.7%). Among the 169 women who reported following a food-avoidance diet due to conditions in the child only, cow's milk was the most commonly avoided food, reported by 92 women (54.4%), while gluten (34; 39.1%) and lactose (20; 23.0%) were most frequently avoided by women reporting maternal causes as the reason for their diet. Women avoiding foods as a result of lifestyle choices (n = 45) most often excluded meat from their diet (64.4%; Figure 2). While cow's milk, gluten, cabbage or other foods were excluded for primary prevention reasons (n = 5).

6.2 | Dietary supplements

Overall, 1,136 of 1,462 (77.8%) breastfeeding women reported using at least one dietary supplement 6 months postpartum. Of these, 423 (28.9%) used one type of dietary supplement, 384 (26.2%) used two types of dietary supplements and 329 (22.5%) used three or more types of dietary supplements. Cod liver oil was the most commonly used dietary supplement, reported in 711 women (48.6%), followed by multivitamins in 573 (39.2%), other dietary supplements in 315 (21.5%), iron in 318 (21.7%), fish oil/omega fatty acids in 288 (19.7%) and folic acid in 156 (10.7%). There was a significant difference in the use of dietary supplements among participants reporting food-avoidance diets (86.1%) compared with those not reporting food-avoidance (75.7%).

6.3 | Factors associated with food-avoidance diets

In the univariate logistic regression analyses, the following variables were significantly associated with the use of food-avoidance

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TABLE 1 Background characteristics for breastfeeding and not breastfeeding women who responded to the 6-month postpartum questionnaire ($n = 1,694$) form December 2014–October 2016 in Norway and Sweden

Background characteristics	Breastfeeding ($n = 1,462$) n (%)	Not breastfeeding ($n = 232$) n (%)	p-value
Age at enrolment ($n = 1,694$)			
16–24 years	19 (1.3)	11 (4.7)	**<.01**
25–34 years	1,005 (68.7)	153 (65.9)	
>35 years	438 (30.0)	68 (29.3)	
Education ($n = 1,583$)			
Primary/High school	98 (7.2)	51(23.8)	**<.01**
Higher education <4 years	424 (31.0)	74 (34.6)	
Higher education >4 years	845 (61.7)	89 (41.6)	
Marital status ($n = 1,586$)			
Married	604 (44.0)	92 (42.8)	.05
Cohabitant	743 (54.1)	113 (52.6)	
Single	27 (2.0)	10 (4.7)	
Country of origin ($n = 1,586$)			
Norway	950 (69.2)	126 (58.9)	**<.01**
Sweden	290 (21.1)	63 (29.4)	
Other Nordic	21 (1.5)	0 (0.0)	
Other than Nordic	111 (8.1)	25 (11.7)	
Family income ($n = 1,567$)			
Low	7 (0.5)	4 (1.9)	**<.01**
Middle	714 (52.5)	135 (65.2)	
High	639 (47.0)	68 (32.9)	
Living environment ($n = 1,586$)			
City, densely	550 (40.1)	67 (31.3)	**.02**
City, less densely populated	520 (37.9)	85 (39.7)	
Suburb	216 (15.8)	39 (18.2)	
Countryside, in village	28 (2.0)	5 (2.3)	
Countryside, outside village	58 (4.2)	18 (8.4)	
Previous pregnancy ($n = 1,692$)			
0	890(61.0)	155 (66.8)	.22
1	499 (30.8)	62 (26.7)	
>1	121 (8.3)	15 (6.5)	
Reported maternal diseases			
Celiac disease ($n = 1,687$)	18 (1.2)	3 (1.3)	n.a.
Asthma doctor diagnosed ($n = 1,586$)	233 (17.0)	42 (19.6)	.34
Atopic eczema doctor diagnosed ($n = 1,586$)	287 (20.9)	45 (21.0)	.97
Allergic rhinitis doctor diagnosed ($n = 1,586$)	294 (21.4)	48 (22.4)	.94
Food allergy any reported ($n = 1,045$)	339 (37.7)	63 (43.4)	.16
Food allergy doctor diagnosed ($n = 1,586$)	174 (12.7)	33 (15.4)	.42

Note: Chi-squared test where used with p-value <.05.

p-value <.05 in bold.

n.a. = p-value could not be calculated due to too small cell counts.

