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Maternal dietary pattern during pregnancy is not associated with recurrent wheeze in children

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Abstract

Background—The rise in asthma prevalence over the last few decades may be due changes in pre-natal or early life environment including maternal diet during pregnancy. Previous studies have found associations between individual foods or nutrients consumed during pregnancy and asthma or wheeze in children, but these may be confounded by overall dietary pattern.

Objective—To determine if overall maternal dietary pattern during pregnancy is associated with recurrent wheeze in children.

Methods—1376 mother-infant pairs from Project Viva, a longitudinal pre-birth cohort, who had responses for food frequency questionnaires in the 1st and 2nd trimester and outcome data at 3 years of age were included. Multivariable logistic regression was used to look at associations between dietary pattern and the primary outcome of recurrent wheeze at 3 years. Overall dietary pattern was examined using Mediterranean diet score, Alternate Healthy Eating Index modified for pregnancy (AHEI-P), and principal components analysis to look at Western and Prudent diets.

Results—None of these dietary patterns was associated with the primary outcome of recurrent wheeze in children in either the crude or in the multivariable models (multivariable model: OR per one point increase Mediterranean diet 0.98 [95% CI 0.89, 1.08] AHEI-P 1.07 [0.87, 1.30] Prudent 1.02 [0.83, 1.26] Western 0.98 [0.81, 1.19]).

Conclusion—Overall dietary pattern during pregnancy is not associated with recurrent wheeze in this cohort. Maternal intake of individual nutrients may be more important determinants ofoffspring wheeze-associated illness than is dietary pattern.

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Keywords

asthma; dietary pattern; Mediterranean diet; healthy diet; principal components; childhood wheeze; pregnancy

Introduction

Asthma is a serious public health problem[1] with a prevalence of over 300 million worldwide that has been increasing[2] over the last several decades. The rise in prevalence as countries adopt a more urbanized, "Western" lifestyle [1] has led to increasing interest in the role of lifestyle factors such as diet in the development of asthma. This along with increasing recognition of the essential role of the pre-natal and early life environment in development of disease[3] has spawned numerous studies on specific dietary risk factors in pregnancy and asthma outcomes in children.

Several studies have investigated specific nutrients or supplements and different foods or food groups consumed by pregnant women in association with asthma outcomes in their children. Some have found decreased risk of wheeze or asthma in children of pregnant mothers who eat fewer nuts or nut products,[4] eat more fish,[5-7] or more apples.[8] In addition higher maternal intake of anti-oxidants,[9-12] omega-3 poly-unsaturated fatty acids[13] and vitamin D[14, 15] have been associated with decreased risk of recurrent wheeze or asthma. Questions remain about whether these associations are due to the individual nutrients and foods themselves or whether these items are instead markers for an overall dietary pattern[16]. Such studies may not take into account "food synergy": the possibility that there are additive effects of foods or nutrients due to their interactions.[17] Additionally, recommendations on overall dietary pattern are appealing as a cohesive and potentially more simplified public health message as compared to individual foods or nutrients.[18]

A small number of studies have examined the connection between maternal dietary pattern during pregnancy and risk of asthma in children. One study found a decreased risk of asthma outcomes if mothers follow a Mediterranean diet.[19] Another study found a negative association between 'health conscious' diet and early wheeze and asthma in children up to age 7; however after adjusting for confounders this was no longer significant.[20] Other studies have found no significant association.[21] Each of these studies looked at dietary pattern using only one method.

To address the issue of whether previous findings of associations of specific nutrients with wheezing outcomes are due to their presence in a larger dietary pattern, we investigated overall dietary pattern in pregnancy, examined using two diet scores (Mediterranean diet and Alternate Healthy Eating Index modified for pregnancy) and with principal components analysis, to determine whether it is associated with decreased risk of wheeze outcomes in children in the Project Viva cohort, a longitudinal cohort study of risk factors during pregnancy and disease outcomes in offspring. To our knowledge, this is the first U.S.-based study to examine overall dietary pattern in pregnancy in relation to wheeze outcomes in children.

