

Association between Household Income and Allergy Development in Children: The Japan Environment and Children's Study

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Keywords

Allergic disease · Household income and socioeconomic status

Abstract

Background: Socioeconomic status has been found to be associated with allergic diseases in children, but results are inconsistent. This study aimed to assess the association between household income and the development of allergic disease in children at 3 years old. **Methods:** We used data from 72,180 participants from the Japan Environment and Children's Study, which is a prospective birth cohort study with participants recruited from January 2011 to March 2014. We examined the associations between household income and allergic diseases (asthma, eczema, and food allergies) in children, adjusting for covariates using multivariate logistic regression. **Results:** The percentages of doctor-diagnosed allergies at 3 years old were 7.5% for asthma, 7.2% for eczema, and 6.2% for food allergies. Children from households with an annual income of <2 million yen (approx. 18,000 USD) had a significantly higher risk of doctor-diagnosed asthma and eczema than those from households with an income of 4–6 million yen. The adjusted odds ratios (aORs) were 1.17 (95% confidence interval [CI] 1.03–1.34) and 1.21

(95% CI 1.06–1.39). Children from households with an income of >6 million yen tended to have an increased risk of food allergies (aOR 1.07, 95% CI 0.98–1.15). **Conclusion:** Low household income was a risk for doctor-diagnosed asthma and eczema, suggesting that public health professionals should recognize low-income groups as vulnerable populations for these conditions.

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Introduction

Socioeconomic status (SES), assessed through measures such as household income and parental education, is associated with child health including allergic diseases in children [1]. Results are not completely consistent, but previous studies on the association between SES and allergic diseases have reported that low SES is a risk factor for asthma [1–5], and high SES is a risk factor for eczema [6–10] and food allergies [1, 11–15]. Possible mechanisms include environmental exposure such as tobacco

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and air pollution and parental stress [1, 4, 5]. These are more prevalent in the low SES group in asthma. The hygiene hypothesis and differences in health-care access may be important in eczema [6, 9, 10] and food allergies [1, 12–15]. However, these mechanisms have not been fully explained, and there is little research on the association between SES and allergic diseases, especially focusing on mechanisms.

There have also been many studies on the association between SES and allergic diseases from Western countries [1] but few from non-Western countries including Japan [8, 16–19]. When studying the relationship between SES and allergic diseases, especially for doctor-diagnosed allergic diseases, it is necessary to study countries separately because of differences in their health-care systems. Studies from Japan on the association between SES and allergic diseases have shown inconsistent results. Some cross-sectional studies have indicated that low SES is a risk factor for allergic diseases [18, 19], but other studies using limited longitudinal data suggested that high SES is a risk factor for allergic diseases [17]. The aim of this study was to clarify the association between household income and allergic diseases in children in a large birth cohort study.

Methods

Participants

The participants in this study were mother-and-child pairs who participated in the Japan Environment and Children's Study (JECS). This is a large nationwide birth cohort study funded by the Ministry of the Environment, Japan in January 2011. The protocol and baseline data for JECS have been described elsewhere [20, 21], but it is an ongoing, nationwide, birth cohort study. The study recruited >100,000 pregnant women between January 2011 and March 2014. The women all lived in one of 15 study areas, which covered a wide geographical area of Japan. The JECS protocol was reviewed and approved by the Ministry of the Environment's Institutional Review Board on Epidemiological Studies (IRB number: 100910001) and by the Ethics Committees of all participating institutions. Written informed consent was obtained from all participants.

This study was based on the JECS dataset jecs-ta-20190930, which was released in October 2019. The dataset included 104,062 fetal records. Of these, we excluded stillbirths and miscarriages ($n = 3,758$), and participants with missing data on household income or parents' academic history ($n = 19,581$) or allergic diseases at 3 years old ($n = 8,543$). The final study population included 72,180 mother-and-child pairs.

