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Fruit and Vegetable Intake and Risk of Upper Respiratory Tract Infection in Pregnant Women

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Abstract

Objective—The study evaluated the association between fruit and vegetable intake and upper respiratory infection (URI) incidence during pregnancy.

Design—In a cohort of 1034 North American women, each subject was asked retrospectively about their fruit and vegetable intake during the six months before the pregnancy and their occurrences of URI during the first half of pregnancy. Multivariable-adjusted hazards ratios (HRs) were calculated with Cox proportional hazards models.

Results—The adjusted HRs of URI for women in the highest quartile (median = 8.54 servings/day) vs. lowest quartile (median = 1.91 servings/day) of total fruit and vegetable intake were 0.74 (95% confidence interval [CI] = 0.53-1.05) for the 5-month follow-up period and 0.61 (95% CI = 0.39-0.97) for the 3-month follow-up period, respectively. A dose-related reduction of URI risk according to the quartiles of intake was found in the 3-month (p for trend = 0.03) but not the 5-month follow-up. No association was found between either fruit or vegetable intake alone in relation to the 5-month or the 3-month risk of URI.

Conclusions—Women who consume more fruits and vegetables have a moderate reduction in risk of URI during pregnancy, and this benefit appears to be derived from both fruits and vegetables, instead of either alone.

Every year about 25 million people in the United States visit their family doctors with uncomplicated upper respiratory infections (URIs) (1), and pregnant women are no exception. As one of the most frequently reported maternal disorders during pregnancy, URI ranging from the common cold, generally mild and self-limited, to more severe and even life-threatening pneumonia (complicated URI), may adversely affect the fetus in a direct or indirect way. For example, shorter gestational age at delivery and higher rate of preterm birth were found to be related with complicated URIs during pregnancy(2). Some congenital abnormalities such as anencephaly and cleft lip were also reported to be associated with maternal common colds (3-5).

Eating five servings of fruits and vegetables each day is commonly recommended to reduce the susceptibility to URI(6), and women are advised to eat more fruits and vegetables during pregnancy(7), since fruits and vegetables are rich dietary sources of a variety of nutrients and many biologically active compounds. However, no study has been conducted to evaluate the association between fruit and vegetable intake and URI incidence during pregnancy. We therefore examined this relationship in a retrospective cohort of pregnant women followed for 5 months since their last menstrual period (LMP).

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Methods

Study Population

Study women were the mothers who had participated in a case-control study of children with congenital craniofacial malformations, which has been described elsewhere. Briefly, in the previous study, children of 3 years of age or younger with idiopathic hemifacial microsomia, facial asymmetry, Goldenhar syndrome, or unilateral anotia/microtia were identified from craniofacial centers in 26 cities across the United States and Canada from 1996 to 2002. Control children, matched to cases by age at ascertainment, were identified from the case's pediatrician's (or a similar) practice (8,9). Mothers of cases and controls were interviewed by telephone about demographic and reproductive factors, pregnancy exposures and behaviors. All 1163 mothers (of 279 cases and 884 controls) served as the eligible cohort of pregnant women for the current study. No protocol approval was need for this study since the data were derived from an existing data resource, which was approved by the Boston University Institutional Review Board.

Dietary Intake Assessment

During the retrospective interview, women were administered the National Cancer Institute (NCI)-Block 60-item food frequency questionnaire (FFQ), which is a semi-quantitative FFQ designed to provide estimates of usual and customary dietary intake. Women were instructed to report their average intakes for the six month period before they became pregnant. They were read each food item and what constituted a medium serving (e.g., orange juice – a 6 ounce glass; broccoli - ½ cup) and were asked how often, on average, they consumed it. There were up to nine possible responses, which ranged from never to four or more times per day. Subjects were also able to indicate if their usual serving was smaller or larger than the stated medium serving. This dietary questionnaire contained eight fruit and eight vegetable food items. For each participant, we estimated the total daily servings of both fruits and vegetables, and fruits and vegetables separately(10). Calories per 100 grams of each food item (from the USDA SR19 database(11)) were adjusted for serving size (0.5 for small; 1.0 for medium; 1.5 for large) and multiplied by the number of average daily servings; total average daily calories was the sum across all food items. Women were grouped into equal-sized quartiles based on the distribution of daily fruit and vegetable intake. Quartiles were used to avoid assumptions about the shape of the dose-response relationship.