Methods

Study design and subjects

Participants in Project Viva were recruited from 8 obstetric offices of Harvard Vanguard Medical Associates (HVMA), a large multispecialty suburban/urban group practice in eastern Massachusetts. Enrollment occurred between April 1999 and July 2002. Women

with a singleton pregnancy were eligible if their first prenatal visit occurred before 22 weeks gestation, they planned to continue care at HVMA, and were able to answer questionnaires in English. Exclusion criteria included multiple gestation (e.g. twins), the inability to answer questions in English, plans to move out of the area before delivery, and a gestational age greater than 22 completed weeks at the initial prenatal clinical appointment. Additional details of subject recruitment and retention are described elsewhere.[22] After obtaining informed consent, trained research assistants performed in-person interviews after the initial prenatal visit, at an average of 10 weeks gestation, and gave participants questionnaires to complete and return by mail. At a second visit at 26-28 weeks gestation, in-person interviews occurred and questionnaires were again given to participants to return by mail. Newborn measurements were taken and a brief interview occurred within 72 hours of delivery, and questionnaires on infant health were administered at 6 months, 1 year and annually thereafter. Information collected from in-person and self-administered questionnaires included demographic data, information on socioeconomic status and reproductive and medical history. Study protocols were approved by the Institutional Review Boards of all participating institutions and all procedures were in accordance with the ethical standards for human experimentation established by the Declaration of Helsinki.

Of the 2128 infants delivered in Project Viva, we excluded 228 because of missing diet assessment data from the first and second trimesters and an additional 524 who did not have 3-year outcome data, leaving a cohort for analysis of 1376 mother-child pairs.

Compared with 752 participants excluded from the analysis, the 1376 participants included showed a higher proportion of maternal white race (73 v. 55%), college or graduate education (72 v. 51%), and annual household income exceeding $70,000 (65 v. 53%). They had lower mean maternal pre-pregnancy body mass index (BMI) (24.6 v. 25.5 kg/m2) and higher mean offspring birthweight (3.49 v. 3.41 kg) but did not differ on mean gestational age at birth (39.5 v. 39.3 weeks) or child sex (48 v. 49% female). Table E1 in the online repository shows characteristics of 1376 included participants compared to 524 excluded due to lack of 3-year outcome data.

Dietary assessment

Maternal diet assessments at the first and second trimester visits were based on a validated, self-administered, 166-item semi-quantitative food-frequency questionnaire (SFFQ) modified for pregnancy.[23, 24] Since reported intakes were comparable between 1st and 2nd trimester visits we used mean responses across both trimesters to reduce variability of the data.[25]

Using dietary data from the SFFQ on a 9-point scale, we determined a modified version of the Mediterranean diet score[26] as follows. We calculated the median values of intake of food groups associated with a traditional Mediterranean diet. Participants received a point on the scale if they measured above the median consumption for dairy, fish, fruit, legumes, nuts, unsaturated-to-saturated fat ratio, vegetables, and whole grains. They also received a point if intake of red and processed meats was below the median value. Since alcohol consumption is not recommended for pregnant women, and the cohort had a very low prevalence of alcohol consumption, this variable was excluded from the analysis. Thus, Mediterranean diet scores ranged from 0 to 9, with higher scores indicating closer adherence to a Mediterranean-type diet.

We used the Alternate Healthy Eating Index, a measure of diet quality based on modified recommendations from the U.S. Department of Agriculture[27, 28], modified for pregnancy (AHEI-P).[29] This index has been previously shown by our group and others to be associated with lower mortality and disease risk.[28, 29] The score is on a 90 point scale, with each of the

following 9 components contributing 10 possible points each: vegetables, fruit, ratio of white to red meat, fiber, *trans* fat, ratio of polyunsaturated to saturated fatty acids, and folate, calcium, and iron from foods. To improve interpretability of odds ratios, we expressed AHEI-P results as "per 10 points of AHEI-P."

