

## Effect of socioeconomic status on allergic diseases and atopy in school children

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**SUMMARY:** Sipahi S, Nacaroğlu HT, Can D, Günay İ, Ünsal-Karkıner CŞ, Kamalı H, Özdemir A, Günay T. Effect of socioeconomic status on allergic diseases and atopy in school children. Turk J Pediatr 2017; 59: 670-677.

Higher family socioeconomic status (SES) has been suggested as a risk factor for allergic diseases. We investigated the effect of SES on the prevalence of allergic diseases and atopy. The study included 13–14-year-old primary school students in Kemalpaşa, Turkey. The International Study of Asthma and Allergies in Childhood phase 1 questionnaire was administered to all students to identify allergic diseases. Those identified as having allergic diseases underwent a skin prick test (SPT). Group I included students with allergic diseases and a positive SPT. Group II comprised students with allergic disease who were SPT negative. The control group was randomly selected from the students with no allergic diseases. Three weighted SES scores were calculated for each student (equally weighted, education-weighted, and social class-weighted). SES was classified as lower, middle, or upper according to the weighted SES scores. Allergic diseases were detected in 657 of the 1,373 children who participated in the study. A higher percentage of children with allergic diseases and atopy were in the lower SES group in all weighted SES analyses compared with controls (Group I: 59%, 83.1%, 67.5%; Group II: 62.9%, 80%, 63.5%; control group: 12.4%, 12.9%, 21.2%). Significantly more children with allergic and atopic diseases (Groups I and II) were in the lower SES group compared with the control group ( $p < 0.001$ ). In contrast to the hygiene hypothesis, we found the incidence of atopic disease was higher in families with lower SES.

**Key words:** atopy, allergic diseases, asthma, ISAAC, socioeconomic status.

The so called “hygiene hypothesis” has been suggested to explain the increased prevalence of childhood asthma and allergic diseases in Western countries.<sup>1,2</sup> However, the findings of large-scale epidemiological studies conducted in the United States over the past 30 years have contradicted the hygiene hypothesis<sup>2</sup>. In particular, allergic diseases were found to be highly prevalent among individuals living in urban slums, suggesting that poverty, overcrowding and poor hygienic conditions did not protect against allergic diseases. Furthermore, environmental risk factors associated with poverty in urban settings, including smoking, overcrowding, poor ventilation, inadequate heating, and

humidity, were found to increase the severity of asthma and allergic diseases.<sup>2-4</sup> An association between socioeconomic status (SES) and the incidence of allergic diseases has been recognized; however, the precise effects of SES on disease status are controversial. To address this issue, it is necessary to conduct prevalence studies in individuals of the same age living in the same geographic region under different socioeconomic conditions. We investigated the relationship between SES and the incidence of allergic diseases and atopy in children.

### Material and Methods

#### Patient population

The study was conducted in Kemalpaşa, İzmir,

Turkey. The populations of the district and city were 91,276 and 59,984, respectively. The International Study of Asthma and Allergies in Childhood (ISAAC) phase I questionnaire was administered to all 13- and 14-year-old students attending the five elementary schools in the district. All of those with allergic diseases according to the ISAAC phase I questionnaire were instructed to visit the medical center to undergo a skin prick test (SPT). Of those, children with SPT-positive responses to any allergen were assigned to Group I, and those who were SPT negative were assigned to Group II. The control group (Group III) consisted of

randomly selected students with no suspected allergic diseases. Students of the groups were instructed to meet at the medical center with their parents, where they were asked to complete a questionnaire to obtain information on demographic characteristics (age, gender, birth weight, maternal and paternal age, and relocations), environmental and familial risk factors (smoking habits, number of siblings living at home, family history, time of birth, whether breastfed, transition to nutritional supplements), and SES (Fig. 1). This study was approved by the local ethics committee of our hospital (2011/07-03). Written parental consent

