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Perinatal Predictors of Atopic Dermatitis Occurring in the First Six Months of Life

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Abstract

Objective—Previous studies of predictors of atopic dermatitis have had limited sample size, small numbers of variables, or retrospective data collection. The purpose of this prospective study was to investigate several perinatal predictors of atopic dermatitis occurring in the first 6 months of life.

Design—We report findings from 1005 mothers and their infants participating in Project Viva, a US cohort study of pregnant women and their offspring. The main outcome measure was maternal report of a provider's diagnosis of eczema or atopic dermatitis in the first 6 months of life. We used multiple logistic regression models to assess the associations between several simultaneous predictors and incidence of atopic dermatitis.

Results—Cumulative incidence of atopic dermatitis in the first 6 months of life was 17.1%. Compared with infants born to white mothers, the adjusted odds ratio (OR) for risk of atopic dermatitis among infants born to black mothers was 2.41 (95% confidence interval [CI]: 1.47, 3.94) and was 2.58 among infants born to Asian mothers (95% CI: 1.27, 5.24). Male infants had an OR of 1.76 (95% CI: 1.24, 2.51). Increased gestational age at birth was a predictor (OR: 1.14; 95% CI: 1.02, 1.27, for each 1-week increment), but birth weight for gestational age was not. Infants born to mothers with a history of eczema had an OR of 2.67 (95% CI: 1.74, 4.10); paternal history of eczema also was predictive, although maternal atopic history was more predictive than paternal history. Several other perinatal, social, feeding, and environmental variables were not related to risk of atopic dermatitis.

Conclusions—Black and Asian race/ethnicity, male gender, higher gestational age at birth, and family history of atopy, particularly maternal history of eczema, were associated with increased risk of atopic dermatitis in the first 6 months of life. These findings suggest that genetic and pre- and perinatal influences are important in the early presentation of this condition. *Pediatrics*

Keywords

atopic dermatitis; eczema; perinatal; infancy; gestational age; race/ethnicity; gender

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ABBREVIATIONS

BMI, body mass index; OR, odds ratio; CI, confidence interval; IgE, immunoglobulin E

Atopic dermatitis is a chronic inflammatory skin disease that occurs with a peak onset in infancy and a large majority of cases presenting in the first few years of life. Its incidence in the developed world has increased dramatically over the past several decades.[1] Atopic dermatitis in the first few months of life causes significant family stress, interference with infant sleep and feeding, physician visits, and health care expenditures. It also may be a risk factor for aeroallergen sensitization, asthma, allergic rhinitis, and urticaria later in childhood.[2,3] Risk for atopy may begin very early in life, even before birth. Both genetic and environmental factors may predispose to allergic disease. In utero exposures may be modulated by postnatal factors to predispose the developing immune system to atopy.

However, there are few studies of the hereditary and environmental predictors of the early-life presentation of atopic dermatitis. Those that do exist have been hampered by a limited range of exposures,[4] failure to control for potential confounders,[5] retrospective data collection,[6] or small sample sizes.[7] Few have assessed early disease in US populations. The purpose of this study was to investigate pre- and perinatal predictors of atopic dermatitis in the first 6 months of life among members of Project Viva, a US cohort study of pregnant women and their children.

METHODS

Subjects

Project Viva is a prospective cohort study examining multiple prenatal factors in relation to outcomes of pregnancy and child health. Recruitment of participants into Project Viva occurs at 8 selected obstetric offices of Harvard Vanguard Medical Associates, a large, multispecialty urban/suburban group practice in eastern Massachusetts. At the first study visit, directly after the woman's initial clinical prenatal visit, we obtain informed consent, administer a brief interview, and provide a take-home self-administered questionnaire. At the second study visit, at 26 to 28 weeks' gestation, we again administer a brief interview and provide a questionnaire. Project Viva participants give birth in 1 of 2 study hospitals, Brigham and Women's Hospital or Beth Israel Deaconess Medical Center. Within 3 days after delivery we briefly interview the mother. Six months after delivery, mothers complete an at-home questionnaire and are interviewed over the phone or in person about themselves and their infants.