Upper Respiratory Infection Definition

Women were asked "Did you have any upper respiratory infections, such as a cold, flu, or sinusitis" and if so, "when did it began and for how long?" For this study, URI was defined as the first reported URI episode, which occurred between the LMP and the end of fifth month after the LMP. Reported occurrences of asthma or allergy were not considered as URIs. Women who reported a URI were also asked whether or not they had had any of a list of symptoms. The start date, duration, and symptoms for each episode of URI were reviewed by hand to determine whether they were a 'probable' or 'possible' URI. URI status was determined using the following criteria:

- Probable URIs: Report of typical symptoms of URI, including nasal stuffiness or congestion, headache, sore throat, cough, achiness and fever, with a duration of no more than 6 weeks.
- Possible URIs: Report of URI, but either a greater than 6 week duration or no typical symptoms of URI.

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Statistical Analysis

Among the 1163 women, we excluded those with an incomplete FFQ (n=88) or those whose estimated daily energy intake outside the plausible range of 2510 to 14644 kJ per day (600 to 3500 kcal per day, n=41)(12), leaving 1034 women for analyses. We used Cox proportional hazards (Cox PH) models to generate hazard ratios (HRs) as estimates of relative risks of URI. Each eligible woman contributed person-time from her LMP to the onset of the first URI episode since the LMP, or the end of the fifth gestational month (after which information on URI was not collected), whichever came first. Within the 5-month period, we recorded a total of 347 URI episodes with a known start date. An additional 44 URI episodes with an unknown start date were excluded from Cox PH model analyses.

Covariables

We categorized each woman's sociodemographic data, including age at pregnancy (13-19, 20-29, and 30-45 years), race (White/Non-White), body mass index (BMI, the weight in kilograms divided by the square of the height in meters, classified as <18.5, 18.5-24.9, 25.0-29.9, ≥ 30 kg/m^2, and unknown), marital status (married, single with partner, and single without partner), employment (yes/no), years of education (≤12, 13-15, and ≥16 years), and annual family income (≤$25000, $25001-$65000, >$65000, and unknown). We also examined lifestyle information, such as multivitamin supplement intake between LMP and the end of the 5th month of pregnancy (never use, 1-2 months use, and ≥ 3 months use), daily calorie intake (2510-6276, 6277-10460, 10461-14644 kJ/day [corresponding to 600-1500, 1501-2500, 2501-3500 kcal/day]), smoking (never/ever/current), and drinking (never/ever/current). In addition, each woman was asked whether pregnancy was planned (yes/no) and the number of previous live births occurring within 5 years, which was used as a proxy for the number of children in household (counted as 0, 1, and ≥2). Based on the month of LMP we assigned a season for each participant (Mar-May, Jun-Aug, Sep-Nov, and Dec-Feb).

All distributions of these covariables were examined according to the quartiles of intake. Using the lowest quartile as the reference group, we estimated the crude and adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) of URI for each higher quartile of intake. We also assessed linear relationships by using ordinal rather than indicator variables for quartiles of fruit and vegetable intake. We judged any covariable to be a potential confounder if it changed, by at least 5%, the coefficient for fruit and vegetable intake and risk of URI when added to the model. Thus, race and daily calorie intake were deemed potential confounders. We repeated these methods with either fruit or vegetable intake alone in relation to the URI incidence. In addition, maternal age was also controlled as a potential confounder in all multivariate models.

