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Diet composition of pregnant Finnish women: changes over time and across seasons

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Abstract

Objective: To describe the diet of a population of pregnant Finnish women over a period of 7 years, with special attention paid to seasonal fluctuations in food consumption and nutrient intake.
Design: A validated 181-item FFQ was applied retrospectively, after delivery, to assess the maternal diet during the 8th month of pregnancy.
Setting: Type 1 Diabetes Prediction and Prevention Nutrition Study Cohort.
Subjects: The cohort comprised a total of 4880 women who had newly delivered during the years 1997–2004, with the offspring carrying increased genetic risk for type 1 diabetes mellitus.
Results: Over the study period, the proportion of energy derived from fat decreased while the intake from protein and carbohydrate increased. The intake of vitamin D increased from food sources. Seasonal variation was observed in the mean daily consumption of vegetables, fruits and berries and cereals. Intake of dietary fibre, total fat, MUFA, vitamins A, D, E and C, folate and iron also showed seasonal fluctuation.
Conclusions: These results show an overall positive trend in the diet of pregnant Finnish women through the study years. However, there is still room for improvement, particularly in the types of dietary fats. Although food fortification with vitamin D since 2003 was reflected in the increased intake of vitamin D from foods, the mean intake levels still fell below the recommendations. Seasonal changes in food consumption were observed and related to corresponding fluctuations in nutrient intakes. The mean folate intake fell below the recommendation throughout the year.

Keywords
Foods
Nutrients
Pregnant women
Seasons

The quantity and quality of the maternal diet during pregnancy is of extreme importance, not just for the health of the mother, but also for the health and development of the fetus, and for the outcome of the pregnancy. In fact, the influence of the maternal diet during pregnancy reaches even further in its impact; it may have permanent effects on the health and well-being of the offspring in later life[1]. A large body of animal study data have provided evidence that maternal diet is associated with the outcome of the pregnancy, as well as with the offspring's lifespan and health in adulthood[2]. Human studies, with data derived mostly from situations of food shortage, have also indicated a link between maternal nutritional status and newborn size, and further between low birth weight and increased risk of adult chronic disease[3]. Epidemiological data from well-nourished populations, however, paints a more contradictory picture[4].

A number of maternal factors have been established to influence fetal growth and pregnancy outcomes in well-nourished populations. Apart from cigarette smoking, many of the other factors, such as low pre-pregnancy BMI or low gestational weight gain, are indicators of maternal nutritional status[5]. Both inadequate and excessive intake of certain nutrients have been related to undesired birth

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outcomes and pregnancy complications[6,7]. A further evolving issue is the prevalence of overweight and obesity, which has been linked to health risks for pregnant women and their babies[8]. Maternal intake of energy-yielding nutrients, vitamins and minerals during pregnancy, especially during certain 'sensitive periods', has also been implicated to influence placental weight and the size of the newborn[9–11]. The combination of these sensitive periods and seasonal variation in food consumption and nutrient intake could potentially influence birth outcomes. A recent pilot study from New Zealand was able to link the seasonal variations found in the nutrient intakes of pregnant women, with the differences in birth measures across different seasons[12]. In Finland, although the diet of the average pregnant woman is thought to be fairly healthy, studies have revealed inadequacies in the intake of folate, iron and vitamin D[13,14]. In a Northern country like Finland, with its extreme variation in climate, the availability and price of fresh foods are most likely to exhibit seasonal variation, and hence temporal differences in food consumption are to be expected.

We set out to study the food consumption and nutrient intakes in a large cohort of pregnant Finnish women. First, we examined whether the food consumption and nutrient intake had changed over the study years, within this cohort of women. Particular attention was paid to whether the optional vitamin D fortification of all fluid milk products and fat spreads that started in February 2003 had had any significant impact on the intake levels[15]. We then proceeded to look for seasonal variations in the consumption of certain foods and food groups, and in the levels of nutrient intakes. On the basis of our findings, we went on to highlight specific areas of concern, and to raise issues that might warrant discussion on maternal diet during pregnancy.