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TABLE 2 The types of foods excluded from the diet in 289 of 1,462 breastfeeding women 6-month postpartum are given overall, as well as by reported maternal diseases among 87 women reporting maternal causes for the diet

Food-avoidance diets	Overall *n* (%)	Maternal food allergy, DD	Maternal food allergy, presumed or DD	Asthma, allergy or atopic dermatitis, DD	Celiac disease
Total use of food-avoidance diets	289 (19.8)	38 (2.6)	50 (3.4)	51 (3.5)	15 (1.0)
Type of food- avoidance					
Cow milk	99 (6.8)	5 (0.3)	6 (0.4)	10 (0.7)	2 (0.1)
Dairy products	46 (3.1)	3 (0.2)	4 (0.3)	6 (0.4)	2 (0.1)
Lactose	33 (2.3)	6 (0.4)	8 (0.6)	11 (0.8)	2 (0.1)
Gluten	36 (2.5)	11 (0.8)	16 (1.1)	17 (1.2)	15 (1.0)
Egg	19 (1.3)	1 (0.07)	2 (0.1)	3 (0.2)	2 (0.1)
Peanuts	16 (1.1)	10 (0.7)	10 (0.7)	13 (0.9)	1 (0.07)
Nuts	15 (1.0)	11 (0.8)	11 (0.8)	12 (0.8)	1 (0.07)
Meat	29 (2.0)	1 (0.07)	1 (0.07)	3 (0.2)	2 (0.1)
Fish	16 (1.3)	3 (0.2)	3 (0.2)	4 (0.3)	1(0.07)
Other	121 (8.3)				
Onion	34 (2.3)	1 (0.07)	1 (0.07)	1 (0.07)	0 (0.0)
Cabbage	17 (1.2)	3 (0.2)	4 (0.3)	4 (0.3)	0 (0.0)

Abbreviation: DD, doctor diagnosed.

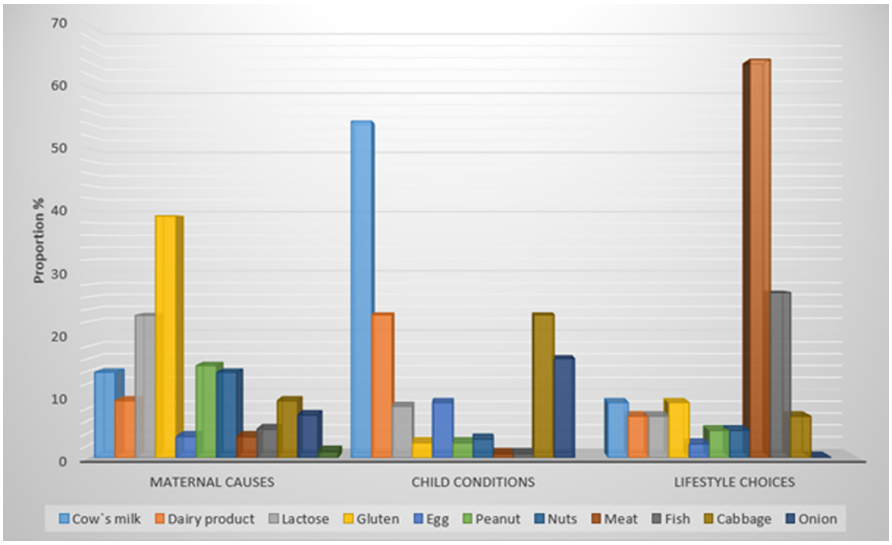

FIGURE 2 The type(s) of food being avoided is shown based on the reason provided for the food-avoidance diet in 289 breastfeeding women at six-months, with the possibility of several answers. The proportions of specific foods excluded from the diet (%) are based upon the overall number of women reporting maternal causes (n = 87), conditions in the child (n = 169), and lifestyle choices (n = 45). Data from the five women who avoided (cows milk n = 1, gluten n = 1, onion n = 1, and other diets n = 3) to prevent disease in their child and 11 women who reported both maternal and child causes for their diet are not shown in the figure

diets during breastfeeding 6 months postpartum: previous pregnancies, country of origin, maternal asthma, allergy, atopic dermatitis, any food allergy (presumed or diagnosed) or celiac disease. In the multiple regression analysis adjusted for the possible confounders listed above, both maternal celiac disease and presumed or doctor-diagnosed food allergy independently increased the odds of maternal food-avoidance diets during breastfeeding (Table 3).