We tested the assumption of proportionality of hazards for the outcome of URI by adding to the Cox model interaction terms of follow-up time with each fruit and vegetable intake indicator variable. The proportional hazards assumption was valid in these data. Since women may change their diet after they realize they are pregnant, fruit and vegetable intake in the six months before pregnancy might be most relevant in relation to URI occurrences in the first trimester. Therefore, we also evaluated the associations between intake and the 3-month risk of URI, using the same methods. There were 188 URI episodes recorded in the first 3-month follow-up.

All analyses were performed using Statistical Analysis Systems statistical software package version 9.1 (SAS Institute, Cary, NC, USA).

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Results

Table 1 shows the medians and ranges of each quartile of total fruit and vegetable intake and of either fruit or vegetable intake alone. The median intake of total fruits and vegetables was 4.62 with a range from 0.07 to 29.04 servings per day for all women. The median intakes of either fruit or vegetables alone were 2.33 (range 0-22.51) and 2.01 (range 0-13.46) servings per day, respectively.

Table 2 presents characteristics of the 1034 pregnant women according to fruit and vegetable intake quartiles. The participants ranged in age from 13 to 45 years; their mean age was 28 years. Generally, women who consumed more fruits and vegetables were older, were more likely to be non-Whites (including Hispanic), had higher daily total energy intake, had higher education level (≥16 years), had higher family income (>$65,000), were less likely to be single, and reported less smoking and drinking. It should be noted that the distributions for most of the above characteristics did not present a linear trend with increasing quartiles. There was no apparent difference in BMI, employment, number of children aged 5 years or younger, multivitamin intake, planned pregnancy, and birth outcome across fruit and vegetable intake quartiles. Moreover, there was no marked relationship between seasonality and quartile of fruit and vegetable intake.

As table 3 indicates, consumption of fruits and vegetables was inversely associated with the 5-month risk of URI in pregnancy. Women in the highest quartile of fruit and vegetable intake were 26% less likely to have a URI, relative to those in the lowest quartile (HR= 0.74; 95% CI 0.53-1.05), after controlling for age, race and calorie intake. Although there seemed to be a decreasing linear trend in the 5-month risk of URI according to quartiles of fruit and vegetable intake, it was not significant (p for trend = 0.11). Neither fruit nor vegetable intake alone was found to be associated with the 5-month risk of URI.

The patterns observed for total fruit and vegetable intake and either fruit or vegetable intake alone in relation to the 3-month risk of URI were consistent with those when assessing the 5-month risk of URI (table 4). Women in the highest quartile of fruit and vegetable intake had a stronger reduced 3-month risk (adjusted HR=0.61, 95% CI 0.39-0.97) than the 5-month risk of URI. Moreover, there was a significant decreasing linear trend for the 3-month risk of URI with consumption of fruits and vegetables (p for trend = 0.03).

We conducted two additional sub-analyses. In order to assess the accuracy of URI, we excluded the 29 women with possible URIs and found that HRs were similar for each measure of intake in relation to both the 5-month and 3-month risks of URI (data not shown). We also restricted the analyses to the subgroup of 780 women with normal infants and found similar risk estimates as those observed for all women (data not shown).

Discussion

Our findings suggest that high consumption of both fruits and vegetables is associated with a moderate reduction in risk of URI among pregnant women. However, no association was found between either fruit or vegetable intake alone and risk of URI. For total fruits and vegetables, there was a dose-related decline in URI incidence according to the quartiles of their intake, especially in the first 3-month after the LMP.

To our knowledge, this is the first study to investigate fruit and vegetable intake in relation to the occurrence of URIs among pregnant women. Frequent intake of fruits and vegetables was reported in association with fewer episodes of acute respiratory infections in the Australian general population(13) and with a lower incidence of influenza-like symptoms in Japanese children(14). Whole fruits and vegetables provide a natural balance of multiple nutrients and

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bioactive compounds which may improve host immune function against exogenous bacterial or viral invasion in a complementary, combined or synergistic manner(15) that could account for the protective effect observed from high consumption of both fruits and vegetables in our study.