Subjects and methods

Subjects

The Type 1 Diabetes Prediction and Prevention (DIPP) project is a multi-disciplinary population-based birth cohort of children with increased genetic risk for type 1 diabetes. The present study is designed to predict the development of type 1 diabetes, and to search for means to prevent or delay progression to clinical type 1 diabetes[16]. All newborn infants in the areas of three university hospitals were screened from cord blood, for major histocompatibility complex, class II, DQ beta 1 (HLA-DQB1) conferred susceptibility to type 1 diabetes, and families with a risk child were invited to participate in the DIPP study. Ethical approval was obtained from the local ethics committees of the participating university hospitals of Turku, Oulu and Tampere. All families participating in the study signed an informed written consent.

The present study is part of the DIPP Nutrition Study, which is being carried out within the framework of DIPP in the university hospitals of Oulu and Tampere. Mothers from the DIPP Study, whose infants carried increased risk for type 1 diabetes were invited through their delivery hospital, to take part in the Nutrition Study. The focus of the nutrition arm is to examine the effects of maternal nutrition during pregnancy and lactation, and of the child's diet, on the development of β-cell autoimmunity, type 1 diabetes, asthma, allergic diseases and obesity in the offspring. The present study consists of mothers of at-risk children born between 20 October 1997 and 5 September 2004. Baseline dietary data were available from 4942 mothers, of whom sixty-two had returned dietary data questionnaires with missing consumption frequencies for ten or more food items. These mothers were omitted from the study, thus leaving us with a final sample size of 4880 (68·3 % of those invited to the study; Table 1).

Dietary assessment

The maternal diet during pregnancy was assessed using a validated, self-administered 181-item FFQ[17]. The FFQ was designed to reflect the diet of Finnish women of reproductive age. The participants received the questionnaire after delivery and returned it at their infant's 3-month visit to the study centre. The information gathered reflected their diet during the 8th month of pregnancy. As this period immediately precedes the time when Finnish mothers start their maternity leave, it is likely to best represent their average diet during pregnancy. The frequency options for the consumption of foods and food groups were 'not at all' or 'number of times per day' and 'week' or 'month'. The respondents were asked to report the consumption frequencies in natural units (e.g. one orange), common household measures (e.g. one glass of milk) or portions (e.g. one portion of lasagne). Since the effect of the pregnancy diet is likely to be modified by differences in the use of food supplementation, the FFQ included an open section to collect information on any supplementation used during the entire pregnancy[13]. The FFQ was checked by a trained study doctor or nurse, and where necessary, completed in consultation with the mother. All returned FFQ were also double-checked by a trained nutritionist.

For the present analysis, we split the food consumption data into ingredients using a recipe composition from the Finnish Food Composition Database (FCDB) Fineli[18]. Two updated versions of the FCDB were used: the first version for study years 1997–2002 and the second version for years 2003–2004. Recipe compositions were changed from the first version to the second in order to reflect changes in food consumption habits that took place during the study period as new foods and food products entered the market. Between the two versions, the compositional changes affected 57 % of the food items in which either the ingredients in the recipes or proportions of ingredients, or both were changed. The changes in recipes were mainly based on food consumption information of

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Table 1 General characteristics of the study population (*n* 7147)

Sociodemographic variable	Pregnant women with dietary data (*n* 4880)		Dietary data not available (*n* 2267)		
	%	*n*	%	*n*	*P*
Maternal age (years)					
<25	19	926	23	526	<0·0001
25–29	35	1700	29	665	
30–34	29	1413	27	621	
≥35	17	841	20	455	
Basic education					
Below high school	36	1734	44	1006	<0·0001
High school	61	2977	44	995	
Missing data	3	169	12	266	
Smoking status during pregnancy					
Current or ex-smoker*	10	467	12	261	0·0123
Non-smoker	87	4247	84	1914	
Missing data	3	166	4	92	
Earlier deliveries					
0	46	2263	30	679	<0·0001
1	31	1514	33	748	
≥2	22	1054	36	805	
Missing data	1	49	2	37	
Gestational age (weeks)					
<37	5	271	6	141	0·1541
37–42	91	4423	90	2038	
>42	3	138	3	55	
Missing data	1	48	1	33	
Use of food supplements during pregnancy					
Yes	78	3806		–†	
No	22	1074		–†	