For additional dietary pattern analysis, we used principal component factor analysis to identify patterns of correlated food groups and used an orthogonal rotation procedure to ensure factors themselves were uncorrelated, as described previously.[30] Factors were retained based on eigenvalue, the Scree test and interpretability. The factor score for each pattern was calculated by summing intakes of food groups weighted by their factor loadings.[31] Factor loadings represent correlation coefficients between the food groups and the particular pattern, with positive loadings representing positive correlations and negative loadings representing inverse correlations. Table E2 in the online repository shows the list of foods and their factor loadings for both dietary patterns. Each participant was assigned a factor score for each dietary pattern, calculated by summing intakes of food groups multiplied by their factor loadings. A factor score represents how closely a participant's diet resembles each common dietary pattern identified within the cohort. Factor scores were standardized to having a mean of 0 and standard deviation of 1. To facilitate comparison with prior studies, we calculated dietary pattern scores using key food items previously identified, (Prudent pattern comprising fruits, tomatoes, cabbages, green leafy vegetables, poultry and fish; Western pattern comprising red meat, processed meat, refined grains, snacks, sweets, and desserts, French fries and pizza).

Outcomes

We assessed for wheeze using the following question: "Since your child was born (12m old/ 2 yrs old), has he/she ever had wheezing (or whistling in the chest)?" We defined our primary outcome, recurrent wheeze, as an answer of "yes" to this question on the 3-year questionnaire and additionally on at least the 1st or 2nd year questionnaires. If the child's parent answered yes to wheezing at year 3, but no at years 1 and 2, that child was excluded from the analysis so that the comparison group to those with recurrent wheeze was those children with no wheeze at all in the first three years of life.

Secondary outcomes included parental report of a doctor diagnosis of asthma in the child at any time, eczema, defined as a parental report of a doctor's diagnosis of eczema, lower respiratory infection, defined as parental report of having had bronchiolitis, pneumonia or bronchitis/croup at any time in the 1st, 2nd or 3rd year of life and atopy. Atopy was analyzed in a subset from whom we collected blood specimens at age 3 years (N=721). Based on previous work[32] we defined atopy as either total IgE levels at the 75th percentile or greater of the distribution (≥75.6 IU/mL) or at least 1 detectable allergy-specific IgE level (≥0.35 IU/mL). Allergens tested included dust mite (*Dermatophagoides farina*), cat dander, dog dander, egg white, cockroach, and mold (*Alternaria tenuis*).

Statistical analyses

To ensure approximate linearity, we first examined characteristics of participants by diet scores in categories. Mediterranean diet score was divided into 3 categories (low: 0 to 3, middle: 4 to 5, and high: 6 to 9) and AHEI-P in quartiles. Since the associations of diets by category with recurrent wheeze appeared linear, we included these variables as continuous exposures in regression models.

To assess the multivariate association between maternal diet and the primary outcome of recurrent wheeze, we first performed bivariate analysis of independent variables to determine the covariates associated with the outcome using chi-square test for binary or

categorical variables and logistic regression for continuous variables. Table E3 in the online repository shows baseline characteristics by recurrent wheeze status. We then performed bivariate analysis of independent variables and diet score (with AHEI-P by quartile, Mediterranean diet by category) using chi-square test for binary or categorical variables and ANOVA for continuous variables. Variables that were associated ($p<0.1$) with both the outcome and exposure or that were considered *a priori* to be important confounders were included in the multivariate model. These variables included maternal race/ethnicity, education and pre-pregnancy BMI; household income, >1 child at home <12 years of age, passive smoking exposure; child sex and breastfeeding duration; maternal and paternal history of asthma. For eczema analysis, we substituted parental history of eczema for parental history of asthma. We performed all analyses using SAS version 9.1 (Cary, NC, USA).