There are numerous studies, including clinical trials, on single nutrients such as vitamin C and zinc in relation to the common cold. However, none has been found to effectively prevent the common cold, though the combination of vitamin C and zinc may reduce the duration of a URI (16). Two large population-based studies also reported no association between vitamin C, vitamin E, beta-carotene, or zinc and risk of common cold(17,18), but both of them estimated intake based on diet and use of supplements. Since accurate estimation of nutrients depends on multiple factors, such as the precision of the nutrient assignments and the exact nature of the quantitation method for each food item(19), rather than food item or food group measurement, investigation of single nutrient exposure is more likely to suffer from misclassification bias. We evaluated collected information on dietary intake of fruits and vegetables as a whole food and thus avoided that potential bias to the extent possible.

There are several possible explanations for why the observed reduction in URI risk was confined to fruit and vegetables combined and not either type of food alone. One possibility could be that consumption levels of either fruits or vegetables were too low for a protective effect against URIs in pregnancy. Pregnant women, whose bodies are in special physiological period involving enormous hormonal, circulatory, and mechanical alternations, may require more fruits and vegetables than usual. In this study, the median consumption of overall fruits and vegetables in the highest quartile of intake was 8.54 servings/day compared to 5.09 per day of fruits and 4.00 per day of vegetables. While these levels are higher than the recommended minimum of 2 servings for fruit and 4 servings for vegetables per day for pregnant women(7), they may be insufficient for some outcomes, such as effective immunity.

Another possible explanation is that either fruit or vegetable intake alone does not provide an optimal protection against URIs unless they are consumed together. Though fruits and vegetables share some common essential nutrients, they vary greatly for many nutrients, such as more vitamin C in fruit but more carotenoids and folate in vegetables. The newly released Food Guide Pyramid underscores the importance of a healthy diet including a variety of both fruits and vegetables for pregnant women(20), not just one or two of them, taking into account the potential complementary effects between them. The NCI-Block 60-item FFQ has been widely used in many large, multifaceted epidemiological studies and national surveys. The accuracy and comprehensiveness of this questionnaire have been well documented and validated(21,22). Median daily servings for each quartile of fruit and vegetable intake in our study were very close to the reported intake in American women from the National Institutes of Health-AARP Diet and Health Study(23), except for a slightly higher median daily serving in the fourth quartile in our study (8.5 vs. 7.3 servings/day). Also, to improve accuracy of the FFQ data, we excluded women with total energy intake beyond plausible ranges. Women were interviewed on average 8 months, but up to 36 months, after delivery, which means they were asked to recall pre-pregnancy dietary intake that was on average 20 months, but as many as 48 months, earlier. Hence, the accuracy of exposure measurement depended on recall of diet and the assumption that these women changed little in their main dietary habits, a challenge for all self-reports of diet(19). As an indirect validation assessment, we conducted a sub-analysis of those women who were interviewed within one year of their pregnancy to see if the finding remained when the recall interval was shorter and presumably more reliable. We found no material difference in risk estimates for this subgroup.

Misclassification of exposure may also exist because the data collected on dietary intake may not represent the most relevant time frame for URI occurrence in pregnancy. For example, if

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women who rarely ate fruits and vegetables before pregnancy changed their diet to include more fruits and vegetables once they realized they were pregnant, the diet information collected during six months prior to the LMP would not provide an accurate assessment and misclassification would attenuate the association between fruit and vegetable intake and URI incidence. When we shortened the follow-up period from the first 5 lunar months to the first 3 months, a stronger decreased risk of URI was observed for women in the highest quartile of fruit and vegetable intake, suggesting that such misclassification may indeed be present. In addition, the stronger HRs for the more recent follow up period lends some credence to the fruit and vegetable – URI association.