7 | DISCUSSION

In a general population of almost 1,700 breastfeeding women, one in five excluded one or more foods from their diet at 6 months postpartum. Maternal food-avoidance diets due to conditions in the child most often involved exclusion of cow's milk and dairy products, while gluten was most often avoided for reasons related to maternal health, and meat avoidance was most often reported

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TABLE 3 The odds for the use of food-avoidance diets during breastfeeding at six-month postpartum is shown by univariate and multivariate analyses

	n	Univariate analyses OR (95% CI) *p*-value	Multivariate analyses OR (95% CI) *p*-value
Age mother			
16–24 years (ref)	1,332		
25–34 years		0.87 (0.28–2.64) .80	
>35 years		0.88 (0.29–2.73) .82	
Education mother			
Primary/high school (ref)	1,336		
Higher education <4 years		0.87 (0.50–1.53) .62	
Higher education >4 years		1.02 (0.60–1.73) .93	
Marital status			
Married (ref)	1,357		
Cohabitant		0.88 (0.67–1.15) .35	
Single/separated/other		0.74 (0.21–2.58) .63	
Country of origin			
Norway (ref)	1,368		
Sweden		**1.40 (1.02–1.92) .03**	1.26 (0.88–1.82) .21
Other Nordic countries		1.40 (0.51–3.86) .52	
Other		0.65 (0.36–1.16) .14	
Family income			
Low/Middle (ref)	1,356		
High		0.80 (0.61–1.06) .11	
Living environment			
City, densely populated (ref)	1,368		
City, less densely populated		0.81 (0.60–1.11) .18	
Suburb		1.17 (0.80–1.71) .42	
Village		0.30 (0.07–1.28) .10	
Countryside, outside village		0.64 (0.29–1.38) .25	
Parity			
0 (ref)	1,368		
1		**0.70 (0.50–0.98) .03**	0.75 (0.51–1.09) .12
>1		0.98 (0.71–1.35) .88	
Maternal asthma, doctor diagnosed			
No (ref)	233		
Yes		**2.30 (1.68–3.15) <.01**	1.44 (0.95–2.18) .08
Maternal allergic rhinitis, doctor diagnosed			
No (ref)	294		
Yes		**1.66 (1.22–2.25) <.01**	1.21 (0.82–1.79) .33
Maternal atopic dermatitis, doctor diagnosed			
No (ref)	286		
Yes		**1.85 (1.36–2.49) <.01**	1.21 (0.82–1.80) .33
Maternal food allergy presumed, or doctor diagnosed			
No (ref)	338		
Yes		**2.55 (1.92–3.40) <.01**	**212 (1.32–3.41) <.01**
Maternal celiac disease			
No (ref)	18		
Yes		**22.60 (6.50–78.60) <.01**	**19.41 (5.37–70.10) <.01**

Note: *p*-value <.05 in bold.

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in relation to lifestyle choices. Maternal celiac disease and food allergy were both independently associated with food avoidance during breastfeeding. Eight in 10 breastfeeding women used at least one dietary supplement, with cod liver oil being used by around half of these.

The finding that one in five breastfeeding women excluded one or more foods 6 months postpartum is lower than observed in a Polish survey from 2019 with 1,074 participants, in which 29% of respondents reported following an elimination diet excluding one or more foods during breastfeeding (Karcz et al., 2020). Nutritional recommendations during breastfeeding are similar in the Nordic countries and Poland (Karcz et al., 2020; The Norwegian Directorate of Health, 2019a). An explanation for the higher use of elimination diets in Poland might be the cultural prevalence of 'myths' about prophylactic dietary restrictions during breastfeeding (Karcz et al., 2020).