Variables

Outcomes

The outcomes of this study were doctor-diagnosed and parent-reported allergic diseases (asthma, eczema, and food allergies) in children aged 3 years old. Information for the outcomes was col-

lected using self-administered questionnaires [22]. Allergic diseases (asthma, eczema, and food allergies) diagnosed by a doctor at 3 years old were defined as a positive answer to the question "Has your child been diagnosed by a doctor as having any of these allergic diseases in the past 12 months or been treated for one of these conditions in the same period?" We used the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire for 6–7-year-olds [23, 24], translated into Japanese and validated, with some modifications. The Japanese version of the ISAAC core questionnaire was used for parent-reported asthma and eczema [25]. Parent-reported asthma was defined as a positive response to the question "Has your child had wheezing in the chest in the past 12 months?" Parent-reported eczema was defined as a positive response to the following 3 questions: "Has your child ever had an itchy rash which came and went for at least 6 months?" "Has your child had this itchy rash at any time in the past 12 months?" and "Has this itchy rash at any time affected any of the following places: folds of the elbows, behind the knees, in front of the ankles, under the buttocks or around the neck, ears or eyes?" To assess parent-reported food allergies, parents were asked if their child avoided eating any of the following foods: hens' eggs, cow's milk, wheat, soybeans, fish, rice, fruits, crustaceans, buckwheat, sesame, and nuts. A parent-reported food allergy was defined as a response of "He/she currently avoids eating some of these foods," "He/she used to eat these foods but now doesn't eat them at all," and "He/she ate these foods and experienced allergic symptoms."

Exposure

Exposure in this study was annual household income. In the second or third trimesters (22–28 weeks' gestation), all the pregnant women were asked about their annual household income using self-administered questionnaires [21]. Household income (million Japanese yen) was classified into 9 answer options: <2 (approx. 18,000 USD), 2 to <4, 4 to <6, 6 to <8, 8 to <10, 10 to <12, 12 to <15, 15 to <20, or ≥ 20 .

Covariates

We selected covariates for models on the basis of previous studies about factors related to development of allergic diseases among children during pregnancy and early infancy [26–30]. We used self-administered questionnaires to collect information on maternal and paternal history of allergies (asthma, atopic dermatitis, allergic rhinitis, and allergic conjunctivitis), child's passive smoking status at 1½ years old, the presence of older siblings, exclusive breast-feeding, daycare attendance at 1 year old, child's eczema at 1 year old, and a history of respiratory syncytial viral infection. Information on age at pregnancy, mode of delivery, gestational age at delivery, prepregnancy body mass index (BMI), birth weight, and sex of the child was collected through transcription from physicians, midwives/nurses, and/or research co-ordinators. Maternal age at delivery was categorized as <25 years, 25–29 years, 30–34 years, and ≥ 35 years. Preterm birth was defined as birth before 37 weeks' gestation. We calculated prepregnancy BMI from prepregnancy height and weight and categorized it into 3 groups: underweight ($<18.5 \text{ kg/m}^2$), normal ($18.5\text{--}24.9 \text{ kg/m}^2$), and overweight ($\geq 25 \text{ kg/m}^2$).

Statistical Analyses

We calculated summary measures of characteristics of the study participants and outcomes. Household income was categorized as <2 million yen, 2–4 million yen, 4–6 million yen, and ≥ 6

Table 1. Characteristics of the study participants (*n* = 72,180)

	<i>n</i>	(%)
Maternal history of allergy		
Yes	35,538	(49.4)
No	36,407	(50.6)
Paternal history of allergy		
Yes	16,158	(22.4)
No	22,418	(31.1)
Unknown	33,604	(46.6)
Prepregnancy BMI		
<18.5	11,513	(16.0)
≥18.5 and <25	53,495	(74.1)
≥25	7,144	(9.9)
Maternal age at pregnancy, years		
<25	7,507	(10.4)
≥25 and <30	20,736	(28.7)
≥30 and <35	25,779	(35.7)
≥35	18,158	(25.2)
Household income (million JPY/year)		
<2	3,403	(4.7)
≥2 to <4	24,303	(33.7)
≥4 to <6	24,364	(33.8)
≥6	20,110	(27.9)
Father's academic history		
Junior high school	4,380	(6.1)
High school	25,280	(35.0)
Technical junior college/technical/vocational college/associate degree	16,569	(23.0)
Bachelor's degree/graduate degree (Master's/Doctor's)	25,951	(36.0)
Mother's academic history		
Junior high school	2,438	(3.4)
High school	21,038	(29.2)
Technical junior college/technical/vocational college/associate degree	31,228	(43.3)
Bachelor's degree/graduate degree (Master's/Doctor's)	17,476	(24.2)
Mode of delivery		
Caesarean section	14,116	(19.6)
Vaginal	57,758	(80.4)
Preterm		
Yes	3,743	(5.2)
No	68,306	(94.8)
Birth weight, g		
<2,500	6,307	(8.8)
≥2,500	65,707	(91.2)
Child's sex		
Male	36,852	(51.1)
Female	35,328	(48.9)
Older siblings		
Yes	38,731	(53.8)
No	33,214	(46.2)
Duration of exclusive breast-feeding		
<6 months	42,520	(59.5)
At least 6 months	28,929	(40.5)
Attends daycare at 1 year old		
Yes	18,468	(26.0)
No	52,699	(74.1)
History of respiratory syncytial virus infection		
Yes	6,925	(9.7)
No	64,524	(90.3)