*Quit smoking during first trimester of pregnancy.
†Dietary data not available, supplement use not known.

women aged 25–44 years from the national dietary surveys, FINDIET 1997[19] and FINDIET 2002[20], respectively. Vitamin D concentrations were systematically changed in milk and fat products due to changes in fortification in 2003[15]. An in-house software program of the National Institute for Health and Welfare was used to convert the food consumption and supplement intake data into a daily food diary, and to generate mean daily food, energy and nutrient intakes. Since the mean daily intake of nutrients from supplements was calculated for the whole tenor of pregnancy, seasonality of supplemental nutrient intake was not examined. However, daily nutrient intakes from supplements were included in the seasonality analysis in order to assess the overall nutrient intake levels for the present study population.

Information on sociodemographic characteristics was registered by a structured questionnaire or obtained from the Finnish Birth Registry. Smoking during pregnancy was divided into three categories (smoker, non-smoker and quit smoking during the first trimester). However, since the number of those who quit was very small, they were grouped together with the smokers.

Data analysis

A χ^2 test was used to test for differences in the demographic variables between the women with dietary data, and those without. Mean nutrient intakes were calculated based on the maternal food consumption during the 8th month of pregnancy, which in turn was determined from the child's birth date. The mean consumption of selected food groups and the intake of nutrients were also calculated according to season (spring, March–May; summer, June–August; autumn, September–November and winter, December–February). ANOVA was used to test for differences in food consumption and nutrient intake between year-groups and seasons. For those variables that were not normally distributed, logarithmic transformation was carried out before the analysis. Variables that showed non-normality even after logarithmic transformation were tested using a non-parametric Kruskal–Wallis test. In addition, pairwise tests were performed using Bonferroni corrections. However, since the Bonferroni correction can be rather stringent, we have reported associations at the conventional level of significance ($P < 0·05$) while taking into account the results of the Bonferroni correction in interpreting our results. Seasonal effects were also tested so that maternal age, education and the number of earlier deliveries were included as covariates in the model. Statistical analyses were carried out with SAS for Windows statistical software package version 8·2 (SAS Institute Inc., Cary, NC, USA).

Results

Table 1 shows the sociodemographic characteristics of the women who participated in the study, as well as of those who did not provide dietary data. Women who did not provide dietary data (*n* 2267) differed from those who

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Table 2 Mean (SD) daily intakes of energy-yielding nutrients from foods and supplements expressed in relation to energy intake (E%/MJ) by year-groups

	Years						
	1997–2000 (*n* 2455)		2001–2002 (*n* 1337)		2003–2004 (*n* 1088)		
	Mean	SD	Mean	SD	Mean	SD	*P*
Protein (E%)	16·2	2·13	16·5	2·28	16·9	2·29	<0·0001
Carbohydrate (E%)	49·4	5·10	49·4	5·08	50·5	5·08	<0·0001
Sucrose (E%)	11·6	3·70	11·5	3·76	11·7	3·74	NS
Fibre (g/MJ)	2·4	0·68	2·4	0·70	2·5	0·73	<0·0001
Fat (E%)	34·3	4·71	34·0	4·78	32·5	4·58	<0·0001
SAFA	14·7	2·85	14·4	2·90	13·6	2·73	<0·0001
MUFA	11·9	1·99	11·9	2·04	11·2	1·90	<0·0001
PUFA	4·6	1·09	4·7	1·08	4·6	1·03	NS
Vitamin D (μg)	6·2	3·78	6·4	3·67	8·9	4·03	<0·0001
Food sources	5·0	2·65	5·0	2·49	7·3	3·20	<0·0001
Supplements	1·2	2·56	1·5	2·62	1·6	2·50	<0·0001*