To ensure the accuracy of self-reported URIs, all symptoms and duration for each URI episode were reviewed by hand. When we analyzed these data based on probable URIs we found similar results with all URIs, providing reassurance that self-reported URIs were satisfactory. Despite this, there is undoubtedly mis-reporting of URIs because other conditions, such as allergies, have URI-like symptoms. Furthermore, our study population comprised mothers both with non-malformed and malformed children in which URIs were reported by more mothers in the latter group. We could not exclude the possibility that mothers with malformed children over-reported or mothers of non-malformed children under-reported URI episodes. However, after we restricted our study subjects to mothers with non-malformed children, there was little change in the relationship between fruit and vegetable intake and risk of URI.

In this study, we collected information on numerous covariables, such as socioeconomic, lifestyle and seasonal variables, to control for potential confounders in our study. We did not, however, put all of them in the multivariate model because a majority of covariables had even distributions over quartiles of fruit and vegetable intake. More importantly, they did not change the association between fruit and vegetable intake and URI incidence by more than 5%. Residual confounding is possible by other covariables not included in models or those we did not collect, such as physical activity. It is noteworthy that of all covariables we examined, only race was significantly associated with URI incidence: White women had an increased risk of URI. They also ate fewer fruits and vegetables, causing slight confounding of HRs.

In conclusion, our results suggest that high intake of fruits and vegetables might moderately reduce URI risk among pregnant women. It appears that these beneficial effects are dependent on intake of both fruits and vegetables, instead of either alone. If diets enriched with fruits and vegetables truly have a preventive or protective effect against URIs in pregnant women, the public health implications may be considerable given that URIs as well as treatments for URI symptoms may affect fetal development(5,9,24). However, the limitations discussed above make it necessary to replicate our findings through studies specially designed to address this question.

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References

1. Adams PF, Hendershot GE, Marano MA, Centers for Disease Control and Prevention/National Center for Health Statistics. Current estimates from the National Health Interview Survey, 1996. Vital Health Stat 1999;10(No 200):1–203.