Table 1 (continued)

	<i>n</i>	(%)
Passive smoking at 1½ years old		
None	55,746	(77.2)
Sometimes	13,772	(19.1)
Frequently	2,662	(3.7)
Doctor-diagnosed allergy		
Eczema at 1 year old	3,011	(4.2)
Asthma at 3 years old	5,401	(7.5)
Eczema at 3 years old	5,207	(7.2)
Food allergy at 3 years	4,440	(6.2)
Parent-reported allergy		
Asthma at 3 years old	12,469	(17.3)
Eczema at 3 years old	8,912	(12.4)
Food allergy at 3 years old	3,890	(5.4)
BMI, body mass index.		

Table 2. ORs of doctor-diagnosed asthma at 3 years old in relation to household income

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Household income (million JPY/year)						
<2	1.27	1.12–1.44	1.21	1.06–1.38	1.17	1.03–1.34
≥2 to < 4	1.09	1.02–1.16	1.07	1.00–1.15	1.06	0.99–1.14
≥4 to <6	Ref		Ref		Ref	
≥6	0.91	0.85–0.98	0.92	0.86–0.99	0.93	0.86–1.00

Model 1, crude; Model 2, adjusted for maternal and paternal history of allergy, maternal BMI, maternal age at pregnancy, mode of delivery, preterm, birth weight, sex of child, older siblings, exclusive breast-feeding, attends daycare at 1 year old, and history of respiratory syncytial virus infection; Model 3, Model 2 + adjusted for passive smoking. Bold indicates statistical significance ($p < 0.05$). OR, odds ratio; CI, confidence interval; BMI, body mass index.

million yen. The group with household income of 4–6 million yen was used as reference for the analysis.

A logistic regression model was used to examine the association of household income with doctor-diagnosed asthma at 3 years old. We constructed a sequence of models. Model 1 was the crude model. Model 2 was adjusted for maternal and paternal history of allergies, prepregnancy BMI, maternal age at pregnancy, mode of delivery, birth weight, gestational age at delivery, sex of the child, the presence of older siblings, exclusive breast-feeding, daycare attendance at 1 year old, and a history of respiratory syncytial viral infection. Model 3 was further adjusted for child's passive smoking status at 1½ years old. We used mediation analysis [31] to determine the proportion of the association between household income and doctor-diagnosed asthma at 3 years old that was mediated by the potential mediator, the child's passive smoking status. For the analysis, we converted both household income and the child's passive smoking into dichotomous variables (<4 million yen vs. 4 million yen or more, and no passive smoking vs. sometimes or frequently).

Using the PROC CAUSALMED in SAS, we estimated the natural direct effects and natural indirect effects of mediators after controlling for all covariates used in Model 2.

We then used logistic regression analyses to estimate the crude odds ratios (ORs), adjusted ORs (aORs), and 95% confidence interval (CI) for the association between household income and doctor-diagnosed eczema and food allergies. We adjusted for maternal and paternal history of allergies, prepregnancy BMI, maternal age at pregnancy, mode of delivery, birth weight, gestational age at delivery, sex of the child, the presence of older siblings, exclusive breast-feeding, daycare attendance at 1 year old, child's passive smoking status at 1½ years old, and child's eczema at 1 year old (for food allergies only). We also used logistic regression analyses to estimate the crude ORs, aORs, and 95% CIs for the association between household income and parent-reported asthma, eczema, and food allergies. All analyses used SAS 9.4 (SAS Institute Inc., Cary, NC, USA). A p value <0.05 was considered significant.