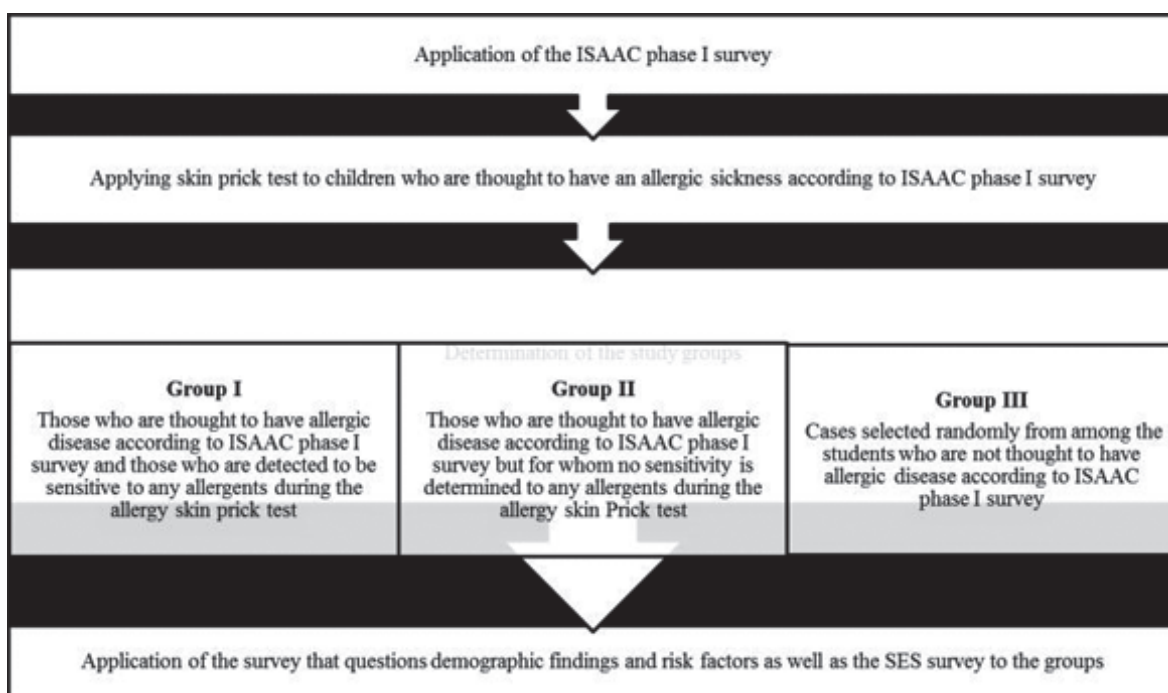


Fig. 1. Study design.

Table I. Scoring System for the Equally Weighted Socioeconomic Index.

Mother's education level	Household social class	Equally weighted socioeconomic index *
Illiterate or literate but left primary school	Lower social class	2 points
	Middle social class	3 points
	Upper social class	4 points
Primary school graduates, left secondary school	Lower social class	3 points
	Middle social class	4 points
	Upper social class	5 points
Secondary school graduates and above	Lower social class	4 points
	Middle social class	5 points
	Upper social class	6 points

\* Lower socioeconomic group A: 2 points, Middle socioeconomic group A: 3-5 points, and Upper socioeconomic group A: 6 points.

**Table II.** Scoring System for the Education-Weighted Socioeconomic Index.

Mother's education level	Household social class	Education-weighted socioeconomic index **
Illiterate or literate but left primary school	Lower social class	1 point
	Middle social class	2 points
	Upper social class	3 points
Primary school graduates, left secondary school	Lower social class	4 points
	Middle social class	5 points
	Upper social class	6 points
Secondary school graduates and above	Lower social class	7 points
	Middle social class	8 points
	Upper social class	9 points

\*\* Lower socioeconomic group B: 1–3 points, Middle socioeconomic group B: 4–6 points, and Upper socioeconomic group B: 7–9 points.

and student assent were obtained separately for each participant.