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2. Bánhidy F, Acs N, Puhó EH, Czeizel AE. Maternal acute respiratory infectious diseases during pregnancy and birth outcomes. Eur J Epidemiol 2008;23:29–35. [PubMed: 18027089]
3. Kurppa K, Holmberg PC, Kuosma E, Aro T, Saxén L. Anencephaly and maternal common cold. Teratology 1991;44:51–55. [PubMed: 1957263]
4. Zhang J, Cai WW. Association of the common cold in the first trimester of pregnancy with birth defects. Pediatrics 1993;92:559–563. [PubMed: 8414827]
5. Acs N, Bánhidy F, Horváth-Puhó E, Czeizel AE. Population-based casecontrol study of the common cold during pregnancy and congenital abnormalities. Eur J Epidemiol 2006;21:65–75. [PubMed: 16450209]
6. Meneghetti, A. Upper respiratory tract infection. 2007. http://www.emedicine.com/med/topic2339.htm
7. Ortega RM. Dietary guidelines for pregnant women. Public Health Nutr 2001;4:1343–1346. [PubMed: 11918477]
8. Werler MM, Sheehan JE, Hayes C, Padwa BL, Mitchell AA, Mulliken JB. Demographic and reproductive factors associated with hemifacial microsomia. Cleft Palate Craniofac J 2004;41:494–450. [PubMed: 15352870]
9. Werler MM, Sheehan JE, Hayes C, Mitchell AA, Mulliken JB. Vasoactive exposures, vascular events, and hemifacial microsomia. Birth Defects Res A Clin Mol Teratol 2004;70:389–395. [PubMed: 15211707]
10. National Cancer Institute. Fruit & vegetable screeners: scoring the all-day screener. 2007. http://riskfactor.cancer.gov/diet/screeners/fruitveg/scoring/allday.html
11. U.S. Department of Agriculture, Agriculture Research Service. USDA National Nutrient Database for Standard Reference, Release 19. 2006. http://www.nal.usda.gov/fnic/foodcomp/Data/SR19/sr19_doc.pdf
12. Hung HC, Joshipura KJ, Jiang R, Hu FB, Hunter D, Smith-Warner SA, Colditz GA, Rosner B, Spiegelman D, Willett WC. Fruit and vegetable intake and risk of major chronic disease. J Natl Cancer Inst 2004;96:1577–1584. [PubMed: 15523086]
13. Douglas RM, Muirhead TC. Fruit, vegetables and acute respiratory infections. Med J Aust 1983;1:502–503. [PubMed: 6843441]
14. Hirota Y, Takeshita S, Ide S, Kataoka K, Ohkubo A, Fukuyoshi S, Takahashi K, Hirohata T, Kaji M. Various factors associated with the manifestation of influenza-like illness. Int J Epidemiol 1992;21:574–582. [PubMed: 1634321]
15. Lampe JW. Health effects of vegetables and fruit: assessing mechanisms of action in human experimental studies. Am J Clin Nutr 1999;70:475S–490S. [PubMed: 10479220]
16. Jaber R. Respiratory and allergic diseases: from upper respiratory tract infections to asthma. Prim Care 2002;29:231–261. [PubMed: 12391710]
17. Takkouche B, Regueira-Méndez C, García-Closas R, Figueiras A, Gestal-Otero JJ. Intake of vitamin C and zinc and risk of common cold: a cohort study. Epidemiology 2002;13:38–44. [PubMed: 11805584]
18. Hemilä H, Kaprio J, Albanes D, Heinonen OP, Virtamo J. Vitamin C, vitamin E, and beta-carotene in relation to common cold incidence in male smokers. Epidemiology 2002;13:32–37. [PubMed: 11805583]
19. Block G, Hartman AM, Dresser CM, Carroll MD, Gannon J, Gardner L. A data-based approach to diet questionnaire design and testing. Am J Epidemiol 1986;124:453–469. [PubMed: 3740045]
20. United States Department of Agriculture. MyPyramid for pregnancy & breastfeeding. 2008. http://www.mypyramid.gov/mypyramidmoms/pregnancy_nutrition_needs.html
21. Block G, Hartman AM, Naughton D. A reduced dietary questionnaire: development and validation. Epidemiology 1990;1:58–64. [PubMed: 2081241]
22. Potischman N, Carroll RJ, Iturria SJ, Mittl B, Curtin J, Thompson FE, Brinton LA. Comparison of the 60- and 100-item NCI-block questionnaires with validation data. Nutr Cancer 1999;34:70–75. [PubMed: 10453444]
23. Thompson FE, Kipnis V, Subar AF, Krebs-Smith SM, Kahle LL, Midthune D, Potischman N, Schatzkin A. Evaluation of 2 brief instruments and a foodfrequency questionnaire to estimate daily

number of servings of fruit and vegetables. Am J Clin Nutr 2000;71:1503–1510. [PubMed: 10837291]

24. Werler MM. Teratogen update: pseudoephedrine. Birth Defects Res A Clin Mol Teratol 2006;76:445–452. [PubMed: 16933214]

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Table1

Quartiles of fruit and vegetable intake (servings/day, N = 1034), 1996-2002

Food Group	**1st Quartile (n = 259)**	**2nd Quartile (n = 259)**	**3rd Quartile (n = 258)**	**4th Quartile (n = 258)**
Fruits and vegetables				
Median	1.91	3.71	5.59	8.54
Range	0.07-2.89	2.90-4.62	4.63-6.70	6.71-29.04
Fruits alone				
Median	0.68	1.80	3.02	5.09
Range	0-1.30	1.31-2.32	2.33-3.86	3.87-22.51
Vegetables alone				
Median	0.73	1.53	2.47	4.00
Range	0-1.11	1.12-2.00	2.01-3.03	3.04-13.46

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Table 2

Characteristics of pregnant women according to quartiles of fruit and vegetable intake (N = 1034), 1996-2002