Table 3. ORs of doctor-diagnosed eczema and food allergies at 3 years old in relation to household income

	Eczema				Food allergy			
	cOR	95% CI	aOR [†]	95% CI	cOR	95% CI	aOR [†]	95% CI
Household income (million JPY/year)								
<2	1.20	1.06–1.37	1.21	1.06–1.39	0.79	0.67–0.93	0.85	0.72–1.02
≥2 to <4	1.06	0.99–1.14	1.06	0.98–1.13	0.95	0.88–1.02	0.98	0.91–1.06
≥4 to <6	Ref		Ref		Ref		Ref	
≥6	0.99	0.92–1.06	0.99	0.92–1.07	1.07	0.99–1.15	1.07	0.98–1.15

Bold indicates statistical significance ($p < 0.05$). cOR, crude odds ratio; aOR, adjusted odds ratio; CI, confidence interval; BMI, body mass index. [†] Adjusted for maternal and paternal history of allergy, maternal BMI, maternal age at pregnancy, mode of delivery, preterm, birth weight, sex of child, older siblings, exclusive breast-feeding, attends daycare at 1 year old, passive smoking, and eczema at 1 year old (only for food allergy).

Table 4. aORs of parent-reported allergies at 3 years old in relation to household income

	Asthma		Eczema		Food allergy	
	aOR [†]	95% CI	aOR [†]	95% CI	aOR [†]	95% CI
Household income (million JPY/year)						
<2	1.11	1.00–1.22	1.04	0.93–1.16	0.70	0.58–0.85
≥2 to <4	1.03	0.98–1.08	0.96	0.91–1.02	0.92	0.85–1.00
≥4 to <6	Ref		Ref		Ref	
≥6	1.01	0.96–1.06	1.06	1.00–1.13	1.03	0.95–1.12

Bold indicates statistical significance ($p < 0.05$). aOR, adjusted OR; CI, confidence interval; BMI, body mass index. [†] Adjusted for maternal and paternal history of allergy, maternal BMI, maternal age at pregnancy, mode of delivery, preterm, birth weight, sex of child, older siblings, exclusive breast-feeding, attends daycare at 1 year old, passive smoking, history of respiratory syncytial virus infection (only for asthma), and eczema at 1 year old (only for food allergy).

Results

Characteristics of the study participants are shown in Table 1. In total, 4.7% of participants had an annual household income of <2 million yen. The percentages of doctor-diagnosed allergies at 3 years old were 7.5% for asthma, 7.2% for eczema, and 6.2% for food allergies. The percentages of parent-reported allergies at 3 years old were 17.3% for asthma, 12.4% for eczema, and 5.4% for food allergies.

Table 2 shows the results of logistic regression evaluating the associations between doctor-diagnosed asthma at 3 years old and household income. The participants from households with the lowest annual income (<2 million yen) were 1.27 times more likely to have asthma than those whose household income was 4 to 6 million yen (Model 1, Table 2). Adjusting for potential confounders slightly reduced the effect of household income on asthma

(Model 2, Table 2). In the final model, adjusting for the child's passive smoking reduced the effect, but the lowest household income remained significantly and positively associated with asthma at 3 years old (OR 1.17, 95% CI 1.03–1.34). From the result of mediation analysis, we also found evidence that the child's passive smoking mediated the relationship between low household income and doctor-diagnosed asthma (7.8%, $p = 0.03$; online suppl. Table 1; for all online suppl. material, see www.karger.com/doi/10.1159/000519153).

The associations between household income and doctor-diagnosed eczema and food allergies at 3 years old are shown in Table 3. The participants from households with the lowest income were 1.20 times more likely to have eczema than those from households with an annual income of 4–6 million yen (crude model, Table 3). Adjusting for potential confounders slightly increased the effect of household income on eczema (aOR 1.21, 95% CI 1.06–

1.39; Table 3). There was a negative association between low household income and doctor-diagnosed food allergies. The effect of household income on food allergies was reduced by adjusting for potential confounders (aOR 0.85, 95% CI 0.72–1.02; Table 3).

The associations between parent-reported allergies at 3 years old and household income are shown in Table 4. The results were similar to those for doctor-diagnosed conditions for asthma and food allergies. However, in contrast to doctor-diagnosed eczema, participants from households with the highest income were 1.06 times more likely to have parent-reported eczema than those from households with income of 4–6 million yen (aOR 1.06, 95% CI 1.00–1.13; Table 4).

Discussion

Our study showed low household income was a risk factor for asthma, and the relationship was partially mediated by passive smoking. Low household income was a risk factor for doctor-diagnosed eczema, but high household income was a risk factor for parent-reported eczema. High household income tended to be a risk factor for doctor-diagnosed food allergies.