Results

Among the 1376 participants, the mean age of the mothers at enrollment was 32.4 years (SD 5) and 73% were white. Most mothers (72%) had at least a college education and most (65%) had a household income of greater than $70,000. Seventeen percent of mothers and 15% of fathers had a history of asthma. Forty-nine percent of the children were female. Mean duration of breast feeding was 6.4 months. Among mothers during pregnancy, mean Mediterranean diet score was 4.57 (SD 2.04, range 0 to 9) and mean AHEI-P score was 61.0 (SD 9.8, range 37.1 to 86.8). Mean Prudent diet was −0.01 (SD 0.98, range −2.36 to 7.73) and Western diet was −0.01 (SD 0.98, range −2.68 to 5.67). Of the children, 18% had recurrent wheeze and 21% had a doctor's diagnosis of asthma by 3 years of age. Thirty-five percent had eczema and 52% had a lower respiratory tract infection at some point during the first 3 years of life. Forty percent had atopy. Other characteristics of the participants are shown in Table I.

In the unadjusted analysis, Mediterranean diet score had a borderline significant association with the primary outcome of recurrent wheeze (OR 0.92 per one point increase in score, [95% CI 0.85, 1.00]). AHEI-P was not significantly associated with recurrent wheeze (OR 0.92 per 10 points, [0.77, 1.08]). When analyzed by category, Mediterranean diet was significantly associated with recurrent wheeze (OR 0.64 for high vs. low [0.43, 0.95]) in the unadjusted analysis. When analyzed by quartile, AHEI-P by quartile did not show an association with recurrent wheeze (OR for highest vs. lowest quartile 0.87 [0.55, 1.37]). We also looked at a graph of the primary outcome versus each diet score as a continuous variable to be sure there was not a threshold value for either score that appeared to be an appropriate cutoff but found no obvious pattern (data not shown). Neither Mediterranean diet nor AHEI-P showed a significant association with the secondary outcomes of doctor's diagnosis of asthma, doctor's diagnosis of eczema, or lower respiratory tract infections in the unadjusted analysis (Table II).

When adjusted for confounders, neither diet score was significantly associated with recurrent wheeze: Mediterranean diet OR 0.98 per 1 point (95% CI [0.89, 1.08]) and AHEI-P OR 1.07 per 10 points (95% CI 0.87, 1.30). In the adjusted models, neither diet score was associated with any of the secondary outcomes (Table II). In further analysis, we found that the greatest confounder of the relationship between dietary pattern and recurrent wheeze was maternal education (4% change in effect estimate) followed by maternal asthma and breast feeding duration (<2% change for each).

We identified two dominant dietary patterns using principal component factor analysis in our cohort: “Prudent” and “Western”. The “Prudent” pattern was high in vegetables, fruit, legumes, fish, poultry, eggs, salad dressing and whole grains. The “Western” pattern

included red and processed meats, sugar-sweetened beverages, French fries, high-fat dairy products, desserts, butter and refined grains. In the unadjusted model, neither dietary pattern was associated with the primary outcome of recurrent wheeze (Prudent (OR 0.98 [0.82, 1.18]) and Western (OR 1.07 [0.91, 1.26]). In the multivariable models, neither dietary pattern showed a significant association with the primary outcome (Prudent OR 1.02 95% CI [0.83, 1.26] and Western OR 0.98 95 % CI [0.81, 1.19]) nor with any of the secondary outcomes (Table II).

Because race and ethnicity may affect access to foods and dietary choices,[33] we also looked for an interaction between race and dietary pattern. We found no significant interaction (p=0.3 to 0.8 for interaction term with race/ethnicity [white vs. non-white] and each of the 4 different dietary patterns).

In the subset of children with IgE results, atopy was associated with prudent diet in the unadjusted analysis, but was not associated with any dietary pattern in the multivariable model (Table E4, online repository).