	1st Quartile (n = 259) No. (%)	2nd Quartile (n = 259) No. (%)	3rd Quartile (n = 258) No. (%)	4th Quartile (n = 258) No. (%)
Age (years)				
13-19	25 (9.6)	18 (6.9)	22 (8.5)	21 (8.1)
20-29	140 (54.1)	125 (48.3)	106 (41.1)	114 (44.2)
30-45	94 (36.3)	116 (44.8)	130 (50.4)	123 (47.7)
Race				
White	194 (74.9)	178 (68.7)	160 (62.0)	132 (51.2)
Non-White	65 (25.1)	81 (31.3)	98 (38.0)	126 (48.8)
Body mass index (kg/m ^{2})				
<18.5	16 (6.2)	10 (3.9)	11 (4.3)	10 (3.9)
18.5-24.9	149 (57.5)	154 (59.5)	166 (64.3)	164 (63.6)
25.0-29.9	50 (19.3)	55 (21.2)	46 (17.8)	50 (19.4)
30+	37 (14.3)	34 (13.1)	25 (9.7)	25 (9.7)
Unknown	7 (2.7)	6 (2.3)	10 (3.9)	9 (3.5)
Employment*				
Yes	172 (66.4)	179 (69.4)	167 (64.7)	156 (60.5)
No	87 (33.6)	79 (30.6)	91 (35.3)	102 (39.5)
Marital status *				
Married	179 (69.1)	190 (73.6)	200 (77.5)	181 (70.2)
Single with partner	42 (16.2)	40 (15.5)	37 (14.3)	53 (20.5)
Single	38 (14.7)	28 (10.9)	21 (8.1)	24 (9.3)
Education (years)				
≤12	114 (44.0)	87 (33.6)	97 (37.6)	114 (44.2)
13-15	71 (27.4)	53 (20.5)	65 (25.2)	51 (19.8)
≥16	74 (28.6)	119 (45.9)	96 (37.2)	93 (36.0)
Family income* ($)				
≤25,000	77 (29.7)	48 (18.5)	60 (23.4)	74 (28.7)
25,001-65,000	102 (39.4)	106 (40.9)	94 (36.6)	74 (28.7)
>65,000	62 (23.9)	86 (33.2)	78 (30.4)	79 (30.6)
Unknown	18 (7.0)	19 (7.3)	25 (9.7)	31 (12.0)
Number of children†				
0	143 (55.2)	142 (54.8)	139 (53.9)	141 (54.6)
1	93 (35.9)	95 (36.7)	92 (35.7)	92 (35.7)
≥2	23 (8.9)	22 (8.5)	27 (10.5)	25 (9.7)
Planned pregnancy *				
Yes	131 (50.6)	143 (55.4)	140 (54.3)	148 (57.4)
No	128 (49.4)	115 (44.6)	118 (45.7)	110 (42.6)
Birth outcome				

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	1st Quartile (n = 259) No. (%)	**2nd Quartile (n = 259) No. (%)**	**3rd Quartile (n = 258) No. (%)**	**4th Quartile (n = 258) No. (%)**
Non-malformed infants	192 (74.1)	205 (79.2)	185 (71.7)	198 (76.7)
Malformed infants	67 (25.9)	54 (20.8)	73 (28.3)	60 (23.3)
Multivitamin intake				
Never use	24 (9.3)	18 (7.0)	16 (6.2)	29 (11.2)
1-2 months use	35 (13.5)	26 (10.0)	23 (8.9)	29 (11.2)
≥ 3 months use	200 (77.2)	215 (83.0)	219 (84.9)	200 (77.5)
Daily calorie (kJ)‡				
2510-6276	161 (62.2)	101 (39.0)	71 (27.5)	28 (10.9)
6277-10460	92 (35.5)	141 (54.4)	151 (58.5)	160 (62.0)
10461-14644	6 (2.3)	17 (6.6)	36 (14.0)	70 (27.1)
Smoking				
Never	158 (61.0)	185 (71.4)	203 (78.7)	200 (77.5)
Ever	30 (11.6)	36 (13.9)	23 (8.9)	27 (10.5)
Current	71 (27.4)	38 (14.7)	32 (12.4)	31 (12.0)
Drinking				
Never	101 (39.0)	95 (36.7)	111 (43.0)	135 (52.3)
Ever	34 (13.1)	31 (12.0)	32 (12.4)	33 (12.8)
Current	124 (47.9)	133 (51.4)	115 (44.6)	90 (34.9)
Season§				
Mar-May	67 (25.9)	52 (20.1)	60 (23.3)	64 (24.8)
Jun -Aug	61 (23.6)	72 (27.8)	57 (22.1)	66 (25.6)
Sep-Nov	71 (27.4)	65 (25.1)	74 (28.7)	69 (26.7)
Dec-Feb	60 (23.2)	70 (27.0)	67 (26.0)	59 (22.9)