Exclusion criteria include multiple gestation (twins, triplets, etc), inability to answer questions in English, plan to move out of the area before delivery, and gestational age >22 completed weeks at initial prenatal clinical appointment. We enrolled 2611 pregnant women (63% of those eligible) between April 22, 1999 and March 1, 2002, of whom 318 subsequently became ineligible because of multiple gestation (n = 18), transferring obstetric care to a non-study site (n = 111), or they were no longer pregnant (n = 189). Of the 2293 remaining participants, 191 (8%) withdrew and 18 (<1%) were lost to follow-up before delivery. Of the 2084 women still enrolled as of March 1, 2002, 332 had not delivered yet, leaving 1752 who delivered a live infant. Of these, 407 had not yet reached the 6-month evaluation, and 52 participants disenrolled before reaching the 6-month evaluation, leaving 1293 women. The 6-month interview was completed by 1056 (82%) of these women. For this analysis, we excluded 51 participants with missing data on the covariates included in our model, resulting in a sample of 1005 mother-infant pairs for this analysis. Human subjects committees of Harvard Pilgrim Health Care, Brigham and Women's Hospital, and Beth Israel Deaconess Medical Center approved the study protocols.

Measurements

We obtain data for Project Viva from multiple sources. We calculated gestational age by using the mother's reported last menstrual period or ultrasound dating if the 2 measures differed by >10 days. At the first visit, we also ask about maternal age, country of birth, number of previous pregnancies, prepregnancy weight, height, history of atopic disorders (asthma, eczema, or allergic rhinitis), maternal education, and household income. We calculated maternal body mass index (BMI) as weight in kilograms divided by the square of height in meters. We took maternal race/ethnicity from maternal responses to the question: "Which of the following best describes your race or ethnicity? You may choose more than one." Response choices were Hispanic or Latina, white or Caucasian, black or African American, Asian or Pacific Islander, American Indian or Alaskan Native, or other (to be specified).

From the hospital vital statistics record we abstracted infant birth weight. We determined birth weight percentiles using as a reference the combined 1999–2000 US Natality data sets,[8] which include birth weights at each completed week of gestation for all infants born in the United States. We then assigned a *z* value for each percentile to have a normally distributed measure of birth weight adjusted for gestational age.

At the 6-month visit we ask: "Have you ever been told by a health care professional, such as a doctor, physician assistant, or nurse practitioner, that your infant has eczema (atopic dermatitis)?" We also ask about infant feeding and household exposures at this visit. Given the broad scope of Project Viva and the extensive range of maternal and infant variables and outcomes assessed, participants were blind to the objectives of our particular analysis.

For those infants in our cohort for whom 1-year follow-up data were already available (n = 551), we assessed the degree of concordance between reported diagnoses of atopic dermatitis at 6 months and 1 year. We ask mothers at the 1-year visit whether they have ever been told by a health care professional that their infant had eczema (atopic dermatitis). We found that 79 of 129 (61%) infants who had been diagnosed with atopic dermatitis by 1 year of age had received that diagnosis within the first 6 months of life, and that 79 of 97 (81%) diagnosed within the first 6 months retained a maternal report of that diagnosis at 1 year.

Data Analysis

Our main outcome was maternal report of a provider's diagnosis of atopic dermatitis in the first 6 months of life. To assess the associations between several simultaneous predictors and atopic dermatitis in the first 6 months of life, we used logistic regression models. We assessed the confounding effect of covariates by examining the association of predictors with atopic dermatitis before and after adding the covariates to the model. If the log odds ratio (OR) associated with a predictor changed by >10%, we concluded that the covariate was a confounder. From the models, we present ORs and 95% confidence intervals (CIs). We kept in our final model covariates that independently predicted outcome, acted as confounders of other predictors, or for which we had strong a priori hypotheses of association with atopic dermatitis. Using stratified analyses, we also studied the data for evidence of effect modification by each of the variables included in our model.