#### Skin prick test

Children were requested to discontinue antihistamine use before the SPT. SPTs for common aeroallergens (*Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*), a mixture of grass pollens (*Lolium perenne*, *Dactylis glomerata*, *Phleum pratense*, *Anthoxanthum odoratum*, *Poa pratensis*, *Festuca elatior*, *Agrostis vulgaris*, *Holcus lanatus*, *Cynodon dactylon*, *Avena sativa*, *Avena fatua*, *Lotus corniculatus*), a mixture of grain pollens (oats, wheat, barley, corn), a mixture of tree pollens (*Acer pseudoplatanus*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Tilia platyphyllos*, *Platanus vulgaris*), weed-mix pollens (*Medicago sativa*, *Trifolium pratense*, *Brassica nigra*, *Urtica dioica*, *Rumex acetosa*), *Alternaria alternata*,

cockroaches (*Blattella germanica*), and cat and dog dander (Stallergenes SA, 92160 Antony, France) were performed on the anterior surface of the forearm using a Stallerpoint device (Stallergenes). Histamine (10 mg/ml) and physiological saline were used as positive and negative references, respectively. Skin reactions were evaluated 20 min after the skin test. A positive reaction was defined as a wheal diameter  $\geq 3$  mm. Atopy was defined as at least one positive reaction to one allergen.<sup>5</sup>

#### SES variables

We used the socioeconomic index developed by Borotav and Belek to assess SES.<sup>6</sup> The socioeconomic indices were calculated from information on parent education level and occupation, family social class, annual family income, and health insurance status.

**Table III.** Scoring System for the Social Class-Weighted Socioeconomic Index.

Mother's education level	Household social class	Social class-weighted socioeconomic index
Education Points	Social Points	Class
Illiterate	1 Employer	45
Literate	2 Highly educated, self-employed	40
Left primary school in first grade	3 Highly trained, paid	35
Primary school graduate	5 White-collar worker	30
Left secondary school	6 Small artisan/craftsman	25
Secondary school graduate	8 Blue-collar worker	20
Left high school	9 Unskilled service worker	15
High school graduate	11 Works whenever job available	10
Left college	13 Unemployed	5
College graduate		

### Family social class

Social class designation was determined by the profession of the highest earning parent. The social class categories were “upper social class” (small and middle/large employers, highly educated self-employed individuals, highly educated workers), “middle social class” (white- and blue-collar workers and small artisans/craftsmen), “lower social class” (unskilled service workers, workers in temporary jobs, and unemployed individuals).

### Socioeconomic indexes

We performed subgroup analyses using weighted indices of the mother’s education level and household social class (based on the social class of the head of the household). The equally weighted socioeconomic index used a scoring system in which the mother’s education level and household social class were equally weighted (Table I). In the education-weighted socioeconomic index, the mother’s education level was weighted more heavily than household social class (Table II). Social class was weighted more heavily than the mother’s education level in the social class-weighted socioeconomic index (Table III). We used the socioeconomic index scores to categorize the families into lower, middle, or upper SES groups.

### Statistical analysis

The Statistical Package for the Social Sciences for Windows 15.0 (SPSS, Inc., Chicago, IL, USA) was used to conduct the statistical tests. The continuous variables are expressed as the mean  $\pm$  SD or the median based on a normal distribution. Student’s independent *t*-tests were used to compare normal and homogeneous distributions of parametric values. Chi-square and Mann–Whitney *U*-tests were used to compare nonparametric values. Multivariate logistic regression was used to identify significant risk factors for atopy. *P*-values  $<0.05$  were deemed to indicate statistical significance.

### Results

The study included 253 children who had allergic diseases based on the ISAAC questionnaire. Of those, 83 were SPT positive (Group I) and 170 were SPT negative (Group II). Additionally, 170 students with no allergies were randomly assigned to the control group (Group III).