*One missing value

†Children aged≤5 years

‡Corresponding to 600-1500, 1501-2500, 2501-3500 kcal

§At the last menstrual period

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Table 3

Five-month risk of upper respiratory infection by fruit and vegetable intake in pregnant women (N = 1034), 1996-2002

Food Group	Crude HR	95% CI	Adjusted HR*	95% CI*	Test for trend *P*
Fruits and Vegetables					
1stQuartile	1.00		1.00		
2ndQuartile	0.91	0.68-1.21	0.90	0.67-1.21	0.11
3rdQuartile	0.88	0.66-1.18	0.89	0.65-1.21	
4thQuartile	0.73	0.54-0.99	0.74	0.53-1.05	
Fruits alone					
1stQuartile	1.00		1.00		
2ndQuartile	1.02	0.77-1.36	1.03	0.77-1.38	0.18
3rdQuartile	0.82	0.61-1.11	0.83	0.61-1.13	
4thQuartile	0.80	0.60-1.09	0.85	0.60-1.20	
Vegetables alone					
1stQuartile	1.00		1.00		
2ndQuartile	1.12	0.82-1.51	1.11	0.81-1.51	0.33
3rdQuartile	1.13	0.84-1.52	1.15	0.84-1.58	
4thQuartile	1.10	0.81-1.49	1.17	0.84-1.64	

HR – hazard ratio; CI – confidence interval.

* For fruit and vegetable, adjusted for age, race and calorie; for fruit alone, adjusted for age, race, calorie and vegetable; for vegetable alone, adjusted for age, race, calorie and fruit

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Table 4

Three-month risk of upper respiratory infection by fruit and vegetable intake in pregnant women (N = 1034), 1996-2002

Food Group	Crude HR	95% CI	Adjusted HR*	95% CI*	Test for trend *P*
Fruits and vegetables					
1st Quartile	1.00		1.00		
2nd Quartile	0.77	0.52-1.12	0.76	0.52-1.13	0.03
3rd Quartile	0.68	0.46-1.01	0.68	0.44-1.03	
4th Quartile	0.62	0.41-0.93	0.61	0.39-0.97	
Fruits alone					
1st Quartile	1.00		1.00		
2nd Quartile	0.93	0.64-1.37	0.97	0.66-1.44	0.27
3rd Quartile	0.71	0.47-1.07	0.76	0.49-1.17	
4th Quartile	0.77	0.52-1.15	0.84	0.53-1.33	
Vegetables alone					
1st Quartile	1.00		1.00		
2nd Quartile	0.97	0.66-1.44	0.97	0.65-1.46	0.78
3rd Quartile	0.81	0.54-1.22	0.84	0.55-1.30	
4th Quartile	0.93	0.62-1.38	0.98	0.63-1.52	

HR – hazard ratio; CI – confidence interval.

* For fruit and vegetable, adjusted for age, race and calorie; for fruit alone, adjusted for age, race, calorie and vegetable; for vegetable alone, adjusted for age, race, calorie and fruit