RESULTS

Nearly 28% of the 1005 subjects classified themselves as racial/ethnic minorities. Reflective of a generally employed and insured managed care population, few subjects had less than a high school education or had annual household incomes below $20 000. Fifty-one percent of the infants were male, and 49% were female. Mean gestational age at birth was 39.4 weeks. The subset of 1005 participants who had completed the 6-month evaluation and had data on

all the covariates included in our model differed slightly from the larger overall group of 1293 mother-infant pairs who had reached the 6-month evaluation. Compared with the overall group, participants were less likely to identify themselves as black (13% vs 16%), Hispanic (5% vs 6%), or Asian (5% vs 6%), whereas other or >1 race/ethnicity was similar in both groups (4%). The participants also had slightly higher educational attainment (8% vs 10% with no more than a high school education). Length of gestation and infant gender did not differ between the groups.

Cumulative incidence of a maternal report of provider-diagnosed atopic dermatitis in the study infants was 172 of 1005 (17.1%) in this cohort (Table 1). Infants with atopic dermatitis were born at later gestational ages and were heavier at birth than infants without atopic dermatitis. Atopic dermatitis was more common in male than in female infants. Infants of black and Asian mothers were nearly twice as likely to have received a diagnosis of atopic dermatitis as those born to white or Hispanic mothers. The diagnosis was more than twice as likely in infants born to mothers with a history of eczema as in those born to mothers without this history.

Table 2 shows the unadjusted and adjusted regression models. The multivariate model included gestational age, birth weight for gestational age (*z* value), infant gender, maternal age, prepregnancy BMI, race/ethnicity, education, maternal history of eczema, and cockroach exposure. The odds of developing atopic dermatitis among infants born to black and Asian mothers was ~2.5 times that of white mothers (Table 2). For infants born to Hispanic mothers, no increased risk was apparent. Figure 1 shows the multivariate-adjusted ORs for atopic dermatitis by maternal race/ethnicity. Male gender was a predictor of atopic dermatitis; the odds of developing atopic dermatitis among male infants was ~1.8 times that of female infants.

Increasing length of gestation up to 40 weeks also predicted increased risk of atopic dermatitis. The adjusted OR for atopic dermatitis in the first 6 months of life was 1.14 (95% CI: 1.02, 1.27) for each 1-week increase in gestational age. The adjusted OR for atopic dermatitis was 1.04 (95% CI: 0.87, 1.25) for each *z* value unit increase in birth weight for gestational age.

Family history of atopy was associated with an increased risk of atopic dermatitis. In adjusted analyses, maternal history of atopy conferred greater risk than paternal history. The strongest parental variable seemed to be maternal history of eczema, for which the adjusted OR was 2.67 (95% CI: 1.74, 4.10). Maternal history of asthma, hay fever, or any atopy also predicted increased risk of atopic dermatitis (Table 2). Paternal eczema was a predictor of infantile atopic dermatitis, but other paternal atopic variables were not. The reported presence of cockroaches within the home also appeared to predict increased risk of atopic dermatitis in the first 6 months of life, with an adjusted OR of 1.86 (95% CI: 0.87, 3.96), but the wide CI precluded a strong inference.

After simultaneous control for all the other variables depicted in Table 2, maternal age, prepregnancy BMI, and education were not associated with atopic dermatitis. Adjustment for infant feeding type at 3 and 6 months, number of previous pregnancies, maternal country of birth, household income, furry pets at home, and household mold exposure did not materially alter any of the risk estimates, and none of these variables were associated with atopic dermatitis in multivariate models (data not shown). Additionally, season of birth did not confound any of the associations we found. We did not include it in our model because, at 6 months of age, each of our subjects had experienced only half of the year. In stratified analyses, we found no evidence of effect modification of any of the observed associations by the variables included in our model.