Intake of vitamin D is expressed as absolute mean daily intakes (μg) from food sources and supplements together and separately.
*Difference between year-groups tested with non-parametric Kruskal–Wallis test.

did (*n* 4880) in terms of age, education, smoking status during pregnancy, parity and gestational age. Women aged <25 or ≥35 years, women whose education was below high-school level, and women with two or more children were all under-represented among the women who provided FFQ data. Large proportion of women who provided dietary data complemented their diet with dietary supplements (78 %).

When we examined the intakes of energy-yielding nutrients from foods expressed in relation to energy intake by year of pregnancy, we found that the mean proportion of energy derived from fat had decreased over the study period, whereas the mean proportions of protein and carbohydrate from energy intake had increased (Table 2). There was a significant increase in the intake of vitamin D both from food sources and supplements against the year-group 2003–2004. However, after the Bonferroni adjustment, the year-group differences in the intake from supplements were no longer significant.

Our data showed seasonal fluctuations in the consumption of vegetables, fruits and berries and cereals, and also in the consumption of specific food items such as rice and pasta, sausages, processed meat, ice cream, tea and soft drinks (Table 3). The overall vegetable intake was highest in the summer and lowest during winter. Seasonal differences were also observed within the vegetable subgroups. The consumption of vegetable fruits exhibited significant variation across seasons. The mean daily consumption of fruits and berries was lowest during the summer while berry consumption on its own peaked during summer and autumn. There was significant seasonal fluctuation in the consumption of the imported citrus fruits, with the highest intakes in the winter. Cereal consumption differed significantly between summer and autumn. Sausages, ice cream and soft drinks were most frequently consumed in the summer, with ice cream showing significantly different consumption levels across seasons. The consumption of tea was highest in the autumn and winter.

When we examined seasonality in the intake of nutrients, we found variation in the intakes of dietary fibre, total fat and MUFA (Table 4). The proportion of energy from total fat was significantly higher in the summer compared to other seasons. The proportion of energy intake from MUFA was also at its highest during summer. The intake of dietary fibre was at its lowest during summer. The intake of vitamin D showed seasonal differences with significantly lower intakes in the autumn. Folate intake was lowest in the summer and highest in the winter, whereas higher vitamin E intakes were observed during the summer months. There were significant differences in the intake of iron between spring, summer and autumn. Although the intakes of vitamin A and C were also found to exhibit seasonal variation, the results after Bonferroni corrections were no longer significant.

We used the ANOVA to adjust for maternal age, education and parity on our seasonality results. Overall, our results headed towards more significance post adjustment, indicating a true seasonality effect (data not shown). The only exception was the intake of carbohydrate in which, after adjustment, the difference in the intake across seasons was no longer significant ($P = 0·077$).

Discussion

In the present study, we described the diet of pregnant Finnish women over a period of 7 years, with special attention paid to seasonal fluctuations in food consumption and nutrient intake, and to any significant changes in nutrient intakes over the study period. As far as we are aware, this is the first study in Europe to link the food consumption and nutrient intake of pregnant women to seasonality.

Our findings indicate an overall improvement in the diet of pregnant Finnish women over the study period. These results are mostly in line with the FINDIET 2007

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Table 3 Mean daily consumption (g) of selected food groups and foods in the diets of pregnant Finnish women by season*