Previous studies on SES and asthma have generally reported low SES to be a risk factor [1–5], and our results were consistent with that. They were also consistent with reports from Japan [18, 19], although some studies have reported that higher parental education was also a risk [17, 32]. There are several possible mechanisms for the association between low SES and asthma, but there is no decisive answer. The main mechanisms are thought to be tobacco-related, living in poor environments with factors such as air pollution, and parental stress [1, 4, 5]. We found a higher proportion of passive smoking in the low household income group than that of the high-income group (online suppl. Table 2), and systematic reviews have reported passive smoking to be a risk factor for asthma [27]. We tested whether passive smoking in children mediates the association between low SES and asthma development and found that it had a partial mediation effect of about 8%. Our results suggest the importance of passive smoking prevention measures among the low SES population, to prevent the development of asthma. Parental stress and air pollution may also be mediating factors [1, 4, 5]. Further research on mediating factors is needed to develop effective interventions.

Previous studies have reported that high SES is a risk for eczema [1, 9, 10], with mechanisms including the hy-

giene hypothesis [33], that is, an over-sterile environment [1, 6, 9, 10], and diagnosis bias, that is, possibility of underdiagnosis in low SES populations because of fewer medical visits [1, 6]. Unlike previous studies, our results showed that low household income was a risk factor for doctor-diagnosed eczema. However, high household income was associated for parent-reported eczema, suggesting that results may vary with the definition of eczema. Our finding that low household income was a risk for eczema was partially consistent with previous results from Japan [17–19]. A cross-sectional study found that eczema diagnosed using International Classification of Disease, Tenth Edition (ICD-10) codes was significantly higher in single parents [19]. A web-based survey found that low SES was a risk for eczema symptoms as defined by the ISAAC questionnaire [18]. However, results from longitudinal data showed that the high paternal level of education was a risk factor for eczema symptoms as defined by the ISAAC questionnaire [17]. The diagnosis bias should lead to high SES being associated with risk of doctor-diagnosed eczema [1, 6], but we found the opposite (Tables 3, 4). We also found that the ratio of doctor-diagnosed eczema and eczema with sleep disturbances to parent-reported eczema was higher in the low-income group (online suppl. Table 3). This could be because the severity of eczema is actually higher in the low household income population, and therefore, it is more often diagnosed by doctors and/or that the high household income population reports more symptoms of eczema, including those of lesser severity. Future research may be needed on the association between SES and eczema, especially considering the severity of the condition. We found that low household income was a risk factor for doctor-diagnosed eczema, suggesting that public health professionals should recognize low-income groups as a population vulnerable to eczema, although the mechanism is unclear. However, parent-reported eczema was associated with high household income, in line with previous studies [1, 9, 10]. It is possible that the biological hygiene hypothesis may be working as a mechanism for parent-reported eczema, but further research is needed.

We found that high household income tended to be a risk factor for food allergies, which is consistent with previous studies [1, 11–15]. Previous studies proposed that the mechanism was the hygiene hypothesis, which states that food allergies are more common in high SES groups because of the over-sterile environment [33], and that food allergies are also more often diagnosed by doctors in this group because of better access to medical care, that is, diagnosis bias [1]. Gupta et al. [14] reported that black

children were more likely to have food allergies than white children but less likely to have the allergy diagnosed, which suggested that differences in prevalence by income may be socially constructed. In Japan's health-care system, patients are free to seek medical care, and the cost of medical care is fixed nationwide. The burden of medical expenses for preschool children is lower than in other countries because of universal medical insurance, and the subsidies provided by municipalities and prefectures for children's medical expenses [34]. Children therefore have fewer barriers to healthcare because of low income than in other countries. However, food challenge testing is the gold standard for diagnosing food allergies, and in severe cases, hospitalization is required for testing. Even if there is no medical expenses burden, it may still be hard for parents to manage the requirements for hospitalization or outpatient visits, such as taking time off work. This may lead to diagnosis bias. Our results showed that the effect of low household income was more profound for parent-reported food allergy symptoms than doctor-diagnosed food allergies. This suggests that diagnosis bias may be less important. The percentage of doctor-diagnosed food allergies was also higher than that of parent-reported food allergies (Table 1). This may be because doctor-diagnosed food allergies included outgrown allergies or allergies diagnosed only through blood tests. In recent years, the dual antigen exposure hypothesis has been reported [35], which suggests that food allergies are caused by percutaneous sensitization from skin barrier dysfunction as a result of filaggrin gene mutation or eczema [36]. This means that eczema is an important risk factor for food allergies. Eczema prevalence was higher in the high SES group, so there may be an increased risk of food allergies in that group. We also adjusted for eczema at 1 year old, but the association between high SES and food allergies remained. Further research on the mechanism is needed.