Discussion

To our knowledge, this study is the first U.S.-based study to examine maternal dietary patterns during pregnancy in relation to wheezing outcomes in children. We examined overall dietary pattern during pregnancy in several ways. We used scores for Mediterranean diet and healthy diet (AHEI-P), both of which have been previously shown to be associated with disease risk[26, 28-30]. We also used principal components analysis to look at “Western” and “Prudent” patterns. We found no association between any of these specific dietary patterns and our primary outcome of recurrent wheeze at 3 years in the offspring, nor with the secondary outcomes of doctor's diagnosis of asthma, eczema, lower respiratory tract infections or atopy.

This study has several strengths. Project Viva includes prospective, longitudinal data on pregnant women and their children, including both dietary information during the 1st 2nd trimesters of pregnancy and yearly data on children's symptoms. This study design decreases the chance of recall bias and increases the reliability of the data on both dietary and symptom assessment, and decreases measurement error.[34] In addition, we comprehensively analyzed dietary pattern in several different ways, looking at diet scores that have been validated in association with disease risk, as well as using methods to account for the variability within our cohort, and did not find any significant associations. Although in the unadjusted analysis, Mediterranean diet showed an association with decreased risk of recurrent wheeze, this was no longer significant once adjusted for confounders.

The Alternate Healthy Eating Index, based on recommendations from the U.S. Department of Agriculture, has been shown to be associated with decreased risk of chronic disease including diabetes and cardiovascular disease[27, 28]. Modified for pregnancy, it has been shown to be associated with lower blood glucose and lower risk of pre-eclampsia.[29] It more accurately predicts disease risk than the Healthy Eating Index.[28, 35, 36] To our knowledge, it has not been looked at in relation to respiratory disease. Investigations into the relationship between dietary pattern and respiratory disease more generally have not revealed a predominant dietary pattern association,[37], 38 though Western diet has been associated with more asthma exacerbations and with chronic obstructive pulmonary disease,[39-41] and Mediterranean diet in children may be associated with decreased risk of asthma, and better lung function.[42-45]

Our findings are consistent with and extend those of other groups who have had similar results, but used only one method to examine overall dietary pattern.[20, 21] De Batlle *et al.*

looked at adherence to Mediterranean diet during pregnancy in mothers in Mexico and at their children's diet at age 6 and found no association between diet during pregnancy and asthma or allergy outcomes. In that study women were asked to recall their diet during pregnancy several years later, when their children were ages 6-7, which may lead to recall bias or lack of reliability on actual intake. Moreover, questions on asthma outcomes were asked at only one point in time. In the Avon Longitudinal Study of Parents and Children (ALSPAC), a study with over 14,000 participants, Shaheen *et al* found a negative association between “health conscious” pattern and asthma outcomes using principal components analysis; this was no longer significant once adjusted for confounders.[20] That study had extensive information on asthma and allergy-related outcomes for children up to the age of 8-9 years, including lung function data. However, food frequency questionnaires were administered at 32 weeks gestation, only one time point near the end of pregnancy, which may or may not capture diet during early pregnancy, the time of initial airway[46] and immune system[47] development. Though our “Prudent” and “Western” pattern are somewhat similar to the “health conscious” and “processed” diet, in different countries and different cohorts, these may not be entirely comparable. In addition, only principal components analysis was used to look at dietary pattern whereas we also looked at diet scores associated with disease risk. Given the size of the ALSPAC cohort and the extensive data on asthma outcomes, it would be interesting to see if a Mediterranean diet score was associated with decreased risk of asthma.

One study in a Menorcan cohort from Spain did show a significant association between high adherence to a Mediterranean diet during pregnancy and decreased risk of wheeze in their children.[19] In this study it was not clear when the investigators obtained data on diet (during pregnancy or later). In addition, the distribution of the diet score among mothers was not shown and it was not clear if a small proportion of the cohort may have accounted for the finding. In our cohort we had 100% power to detect the effect size found in that study, given the distribution of Mediterranean diet in our study, but did not have similar findings. Given the sample size in our study, we cannot completely rule out a very small effect (OR 0.98) of Mediterranean diet on wheeze outcomes. Based on our power calculations, to detect an effect of this magnitude would require over 10,000 subjects.