In a Korean study, 100% (145) of respondents reported avoidance of one or more types of foods during breastfeeding (Jeong et al., 2017), while in a study from New Zealand, 70% of 458 women avoided specific types of food and beverages during breastfeeding (Brown et al., 2020). The difference with breastfeeding Korean women can possibly be explained by the difference in cultural food habits and tradition, as Asian woman are recommended to avoid both raw and spicy foods to prevent harm and discomfort in infants (Jeong et al., 2017). Different sources of dietary guidance may also be an explanation: in Korea, family and friends were the main source of nutritional information and advice. Only a small proportion of the women got information from medical professionals (Jeong et al., 2017). In the New Zealand study, over half of the women avoided alcohol, a factor not investigated in the present study. However, 35% of the participants in the New Zealand study reported avoiding milk and milk products (Brown et al., 2020). In the New Zealand study, the majority relied on alternative health practitioners, the Internet, and family and friends regarding dietary recommendations (Brown et al., 2020). Our study did not investigate where participants obtained information regarding dietary recommendations.

One in 10 breastfeeding women avoided cow's milk or dairy products in their diet. However, cow's milk is among the main sources of iodine in the Norwegian diet (Nerhus et al., 2018) and breastfed infants depend on sufficient maternal iodine intake for optimal growth and neurological development (Azizi & Smyth, 2009; Jorgensen et al., 2016). The iodine concentrations in breastmilk are likely to be suboptimal with inadequate maternal intake of iodine from food and supplements (Henjum et al., 2017) highlighting the importance of nutritional awareness in breastfeeding women who avoid cow's milk and other dairy products (The Norwegian Directorate of Health, 2019a).

Conditions in the child were most frequently reported as the reason for food-avoidance diets in our study, in line with studies reporting avoidance of milk or dairy products during breastfeeding due to a belief that dairy causes infant colic, reflux or allergic symptoms (Brown et al., 2020) or to prevent development or symptoms of allergies (Karcz et al., 2020).

Such conditions, including suspected intolerance/food allergy, were the reason 57% of the participants avoided some food products. However, there is no scientific evidence to support dietary restrictions during pregnancy or breastfeeding to prevent allergic disease development (Greer et al., 2019). Our results indicate that a significant proportion of food-avoidance diets during breastfeeding may not be indicated, which is of concern as elimination of food is not without nutritional risk (Rajani et al., 2020).

Lactose and gluten were the food ingredients most frequently avoided by women who reported maternal causes for their diet. Having celiac disease was associated with food avoidance during breastfeeding and may be one reason for avoiding gluten. The demand for gluten-free products is increasing, including people not diagnosed with celiac disease. There is no scientific evidence of health benefits for this trend (Forskning.no, 2020). However, a gluten-free diet may result in a lack of special dietary fibre, as well as minerals such as magnesium, zinc, iron and calcium and micronutrients such as vitamin B, vitamin C and folate (Vici et al., 2016). Gluten-free products are less nutritious, and following a gluten-free diet should therefore be restricted to those with medical requirements (Myhrstad et al., 2021).

Over half of those who cited lifestyle as the cause of food avoidance avoided meat. This is in line with the increasing number of vegetarians in Norway (IPSOS, 2020). A breastfeeding women following a meatless or vegetarian diet can follow the same dietary advice as for the general population but needs an extra supply of some vitamins and minerals such as vitamin B12, iodine, vitamin D, folate, selenium, riboflavin and vitamin B6 (The Norwegian Directorate of Health, 2019a).

Nearly 80% of the breastfeeding women in the current study used dietary supplements, which is in line with studies from New Zealand and the United States (Brown et al., 2020; Jun et al., 2020; Picciano & McGuire, 2008). Around half of the breastfeeding participants used cod liver oil supplements as a source of vitamin D, which is a Norwegian recommendation and tradition (The Norwegian Directorate of Health, 2019a). In addition, cod liver oil may have positive neurological and cardiovascular effects for the infant (Drevon, 2004). In addition, 20% used omega fatty acids other than cod liver oil, in line with the national recommendations to maintain sufficient levels of vitamin D (The Norwegian Directorate of Health, 2019a, 2019b). Maternal intake of fish oil might have benefits for the child, including a decreased risk of atopic dermatitis and sensitization to food allergens (Garcia-Larsen et al., 2018). Both omega fatty acids and cod liver oil contain Omega-3 polyunsaturated fatty acids (PUFA), which, when ingested in breast milk, have been suggested to have a positive impact on the health and development of infants later in life in some studies (Olafsdottir et al., 2006), although not all (Delgado-Noguera et al., 2015). Presently, there is inconclusive evidence to support or dismiss the practice of PUFA supplementation in breastfeeding women in terms of neurodevelopment (Delgado-Noguera et al., 2015) and as to whether maternal supplements are beneficial or carry a potential risk for excessive nutrient supply in the child (Zeisel, 2008).