### Gender

Group I included 31 (37.3%) males and 52 (62.7%) females, Group II had 126 (74.1%) males and 44 (25.9%) females, and the control

**Table IV.** Characteristic and Demographic Features of the Cases.

	SPT positive (Group I)	SPT negative (Group II)	P
Gender			
Male	31 (37.3%)	70 (41.2%)	0.55
Female	52 (62.7%)	100 (58.8%)	
Number of siblings			
2 and below	45 (55.6%)	105 (64%)	0.20
3 and above	36 (44.4 %)	59 (36%)	
Breastfeeding (month)	12.21 $\pm$ 7.46	11.55 $\pm$ 7.44	0.51
Passive smoking			
Present	51 (61.4%)	86 (50.6%)	0.10
Absent	32 (38.6%)	84 (49.4%)	
Family history of asthma			
Present	17 (20.5%)	12 (7.1%)	0.02
Absent	66 (79.5%)	158(92.9%)	
Family history of allergic rhinitis			
Present	30 (36.1%)	17 (10%)	<0.001
Absent	53 (63.9%)	153(90%)	
Family history of atopic dermatitis			
Present	6 (7.2%)	9 (5.3%)	0.57
Absent	77 (92.8%)	161 (94.7%)	
Timing of additional food during infancy (month)	6.23 $\pm$ 1.77	6.55 $\pm$ 2.61	0.30

**Table V.** Socioeconomic Status of Children in Groups I, II, III and Comparisons of Groups I and II Versus Group III According to Socioeconomic Status.

	Group I n (%)	Group II n (%)	Group III n (%)	Group I - III P	Group I-II P	Group II - III P
Equally weighted socioeconomic group A	49 (59)	107 (62.9)	21 (12.4)	<0.001	<0.001	<0.001
Middle and Upper socioeconomic group A	34 (41)	63 (37.1)	149 (87.6)			
Education-weighted socioeconomic group B	69 (83.1)	136 (80)	22 (12.9)	<0.001	<0.001	<0.001
Middle and Upper socioeconomic group B	14 (16.9)	34 (20)	148 (87.1)			
Social-class weighted socioeconomic group C	56 (67.5)	108 (63.5)	36 (21.2)	<0.001	<0.001	<0.001
Middle and Upper socioeconomic group C	27 (32.5)	62 (36.5)	134 (78.8)			

group included 70 (41.2%) males and 100 (58.8%) females. No significant gender-related differences were found between Group I and the control group; however, Group II had significantly more males than did the control group ( $p < 0.001$ ). The logistic regression analysis revealed that the likelihood of developing allergic diseases (Group I-II) in males was 4.09 times higher than that for the control group (Group III) (Odds ratio (OR): 4.09, 95%)

**Number of siblings**

The average number of siblings was two (range, 0–7 siblings). Atopy was detected in 45 children who had two siblings (55.6%) and in 36 children who had three or more siblings (44.4%). We did not find a significant association between the number of siblings and atopy ( $p=0.20$ ) (Table IV).

**Breastfeeding**

The overall average duration of breastfeeding was 11.7 months (range, 0–48 months): 12.2 months in Group I and 11.5 months in Group II. No significant association was found between breastfeeding duration and atopy ( $p>0.05$ ) (Table IV).

**Passive smoking**

In Group I, 51 (61.4%) children were exposed to passive smoking at home compared with 32 (17.7%) children in Group II. Passive smoking was not significantly associated with atopy ( $p = 0.10$ ). Similarly, the smoking rate of parents was not associated with the incidence of atopy in the children ( $p = 0.057$ ,  $p = 0.32$  for groups I and II, respectively) (Table IV).

**Family history of asthma**

A total of 17 (20.5%) children in Group I had a family history of asthma compared with 12 (7.1%) children in Group II. Our findings revealed that a family history of asthma significantly increased the risk of atopy in children ( $p = 0.02$ ) (Table IV).