Several groups, including ours, have looked at maternal intake of specific nutrients or supplements[9-11, 14, 15] foods or food groups[4-8] in relation to asthma outcomes in their children and found significant associations. Specifically, in the Project Viva cohort, both maternal intake of anti-oxidants (vitamin E)[10] as well as of vitamin D[14] have been found to be associated with decreased risk of recurrent wheeze in children. In such analyses the question often lingers as to whether the finding is truly due to the nutrient, food or food group or whether these items are simply a marker for an overall dietary pattern. Our current analysis bolsters the results of these individual analyses, suggesting that it is unlikely that these previous findings are explained by dietary pattern.

Our results must be interpreted in the context of our study design. Diagnosis of asthma in early childhood is difficult. We used recurrent wheeze at 3 years of age as our primary outcome and there may be misclassification of wheezers as children with asthma. Information in questionnaires did not distinguish between wheezing with and without concomitant infection. However, children with recurrent wheezing are more likely than those with isolated episodes of wheezing to develop asthma.[48, 49] In addition, we looked at other possible overlapping outcomes including doctor's diagnosis of asthma, eczema, atopy and respiratory infections, often the cause of wheeze in young children, and found similar results. Continued follow-up of this cohort will allow for a more accurate diagnosis of asthma. Aside from breast feeding, we did not include other information on post-natal diet in the children. It is possible that child's diet may have an effect on the outcomes of interest,

although thus far there is conflicting data regarding the role of post-natal diet in development of asthma.[50]

Participants excluded from our analysis because of missing data were more likely to be of non-white race, have lower household income, and were less likely to have a college education. Some of these characteristics are also associated with both higher risk of asthma[51] as well as lower likelihood of adherence to a "healthy" diet[52] and exclusion of these subjects may have made us more likely to find a null result. We looked for an interaction between race and dietary pattern and found there was no significant heterogeneity in results among people of different races who were included in the study, however it is also possible that we were underpowered to detect a difference between strata since, once divided into strata, the sample size was smaller. Future studies should include outcomes later in childhood, as well as cohorts with better representation from other socio-economic and ethnic backgrounds.

Furthermore, how and where foods are obtained and prepared may influence their nutrient content. For example, wild salmon has significantly higher vitamin D content than farmed; baking salmon preserves this whereas frying leads to a loss of 50%.[53] Additionally, selenium content of vegetables is dependent on several factors including soil, geographic location, and processing.[54] Since categorization of these dietary patterns is based on reported intake of foods, it is possible that following a Mediterranean diet may translate to different specific nutrient intakes in different places. This may account for different findings in cohorts that vary geographically. Intervention studies with foods or nutrients will help confirm observational results that have been previously found in the Project Viva cohort and others.

In summary, we used multiple methods to assess dietary pattern in pregnant women and found no association with recurrent wheeze, doctor's diagnosis of asthma, eczema, respiratory tract infections, or atopy in their children in the Project Viva cohort. The possibility of an intervention during pregnancy to affect asthma prevalence holds immense promise. The results of this study and others suggest that these interventions may be more powerful if focused on individual supplements, foods or nutrients rather than overall dietary pattern.

Clinical Implications

Maternal dietary pattern during pregnancy was not associated with recurrent wheezing in their children at 3 years. Future analyses and intervention studies should focus on individual foods or nutrients.

Capsule summary

Early life exposures may be linked to asthma. In this study, maternal dietary pattern assessed using several methods in a longitudinal birth cohort showed no association with wheeze-related illness in children at 3 years.