	Season										
	Whole year (*n* 4880)		Spring (*n* 1285)		Summer (*n* 1306)		Autumn (*n* 1081)		Winter (*n* 1208)		
Food items (g/d)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P*
Vegetables	245	144	245	139	267	144	246	161	221	129	<0·0001
Roots and tubers	54	54	52	49	49	45	60	65	58	55	<0·0001
Leafy vegetables	27	25	27	26	29	27	25	26	24	23	<0·0001
Vegetable fruits	109	85	112	82	134	97	104	85	84	67	<0·0001
Cabbages	16	21	14	17	17	22	18	25	15	19	0·0003
Potato	112	57	112	58	110	56	112	59	113	54	NS
Fruits and berries	213	160	210	147	188	134	229	196	228	162	<0·0001
Citrus fruit	54	81	57	74	29	48	57	98	74	91	<0·0001†
Other fresh fruit	132	110	131	102	127	102	142	132	131	106	NS
Berries	26	37	22	28	32	40	30	47	22	28	<0·0001
Cereals	174	62	174	62	171	62	178	61	174	61	0·04
Rye	54	39	54	38	53	38	56	41	54	38	NS
Wheat	91	46	91	47	90	45	93	46	90	45	NS
Rice and pasta	29	16	30	17	28	15	29	16	30	16	0·021
Fats and oils	35	18	35	19	35	19	36	18	35	18	NS
Fish	24	21	24	20	25	21	24	21	23	21	NS†
Meat	158	69	157	69	158	66	157	71	159	72	NS†
Red meat and game	73	37	74	39	71	33	72	37	75	40	NS†
Poultry	37	32	37	32	37	32	37	34	37	32	NS†
Sausages	34	29	34	28	37	29	33	30	33	29	<0·0001†
Processed meat	14	15	13	14	14	15	15	16	14	15	0·011†
Milk and dairy	844	421	836	405	828	422	861	408	852	445	NS
Icecream	22	27	22	30	32	31	18	23	14	19	<0·0001†
Sweets and chocolate	30	30	30	31	29	30	30	29	31	30	NS†
Beverages	818	459	808	467	827	470	835	451	803	446	NS†
Tea	137	170	130	170	120	156	151	175	150	176	<0·0001†
Coffee	199	212	193	218	203	213	198	206	204	212	NS†
Soft drinks	108	186	107	178	125	207	107	195	92	159	<0·0001†
Fruit juice	261	266	268	273	260	267	261	263	256	260	NS†
Berry-based drinks	113	207	111	207	119	216	119	204	102	199	NS†

*Seasons are defined as spring, March–May; summer, June–August; autumn, September–November; and winter, December–February.
†Difference between seasons tested with non-parametric Kruskal–Wallis test.

Table 4 Mean daily nutrient intakes from foods and supplements for pregnant Finnish women by season*