DISCUSSION

In this study of perinatal predictors of atopic dermatitis occurring in the first 6 months of life, we found several variables that predicted increased risk, including black and Asian race/ethnicity, male gender, increasing gestational age at birth, and family history of atopy, particularly maternal history of eczema. Our study assessed atopic dermatitis early in infancy in a US population and had a large sample size, prospective data collection, and information on a wide range of potential covariates.

Race/Ethnicity

The increased risk of atopic dermatitis for blacks and Asians persisted after control for multiple maternal, socioeconomic, and family variables. Our findings are consistent with several previous reports of higher rates of atopic dermatitis in blacks and Asian/Pacific Islanders in the United States and abroad. Increased physician visits for atopic dermatitis by patients from these racial/ethnic groups in the United States has been reported recently.[9] Williams et al[10] reported an increased risk of atopic dermatitis in black Caribbean children born in the United Kingdom versus white children, as assessed through multiple measures, including a cross-sectional prevalence survey, dermatologist's examination, and parental report. Golding and Peters[6] also found children of West Indian origin to be at increased risk for eczema, as assessed by parental report of eczema in the first 5 years of life, compared with white infants. Increased referrals for atopic dermatitis among Asians compared with non-Asians in the United Kingdom have been reported,[11] as has an increased prevalence of atopic dermatitis in Chinese versus white infants in Hawaii[12] and Australia.[13]

Migration has been suggested as a risk factor for atopic dermatitis,[12] perhaps because of exposure to new or increased concentrations of allergens on migration.[14] However, in our analysis, racial/ethnic differences did not change materially after control for maternal country of birth (US-born versus not US-born), so maternal migration did not seem to explain the racial/ethnic differences in infant atopic dermatitis risk we observed in our study (data not shown). These differences also persisted after control for infant feeding and multiple socioeconomic variables. Biological differences such as differences in staphylococcal colonization,[15] increased antigen sensitivity, increased susceptibility to cutaneous irritation and skin barrier dysfunction[16] and differences in immunoglobulin E (IgE) levels resulting from selection for defense against helminths,[17] although not assessed in our study, may also explain racial/ethnic differences in rates of atopic dermatitis.

Differential access to medical care[18] or cultural norms regarding disease reporting[5] may play a role in the differences we observed. Changes of flexural dermatitis and postinflammatory pigmentary changes that are more visible and persist longer in darker skin may lead to more-frequent diagnosis.[9] Milder cases may be overrepresented,[9] or pediatricians may have greater difficulty diagnosing or managing unclassified dermatoses in patients with darker skin, leading to a label of atopic dermatitis. This reason may explain the higher risk we observed in black infants but would be harder to invoke for higher risk among Asians or the lack of risk among Hispanic infants, although our null finding for Hispanics might be due to small numbers. Studies are needed that further isolate particular environmental, genetic, social, or cultural exposures associated with self-identified race/ethnicity.[19]

Infant Gender

In our cohort, the adjusted OR for atopic dermatitis in the first 6 months of life was 1.76 for male versus female infants. Many previous international studies of atopic dermatitis have found more affected girls than boys,[5,20] with a 1.3:1 girl/boy ratio frequently cited. Most studies, however, have examined point prevalence later in childhood or have assessed cumulative

disease incidence over a longer period of follow-up. A Swedish community birth cohort study[21] found that, at the age of 2 years, more boys than girls had ongoing atopic dermatitis. Higher IgE levels have been reported in male versus female infants at birth[22] and at 6 months and 6 years of age.[23] Our data may parallel reports that wheezing and asthma are more common in boys than girls during infancy and childhood but that this pattern is reversed at puberty,[24] although some feel that the early differences in wheeze relate to a mechanical rather than an immune male disadvantage. Prenatal hormonal exposures may program the fetal immune system,[25,26] but the biological or cultural factors involved in shifting gender differences in atopic disease are not fully known.[27]

Birth Weight and Gestational Age

Prior studies have suggested that increasing gestational age at birth may predict increased risk of atopic dermatitis,[7,28,29] but few analyses have examined both birth weight and length of gestation as predictors of the disease in infancy. A Danish cohort study[28] of children up to the age of 7 years found that those born after term had a significantly increased risk of atopic dermatitis, as did children with birth weights that were high for gender and gestational age. A low prevalence of atopic dermatitis was found in a hospital-based follow-up cohort study of very low birth weight infants,[30] although this analysis did not control for gestational age. A Japanese study[31] found a low prevalence of atopic eczema in low birth weight infants at 18 months of age, but the overall prevalence of atopic eczema in the normal birth weight group was only 2.3%.