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Abbreviations

AHEI-P	Alternate Healthy Eating Index modified for pregnancy
BMI	body mass index
SFFQ	semi-quantitative food-frequency questionnaire
ALSPAC	Avon Longitudinal Study of Parents and Children

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Table I

Characteristics of 1376 mother-infant pairs in Project

	Total		
	N	**Mean**	**SD**
Dietary intake score			
Mediterranean diet score	1376	4.6	2.0
AHEI-P[§] score	1376	61.0	9.8
Prudent score	1376	−0.01	0.98
Western score	1376	−0.01	0.98
Mother and family			
Maternal age at enrollment (yrs)	1376	32.4	4.9
Pre-pregnancy BMI[#] (kg/m^2)	1372	24.6	5.2
Passive smoking exposure (hr/wk)	1266	0.24	1.20
	N	**%**	
Maternal race/ethnicity			
Black	160	11.6	
Hispanic	82	6.0	
Other	134	9.8	
White	999	72.7	
Maternal education, >college degree	986	71.7	
Mother smoked during pregnancy	140	10.4	
Household income, >$70,000	837	64.8	
Any passive smoke exposure at home	94	7.4	
More than 1 child <12 years old at home	694	52.9	
Maternal history of asthma	235	17.1	
Maternal history of eczema	265	19.3	
Paternal history of asthma	203	14.8	
Paternal history of eczema	186	13.5	
Child			
Female, %	674	49.0	
	N	**Mean**	**SD**
Gestational age at birth (wk)	1376	39.5	1.8
Birth weight (kg)	1375	3.49	0.56
Fetal growth (bw/gest age z-score)	1375	0.21	0.95
Breastfeeding duration (months)	1306	6.4	4.5
	N	**%**	
Outcomes at 3 years			
Recurrent wheezing			

	Total		
	N	**Mean**	**SD**
No	801	82.1	
Yes	175	17.9	
Asthma diagnosis			
No	1082	78.9	
Yes	289	21.1	
Eczema diagnosis			
No	889	64.8	
Yes	483	35.2	
Lower respiratory tract infection			
No	584	48.3	
Yes	624	51.7	

[§]AHEI-P: Alternate Healthy Eating Index modified for Pregnancy

[#]BMI: Body Mass Index

Table II

Unadjusted and Multivariable models for dietary pattern and outcomes

		Recurent wheezing	Asthma diagnosis	Eczema**	Respiratory infection
Effect	**Model***	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Mediterranean diet score	1	0.92 (0.85, 1.00)	0.97 (0.91, 1.03)	1.01 (0.95, 1.06)	1.03 (0.97, 1.09)
Mediterranean diet score	2	0.98 (0.89, 1.08)	1.01 (0.94, 1.09)	1.00 (0.94, 1.06)	1.04 (0.98, 1.10)
AHEI-P§ (10 points)	1	0.92 (0.77, 1.08)	0.96 (0.84, 1.09)	0.97 (0.87, 1.08)	0.95 (0.85, 1.07)
AHEI-P§ (10 points)	2	1.07 (0.87, 1.30)	1.07 (0.92, 1.25)	0.94 (0.82, 1.08)	0.96 (0.85, 1.10)
Prudent	1	0.98 (0.82, 1.18)	1.02 (0.89, 1.16)	1.01 (0.90, 1.13)	0.96 (0.85, 1.09)
Prudent	2	1.02 (0.83, 1.26)	1.08 (0.93, 1.26)	0.95 (0.83, 1.09)	0.96 (0.84, 1.11)
Western	1	1.07 (0.91, 1.26)	1.00 (0.87, 1.14)	1.04 (0.93, 1.17)	1.09 (0.97, 1.23)
Western	2	0.98 (0.81, 1.19)	0.89 (0.76, 1.04)	1.06 (0.93, 1.22)	1.06 (0.93, 1.21)

*Model 1 is unadjusted

Model 2 adjusted for child's gender, maternal race, maternal education level, household income, maternal and paternal history of asthma, presence of children <12yrs of age at home, maternal pre-pregnancy BMI, breast feeding duration, passive smoke exposure

§AHEI-P: Alternate Healthy Eating Index modified for Pregnancy

**For eczema, maternal and paternal history of eczema is substituted for maternal and paternal history of asthma in multivariable model.