**Family history of allergic rhinitis**

In Group I, 36 (43.3%) children had a family history of allergic rhinitis compared with 17 (10%) children in Group II. We found a significant association between family history of allergic rhinitis and the risk of atopy in children ( $p < 0.001$ ) (Table IV). The logistic

regression analysis revealed that the likelihood of developing allergic diseases in children with a family history of allergic rhinitis was 2.42 times higher than that of children in the control group (OR: 2.42, 95%)

#### **Socioeconomic status**

We found that the incidence of atopic disease was significantly higher among children in the lower than in the other social class groups ( $p < 0.001$ ). Comparisons of Groups I and II with the control group revealed that significantly more children with allergic disease, with or without atopy, were in the lower SES group ( $p < 0.001$  for both; Table V). Furthermore, the logistic regression analysis revealed that the likelihood of developing allergic diseases in children whose families had a lower SES was 12 times greater than that of children in the control group (OR: 12.05, 95%).

#### **Discussion**

We investigated the relationship between social status and the incidence of allergic diseases and atopy. Contrary to the hygiene hypothesis, we found a higher incidence of allergic diseases and atopy in the children of parents of lower SES. Furthermore, the analyses of the equally weighted, social class-weighted, and education-weighted SES groups revealed that significantly more children from low SES families had atopy or allergic diseases ( $p < 0.001$ ). Our study differs from previous studies in that the epidemiological conditions were optimal: all of the children in our sample were the same age and lived in the same region. Furthermore, because our study was conducted in inner-city schools in Kemalpaşa, an industrial area with several environmental risk factors for allergies and atopic disease, the setting provided an excellent laboratory for exploring several risk factors.

We used the socioeconomic index scoring system developed by Boratav to standardize SES. Boratav's study of social class in Turkey was one of the investigations to use theoretical and empirical approaches. The findings of several recent Turkish investigations of SES using Boratav's social class index, which is based on the profession of the head of the household, suggest that this index is sensitive to health indicators<sup>6</sup>. Thus, we used Boratav's socioeconomic index to assess SES.

Several studies have been conducted to clarify the relationship between bronchial asthma and socioeconomic conditions.<sup>6,8-14</sup> Although some previous studies have found that allergic diseases were more common among families of higher SES<sup>6</sup>, others have found no association<sup>8</sup> or have reported that allergic diseases were more common in families of lower SES.<sup>9-11</sup> Stewart et al.<sup>7</sup> found no association between SES and the prevalence of asthma. Persky et al.<sup>10</sup> and Duran-Tauleria et al.<sup>11</sup> found a negative correlation between the severity of asthma and SES. Investigations of the association between allergic diseases and SES in Turkey have yielded conflicting results.<sup>12,13</sup> While studies conducted in Ankara, Istanbul, and Edirne found no association between SES and allergic diseases, a prevalence study conducted in Edirne, found that higher SES was a risk factor for asthma<sup>13</sup>. Talay et al.<sup>14</sup> reported that lower SES increased the risk of asthma. These findings suggest a relationship between SES and the prevalence of allergic diseases, although the nature of the relationship is controversial. A number of factors, particularly environmental and genetic, may account for these disparate findings.

We examined the impact of SES on the incidence of allergic diseases and atopy and the demographic characteristics of children with these conditions. The logistic regression analysis revealed that the likelihood of males developing allergic disease was 4.09 times higher (Group I-II) compared with the control group. Although some studies have found that males are at higher risk of asthma before adolescence, this finding is controversial.<sup>15,16</sup> Overall, previous studies suggest that asthma symptoms are more common in males before puberty and in females at and after puberty; this difference is attributed to hormonal differences and gender-related differences in the development of the lungs and airways.<sup>16</sup> Airway size is larger in girls until puberty and in males at and after puberty.<sup>16</sup> Moreover, differences in anatomical development may contribute to variations in symptom sensitivity.<sup>16</sup> We investigated the association between the number of siblings and atopy, which we believe is associated with SES. We found that the number of siblings or people/siblings living at home was not associated with the incidence of allergic diseases with or without atopy. In a meta-analysis of studies investigating the