In our study we observed an increased risk of atopic dermatitis with increased gestational age at birth. We did not find that increasing birth weight for gestational age (*z* value) was a predictor. Our data thus suggest that the increased risk associated with increased birth weight may be ascribed more precisely to the effects of increasing length of gestation than to increased fetal growth.

These results raise the question of why increasing length of gestation may confer an increased risk of atopic dermatitis. Fetal insults such as transplacental allergen exposure or maternal nutritional factors during critical periods of late gestation could predispose toward fetal atopy; early postnatal antigen exposure in infants born at earlier gestational ages could also preferentially result in the development of tolerance instead of sensitization.[32] Higher birth weight and postmaturity have been associated with increased serum total IgE, and postmaturity may be associated with a reduction in thymic weight that may alter the balance of T helper (Th) 1 and Th2 cell populations in the thymus in favor of Th2 cells.[33] A longer period of exposure to the Th2 cytokines of pregnancy may also bias the fetal immune system toward atopy.[34] Examination of placental material, cord blood IgE, and lymphocyte proliferation in future studies may elucidate the biological explanations for our findings.

Family History of Atopy

Our study found an increased risk of atopic dermatitis in infants born to parents with a history of atopy, with maternal history more predictive than paternal history. Risk was highest for infants born to mothers with a history of eczema. Paternal eczema was a predictor of infantile atopic dermatitis, but other paternal variables were not. These data are consistent with previous reports that children are likely to develop atopic diseases similar to those of their parents and that maternal history predicts greater risk for childhood eczema than does paternal history.[35–37]

Atopy may be inherited preferentially through the maternal line, or mothers may carry relatively more of the predisposing genes.[38] Transplacental transfer of antigens, maternal antibodies, and maternally-derived cytokines may shape early atopy,[39] and intense sharing of

postnatal environmental factors through breastfeeding and a shared home environment may also play a role.[40] In our study, the risk estimate associated with a maternal history of eczema was not altered when controlled for early infant feeding practices.

A history of atopy in a first-degree relative is 1 of the diagnostic criteria for atopic dermatitis in infancy;[41] thus, it is likely that some infants with other dermatoses will be misclassified as having eczema based on family history. In assessing atopic dermatitis during infancy we may also be preferentially including children of atopic mothers, who have been shown to present earlier.[35] In addition, because the mothers reported for the fathers, our assessment of paternal history may contain misclassification. Litonjua et al[36] found that mothers were more likely to classify fathers correctly if a child had eczema than if none of their children had eczema.

Other Factors

In our cohort, household presence of cockroaches was associated with an adjusted OR of 1.86 (95% CI: 0.87, 3.96) for atopic dermatitis in the first 6 months of life. The association between sensitization to cockroach antigen and asthma is well documented,[42,43] whereas associations with atopic dermatitis are suggested.[44,45] Our data also suggest increased risk, but more studies are needed with increased exposure prevalence and objective measures of exposure.

Season of birth has been associated with risk of atopic dermatitis, with greater risk in those children born in the fall than those born in the spring,[46] and exacerbations of atopic dermatitis during dry winter months are common. However, we did not include birth season in this analysis, because we assessed our outcome at only 6 months of age, before every infant had experienced each season.