The strength of this study was that it was a large sample which represented the Japanese population. We also adjusted for many potential confounders. The longitudinal data allowed us to examine the incidence of allergic diseases with less recall bias. Our results indicate that low-income groups are vulnerable to asthma and eczema. They therefore provide public health evidence that low-income populations should be a target for early detection of childhood allergic diseases. However, the study also had several limitations. First, the sample was representative of the Japanese population, but it remains difficult to generalize to other countries because of differences in the degree of poverty and access to healthcare. Second, the

assessment of allergic diseases was self-reported. However, we asked about doctor-diagnosed allergic diseases and also used a validated questionnaire for asthma and eczema [25]. Finally, we expected more dropouts at follow-up in the low household income group, so we may have underestimated the association with allergic diseases in the low household income group. Our results would be robust to this because the association was significant even under these conditions.

In conclusion, low household income was a risk factor for asthma, and the relationship was partially mediated by passive smoking. Low household income was also a risk factor for doctor-diagnosed eczema, but high household income was associated with parent-reported eczema. High household income tended to be a risk factor for doctor-diagnosed food allergies. Our results suggest that public health professionals should consider low-income populations as vulnerable for asthma and eczema, although the mechanism is unclear.

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Statement of Ethics

The JECS protocol was approved by the Ministry of the Environment's Institutional Review Board on Epidemiological Studies (IRB No.: 100910001) and by the Ethics Committees of all participating institutions. Written informed consent was obtained from all participants.

Conflict of Interest Statement

The authors declare no conflict of interest.

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Author Contributions

R.K. contributed to the conception and design of this study, performed the statistical analysis, and drafted the manuscript. M.K., S.O., H.Y., Y.A., T.O., K.M., and S.H. critically reviewed the manuscript. R.S. and Z.Y. critically reviewed the manuscript and supervised the whole study process. All authors read and approved the final manuscript.

Data Availability Statement

Data are unsuitable for public deposition due to ethical restrictions and legal framework of Japan. It is prohibited by the Act on the Protection of Personal Information (Act No. 57 of 30 May 2003, amendment on 9 September 2015) to publicly deposit the data containing personal information. Ethical Guidelines for Medical and Health Research Involving Human Subjects enforced by the Japan Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Health, Labour, and Welfare also restricts the open sharing of the epidemiologic data. All inquiries about access to data should be sent to: jecs-en@nies.go.jp. The person responsible for handling inquiries sent to this e-mail address is Dr. Shoji F. Nakayama, JECS Programme Office, National Institute for Environmental Studies.

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Table S1. Estimates of direct and indirect effects (mediated through passive smoking) of association between household income and asthma

	Estimated value	p value	Proportion mediated (%)	p value
Total effect	0.015	< 0.0001		
Natural indirect effects	0.0011	0.02	7.8	0.03
Natural direct effects	0.013	< 0.0001		

Household income was treated as dichotomous, with 0 = 4 million yen or more and 1 = less than 4 million yen. Models:
Adjusted for maternal and paternal history of allergies, pre-pregnancy BMI, maternal age at pregnancy, mode of delivery, birth weight, gestational age at delivery, sex of the child, the presence of older siblings, exclusive breast-feeding, daycare attendance at 1 year old, and a history of respiratory syncytial viral infection

Table S2. Household income and passive smoking

Household income (million JPY/year)	Passive smoking at 1½ years					
	None		Sometimes		Frequently	
< 2	2059	(60.5)	1029	(30.2)	315	(9.3)
≥ 2 to < 4	17393	(71.6)	5716	(23.5)	1194	(4.9)
≥ 4 to < 6	19321	(79.3)	4324	(17.8)	719	(3.0)
≥ 6	16973	(84.4)	2703	(13.4)	434	(2.2)

Chi squared test: p < 0.01

Table S3. Household income and eczema

Household income (million JPY/year)	Eczema at 3 years old					
	Doctor-diagnosed		Parent-reported		With sleep disturbance	
< 2	284	(8.4)	414	(12.2)	180	(5.3)
≥ 2 to < 4	1808	(7.4)	2882	(11.9)	1228	(5.1)
≥ 4 to < 6	1715	(7.0)	3011	(12.4)	1183	(4.9)
≥ 6	1400	(7.0)	2605	(13.0)	1005	(5.0)