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The prevalence of multivitamin use found in our study (40%) is lower than among breastfeeding women in United States (64%; Jun et al., 2020). However, multivitamin supplements are not routinely recommended for healthy breastfeeding women in Norway and Sweden due to uncertainty as to the benefits or potentially harmful effects to the child (Norden., 2012; Swedish Food Agency, 2019; The Norwegian Directorate of Health, 2019a).

The prevalence of food avoidance during breastfeeding in the present study is lower than what has been reported in other countries; however, all studies show that evidence-based communication of dietary recommendations is needed during the breastfeeding period. In Norway, public health nurses, in collaboration with clinical nutritionists, have an important role as nutritional counsellors during follow-up consultations with new mothers (The Norwegian Directorate of Health, 2016).

7.1 | Strengths and limitations

The assessment of risk factors associated with maternal food-avoidance diets during breastfeeding in the present study is strengthened by the prospective cohort design from a general population. Furthermore, in our study, we asked the mothers about their reasons for excluding certain foods during breastfeeding, which reflect their perceptions rather than being restricted to documented disease. The questions with pre-specified food categories explicitly asked for foods that were excluded from the diet rather than those consumed in reduced quantities or partially avoided. Furthermore, we used pre-specified categories to report causes of avoidance diets to limit classification and interpretation by the researchers during analysis.

However, the present study aimed to assess the reasons for following an avoidance diet as perceived by the mother, rather than documenting the correctness of her assumptions. Furthermore, we report the foods avoided for maternal causes based on reported maternal disease, without ascertaining a link between the excluded food and the disease.

One limitation of our study is the participants' generally higher educational attainment level compared to both the non-included participants and the national average. The prevalence of celiac disease is as expected in a general population, as is the 12.7% doctor-diagnosed food allergy, and 38% reported food allergy (presumed or diagnosed). Current national data from Norway and Sweden on food allergies in adults are lacking; thus, we cannot rule out some bias due to increased allergic disease in our cohort, limiting the generalizability of our study. However, our discrepant findings may also represent a trend change in increasing use of food-avoidance diets. Further limitations include the lack of free-text responses for causes of food-avoidance diets and no additional details for the option 'symptoms or other diseases in the child'. There were also limited answer options to the question regarding 'other' dietary supplements. The data in this study are based on self-reported questionnaires; the questions go back 3 months in time, potentially leading to recall bias that must be considered when interpreting the findings. The use of food diaries would provide more reliable dietary data, but given the size of our study, this burdensome methodology was not logistically feasible and would likely have resulted in a lower response rate, thereby introducing a selection bias.

8 | CONCLUSION

Six months postpartum, 20% of breastfeeding women reported following a food-avoidance diet, most often due to intolerance, allergy, ailment or other disease in the child; around one third were due to maternal causes. Cow's milk and other dairy products were most often excluded due to conditions in the child. Gluten was most often avoided for reasons related to the maternal causes, while meat avoidance was most often a lifestyle choice. Food-avoidance diets during breastfeeding were associated with maternal food allergy (presumed or diagnosed) and celiac disease and not with general demographic factors.

As use of a maternal food-avoidance diet during breastfeeding may impact the child, our results suggest a need for increased awareness and knowledge about nutritional intake in breastfeeding women, perhaps through the inclusion of dietary guidance as part of the nursing practice in primary care. Further research on the use of food-avoidance diets and dietary supplements during breastfeeding and the possible effects on infants is needed.

AUTHOR CONTRIBUTIONS

All authors have contributed substantially to the design and/or clinical follow-up of the PreventADALL study, and they have revised the work critically for important intellectual content and approved the final version before submission.

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CONFLICT OF INTEREST

The authors have no conflicts of interests to disclose.

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DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ETHICAL APPROVAL

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