Strengths and Limitations

We assessed atopic dermatitis in the first 6 months of life, a period during which the condition causes considerable morbidity, in terms of sleep and feeding disruption, parental stress, economic costs, and later atopic outcomes. These children with early atopic dermatitis may also represent a severe or long-lasting subgroup and thus are important to study. However, predictors of later-onset atopic dermatitis may be different, and we may have included some cases of dermatoses that are eventually reclassified as nonatopic.

Although 288 of the 1293 enrolled mother-infant pairs that had reached the 6-month evaluation did not complete the 6-month interview or were missing covariate data, the eligible subjects differed only slightly from the 1005 participants in several salient characteristics. Although our observed associations are likely valid for this study population, the predominantly urban/suburban population and relatively high socioeconomic position of our participants could limit generalizability. Our study is also limited by the use of maternal report of provider-diagnosed atopic dermatitis as the outcome variable. Maternal report of physicians' diagnoses of eczema, however, has been previously validated versus clinical examination in the United States[47] and versus chart-recorded diagnosis in the United Kingdom.[48]

CONCLUSIONS

We observed an increased risk of atopic dermatitis in the first 6 months of life among infants born to black and Asian parents, male infants, infants born at later gestational ages, and infants born to parents with a history of atopy, especially eczema and maternal atopy. An enhanced understanding of the biological and environmental causes of early childhood atopic disease will allow for targeted early intervention and improved prevention and treatment of these increasingly common conditions.

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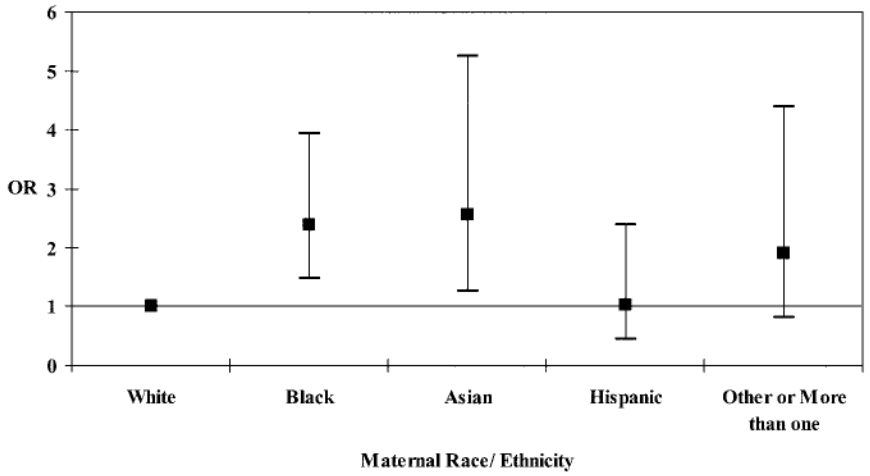

Fig 1.
Multivariate-adjusted ORs and 95% CI for atopic dermatitis occurring in the first 6 months of life, by maternal race/ethnicity. Data from 1005 participants from Project Viva.

TABLE 1

Infant, Maternal, Family, and Environmental Characteristics Among 1005 participants From Project Viva, by Atopic Dermatitis Status in the First 6 Months of Life

Characteristic	Atopic Dermatitis	
	Present *n* = 172 (17.1%)	Absent *n* = 833 (82.9%)
	Mean (SD)	
Infant characteristics		
Gestational age, wk	39.7 (1.6)	39.4 (1.9)
Birth weight, kg	3.57 (0.57)	3.47 (0.59)
Maternal characteristics		
Maternal age	32.3 (5.0)	32.3 (4.8)
Prepregnancy BMI	25.2 (5.5)	24.7 (5.4)
No. of previous pregnancies	1.65 (1.5)	1.42 (1.5)
	No. (row %)	
Infant gender		
Male	107 (21)	403 (79)
Female	65 (13)	430 (87)
Maternal characteristics		
Race/ethnicity		
White or Caucasian	106 (15)	620 (85)
Black or African American	37 (27)	98 (73)
Asian or Pacific Islander	13 (25)	39 (75)
Hispanic or Latina	7 (13)	46 (87)
Other or >1	9 (23)	30 (77)
Education		
High school graduate or less	9 (12)	69 (88)
Some college	41 (19)	173 (81)
Bachelor's degree	76 (19)	317 (81)
Graduate degree	46 (14)	274 (86)
Family characteristics		
Maternal history of eczema		
Yes	41 (32)	
No	131 (15)	89 (68)
Paternal history of eczema		
Yes	14 (26)	744 (85)
No	155 (17)	40 (74)
Maternal history of any atopy		
Yes	93 (23)	765 (83)
No	78 (13)	312 (77)
Paternal history of any atopy		
Yes	53 (17)	521 (87)
No	112 (17)	264 (83)
Environmental characteristics		530 (83)
Household cockroach exposure		
Yes	11 (28)	29 (73)
No	161 (17)	804 (83)