	Season										
	Whole year (*n* 4880)		Spring (*n* 1285)		Summer (*n* 1306)		Autumn (*n* 1081)		Winter (*n* 1208)		
Nutrient	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*P*
Energy (MJ/d)	11·4	3·36	11·4	3·42	11·4	3·33	11·6	3·29	11·4	3·39	NS
Protein (E%/d)	16·4	2·22	16·4	2·23	16·4	2·18	16·4	2·24	16·5	2·23	NS
Carbohydrate (E%/d)	49·7	5·11	49·9	5·03	49·3	5·27	49·8	5·10	49·7	5·02	0·025
Sucrose (E%/d)	11·6	3·73	11·7	3·82	11·7	3·82	11·6	3·65	11·5	3·58	NS
Fibre (g/MJ/d)	2·43	0·70	2·43	0·69	2·39	0·70	2·46	0·73	2·46	0·69	0·019
Total fat (E%/d)	33·8	4·75	33·6	4·69	34·2	4·85	33·7	4·75	33·7	4·69	0·0023
SAFA (E%/d)	14·4	2·86	14·3	2·88	14·5	2·89	14·4	2·85	14·3	2·82	NS
MUFA (E%/d)	11·7	2·00	11·6	1·91	11·9	2·11	11·7	1·98	11·7	1·97	0·001
PUFA (E%/d)	4·64	1·07	4·59	1·02	4·69	1·15	4·60	1·05	4·68	1·06	NS
Vitamin A (μg/MJ/d)	111·0	63·5	108·0	59·9	108·0	60·2	115·0	69·8	114·0	64·4	0·0145
β-Carotene (μg/MJ/d)	404·0	343·4	394·0	314·9	394·0	293·6	427·0	415·0	405·0	349·9	NS
Vitamin D (μg/MJ/d)	0·61	0·35	0·64	0·38	0·62	0·34	0·57	0·33	0·62	0·33	<0·0001†
Vitamin E (mg/MJ/d)	1·10	0·72	1·10	1·02	1·12	0·48	1·10	0·86	1·08	0·32	0·0002†
Vitamin B_6 (mg/MJ/d)	0·33	0·60	0·36	0·96	0·31	0·33	0·31	0·27	0·34	0·53	NS†
Folate (μg/MJ/d)	36·4	11·7	36·7	12·6	35·9	12·1	36·2	10·8	37·0	11·1	0·0073
Vitamin B_{12} (μg/MJ/d)	1·06	2·61	1·21	4·24	0·96	1·67	1·04	1·71	1·05	1·64	NS†
Vitamin C (mg/MJ/d)	19·5	12·1	20·0	12·7	18·8	11·3	19·3	12·6	20·0	11·7	0·0259
Calcium (mg/MJ/d)	169·0	44·1	169·0	45·5	166·0	43·4	169·0	42·7	170·0	44·4	NS
Iron (mg/MJ/d)	3·92	3·22	3·74	3·10	4·12	3·30	3·94	3·21	3·87	3·27	0·0024†
Thiamin (mg/MJ/d)	0·26	0·27	0·27	0·37	0·25	0·23	0·26	0·21	0·26	0·24	NS†
Riboflavin (mg/MJ/d)	0·34	0·26	0·35	0·33	0·33	0·24	0·34	0·24	0·34	0·23	NS†

*Seasons are defined as spring, March–May; summer, June–August; autumn, September–November; and winter, December–February.
†Difference between seasons tested with non-parametric Kruskal–Wallis test.

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Survey[21], which documented a general improvement in the dietary habits of the adult Finnish population as a whole. We found that over the study period, the mean daily energy derived from fat decreased, while there were increases in the energy derived from protein and carbohydrate, and in the intake of dietary fibre. Our results also illustrate a considerable leap in vitamin D intake from food sources between the 2001–2002 and 2003–2004 year-groups, reflecting the effect of fortification of liquid milk products with vitamin D[15]. Seasonal differences in food consumption were accompanied by corresponding variations in the intake of nutrients. Even with the inclusion of intakes from supplementation, the mean intakes of vitamin D and folate fell below the recommended levels throughout the year[22].

The main strength of the present study was the use of a large, population-based cohort. Given that virtually all childbirths in Finland take place in public hospitals, the study sample was likely to be a close representation of the overall population of pregnant Finnish women within the university hospital areas in the present study[23]. A further strength of the study was the use of an FFQ that was designed specifically for the DIPP Nutrition Study and found to rank participants reasonably well according to their dietary intakes[17].

However, the study is not without its limitations, and these were related mostly to the use of the FFQ method and its potential for information bias. Since the mothers filled in the FFQ retrospectively, the influence of current diet is a possible source of bias[24]. However, when the FFQ used in our study was validated, it was found that FFQ and food records completed 1 month after delivery, agreed well with those completed during the 8th month of pregnancy, indicating that the influence of current diet on our results was likely to be minimal. Another bias may be caused by seasonal reporting which has been shown to afflict the use FFQ[25]. We also found that our study sample was biased towards women with higher education and a smaller number of children (Table 1). These respondents are likely to be more health conscious than the non-respondents, which may have had some bearing on our results.