relationship between family size and asthma symptoms, Karmaus and Botezan<sup>17</sup> reported that 22 studies found that bronchial asthma symptoms decreased as family size increased and six studies found no association between the incidence of asthma and family size. Wang et al.<sup>18</sup> conducted a study in five Canadian cities in 2003 and found no relationship between the number of people living at home and the incidence of bronchial asthma. In a study conducted in 2009 in Denizli, Turkey, Akçay et al.<sup>19</sup> found no association between the number of people living at home and bronchial asthma.

We investigated the effect of exposure to passive smoking at home and parents' smoking rate on the development of atopic diseases. Exposure to smoking during childhood is a known risk factor for allergic diseases, particularly bronchial asthma. A study of the association between exposure to smoking and asthma in 4,331 children aged 0–5 years found a more than 2.1-fold increased risk of asthma in children whose mothers smoked at least half a pack of cigarettes per day, and the risk was 2.6 times greater in 1-year-old children<sup>17</sup>. Kulig et al.<sup>20</sup> reported that postnatal exposure to cigarette smoke was a risk factor for the development of wheezing in the first 3 years of life, inhibition of lung function development up to 7 years of age, and for the development of bronchial asthma after 7 years of age. We found no significant relationship between exposure to smoking at home and the incidence of atopy in children ( $p=0.10$ ). Furthermore, we did not find an association between atopy and the smoking rate of parents ( $p=0.07$ ,  $p=0.32$ ). The fact that cigarette smoking is very common in Turkey may explain this negative finding.

We examined the relationship between breastfeeding duration and the incidence of atopy. Although information about breastfeeding and its duration varies among countries and regions, several studies have shown that breastfeeding is protective against the development of wheezing in early childhood. In a 2-year follow-up study, Wright et al.<sup>21</sup> found a significant reduction in the prevalence of recurrent wheezing in children fed only breast milk for 4 or more months. However, our finding of no association between the duration of breastfeeding and atopy ( $p > 0.05$ ) is consistent with that of Selcuk et al.<sup>22</sup>, who found no association between

breastfeeding duration and bronchial asthma or other allergic diseases in a study conducted in Edirne, Turkey. Given that most of the children with allergic diseases and atopy in our study were in the lower SES group and that lower SES is associated with lower maternal education level, we suggest that factors in addition to education contributed to the education-related differences in breastfeeding. Whether to breastfeed is a decision that all mothers must make regardless of their SES or level of education.

The etiology of atopic diseases is thought to involve a complex interaction between environmental and genetic factors, with the genetic contribution estimated to be 50–70%<sup>23</sup>. Twin studies conducted in Denmark found that the prevalence of asthma was 4.8% in dizygotic and 19.8% in monozygotic twins, whereas an Australian study found that the prevalence was 12% in dizygotic and 30% in monozygotic twins.<sup>24</sup> Kalyoncu et al.<sup>25</sup> reported that a family history of atopy is the most important risk factor for all types of allergic diseases. Similarly, we found that family histories of atopy ( $p = 0.02$ ) and allergic rhinitis ( $p = 0.00$ ,  $p < 0.05$ ) were significantly associated with increased risk of atopic diseases in children. However, a family history of eczema was not significantly associated with atopy ( $p = 0.57$ ,  $p < 0.05$ ).

In conclusion, we found that the prevalence of atopic disease was significantly higher in the children of families of lower SES. Our findings contradict the hygiene hypothesis, which postulates that atopy and allergic diseases are more prevalent in the children of families of higher SES. Kemalpaşa is in an industrial area with a large population due to frequent migration. Thus, poverty, overcrowding, and environmental risk factors such as severe air pollution, poor hygiene, smoking, poor ventilation, inadequate heating, and humidity may have increased the risk of atopic disease in our study population.

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