SD indicates standard deviation.

TABLE 2

Predictors of Atopic Dermatitis in the First 6 Months of Life From Logistic Regression Models

Variable	Unadjusted		Adjusted*	
	OR	95% CI	OR	95% CI
Infant characteristics				
Gestational age (per week)	1.10	1.00–1.22	1.14	1.02–1.27
Birth weight for gestational age (z value)	1.11	0.94–1.30	1.04	0.87–1.25
Male gender (vs female)	1.76	1.25–2.46	1.76	1.24–2.51
Maternal characteristics				
Age (per year)	1.00	0.97–1.04	1.01	0.97–1.05
Prepregnancy BMI (kg/m^2)	1.02	0.99–1.05	1.01	0.98–1.05
Race/ethnicity				
White or Caucasian	1.00	—	1.00	—
Black or African American	2.21	1.44–3.40	2.41	1.47–3.94
Asian or Pacific Islander	1.95	1.01–3.78	2.58	1.27–5.24
Hispanic or Latina	0.89	0.39–2.02	1.02	0.44–2.40
Other or >1	1.76	0.81–3.80	1.90	0.82–4.39
Education				
High school graduate or less	0.78	0.36–1.66	0.66	0.28–1.54
Some college	1.41	0.89–2.24	1.27	0.77–2.12
Bachelor's degree	1.43	0.96–2.13	1.48	0.97–2.24
Graduate degree	1.00	—	1.00	—
History of eczema	2.62	1.73–3.96	2.67	1.74–4.10
Environmental characteristics				
Home cockroach exposure	1.89	0.93–3.87	1.86	0.87–3.96
Other infant characteristics				
Not exclusively breastfed at 3 months(vs exclusively breastfed at 3 months)	1.06	0.75–1.50	—	—
Not exclusively breastfed at 6 months(vs exclusively breastfed at 6 months)	0.96	0.64–1.43	—	—
Other maternal and family characteristics				
Number of previous pregnancies	1.10	0.99–1.23	—	—
Mother foreign-born (vs US-born)	1.27	0.84–1.91	—	—
Family history				
Paternal history of eczema	1.73	0.92–3.25	—	—
Maternal history of asthma	1.58	1.01–2.47	—	—
Paternal history of asthma	1.16	0.69–1.94	—	—
Maternal history of hayfever	1.36	0.96–1.92	—	—
Paternal history of hayfever	1.02	0.70–1.50	—	—
Maternal history of any atopy	1.99	1.43–2.78	—	—
Paternal history of any atopy	0.95	0.66–1.36	—	—
Household income				
Less than $40 000/year	0.85	0.47–1.53	—	—
$40 000 to $70 000/year	1.11	0.73–1.68	—	—
More than $70 000/year	1.00	—	—	—
Other environmental characteristics				
Household mold exposure	1.29	0.81–2.08	—	—
Furry pet at home	0.79	0.56–1.10	—	—

Data are from 1005 mothers and newborns participating in Project Viva.

*Adjusted for gestational age at birth, birth weight for gestational age (z value), and infant gender; maternal age, prepregnancy BMI, race/ethnicity, education, and history of eczema; and home cockroach exposure.