The differences in food consumption between seasons, observed in our study, are most likely a result of cultural habits and seasonal changes in the availability and price levels of fresh food products in Finland. Our observations of seasonal patterns in the consumption of fresh food products are in accordance with the annual purchase reports on vegetable consumption in Finland[26]. In the autumn and winter, roots and tubers were popular, whereas leafy vegetables and vegetable fruits formed a larger part of the diet in the spring and summer, and citrus fruits were favoured in the winter. Consumption of staple foods, such as potatoes, was found to be fairly constant over the seasons, as has been reported in earlier studies[27]. Although overall fruit and berry consumption was lowest in the summer, the abundant supply of strawberries in the summer leads to their consumption, overshadowing that of other berries, the effect of which can be seen in our study. The long Finnish summer holiday season and the resulting change in dietary behaviour are likely explanations to the increased consumption of sausages (commonly barbequed), ice cream and soft drinks during the summer. The holiday season has been identified as influencing dietary habits and causing small increases in body weight[28]. Higher consumption of tea in the autumn and winter is a likely reflection of the adjustment to the cold season.

In line with most studies to date, we did not observe significant seasonal differences in daily energy intake[29–31]. Neither did we observe significant seasonal fluctuations in the proportion of energy derived from protein, which is in agreement with findings from previous reports[29,32–34]. Earlier studies have, however, reported seasonal differences in the intake of fat, with the highest intakes occurring during winter[30,31], spring[12,31] and autumn[32]. We observed that the proportion of energy derived from total fat exhibited seasonal changes was highest in the summer, this being the result of the holiday season and the dietary changes mentioned earlier. We further observed that the intake of dietary fibre was lowest in the summer, when consumption of cereals, and the overall consumption of fruits and berries was at its lowest as well. Lower intakes of dietary fibre in the summer have also been reported in previous studies[12,31].

Our data showed the lowest folate intakes in the summer, with mean intake levels falling below the recommendation during pregnancy throughout the year[22]. This confirms earlier findings of low folate intake in a large proportion of pregnant Finnish women[13,14] despite the recommendations to increase the consumption of folate-rich foods during pregnancy[35]. At this time, there are no folate supplementation recommendations for pregnant women in Finland, except in cases of poor dietary habits, certain illnesses or neural tube defects in the family. However, our results indicate a need to look for stronger and more persuasive ways to increase folate intake during pregnancy to ensure adequate intake levels for all pregnant women.

Although we did observe an improvement in the intake levels of vitamin D from food sources over the study years, this cohort's mean intake in 2003–2004 still did not reach the target recommendation of 10 μg per day (400 IU)[22]. Because of the increasing evidence of the importance of vitamin D in the prevention of many chronic diseases[36–38], there is a clear need to find ways to promote vitamin D supplementation. Past studies have shown that only around 30–40 % of pregnant Finnish women adhere to the vitamin D supplement recommendation[13,14]. Although dietary means alone are likely to be insufficient to tackle the inadequate intakes, a diet comprised of more fish and margarines would be a step towards the right direction. Recent discussions have

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urged a revision of both vitamin D fortification policies and supplement recommendations[39,40].

In conclusion, our findings indicated positive changes in the diet of pregnant Finnish women over the 7-year study period. We did, however, identify areas needing further improvement; in particular, the type of fat in the diet and the intake levels of folate and vitamin D. To achieve the standards set by the Finnish nutrition recommendations, there is a need to cut down the intake of saturated fat while increasing the intake of PUFA[22]. There is also a call for increasing the intake of energy derived from carbohydrate while cutting down the intake of sucrose, which can be achieved by adding more unrefined cereals, vegetables, fruits, berries and potatoes into the diet. High intake of the above-mentioned foods is a step towards an overall healthier diet and will in addition help to reduce the intake of saturated fat and add more dietary fibre in the diet.

Since optimising the nutritional status of pregnant women is extremely beneficial for both the mother and the child, the health-care sector can only gain from paying special attention to maternal nutrition. Nutritional counselling by health-care workers through the child health-care clinics has limited time to reach the larger population of women of reproductive age, and new ways are needed to communicate the importance of pregnancy diet. In this modern age, the Internet offers an efficient way to reach a large part of the target group, especially in Finland where Internet usage is high and discussion groups on some 'mother & baby' magazine sites are the most popular in the country.

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