

## PREVALENCE AND RISK FACTORS OF ALLERGIES IN TURKEY

### (PARFAIT): Results of Adults of a Multicentric-Cross Sectional Study#.

Emel Kurt<sup>1,2</sup>, Selma Metintas<sup>3</sup>, Ilknur Basyigit<sup>4</sup>, Ismet Bulut<sup>5</sup>, Evsen Coskun<sup>6</sup>, Sennur Dabak<sup>7</sup>, Figen Deveci<sup>8</sup>, Fatma Fidan<sup>9</sup>, Hasan Kaynar<sup>10</sup>, Esra Kunt Uzaslan<sup>11</sup>, Kevser Onbasi<sup>12</sup>, Sibel Ozkurt<sup>13</sup>, Gulden Pasaoglu Karakis<sup>14</sup>, Sami Sahan<sup>15</sup>, Unal Sahin<sup>16</sup>, Kivilcim Oguzulgen<sup>2</sup>, Fusun Yildiz<sup>2</sup>, Dilsad Mungan<sup>2</sup>, Arzu Yorgancioglu<sup>2</sup>, Bilun Gemicioglu<sup>2</sup>  
A. Fuat Kalyoncu<sup>2</sup>, for the PARFAIT Study of Turkish Thoracic Society Asthma-Allergy

Working Group.

<sup>1</sup> Eskisehir Osmangazi University Pulmonary Diseases Dept., Eskisehir,

<sup>2</sup> Asthma and Allergy Working Group of Turkish Thoracic Society.

<sup>3</sup> Eskisehir Osmangazi University Public Health Dept., Eskisehir;

<sup>4</sup> Kocaeli University Pulmonary Diseases Dept., Kocaeli;

<sup>5</sup> Abant Izzet Baysal University Pulmonary Diseases Dept, Duzce;

<sup>6</sup> Celal Bayar University Pulmonary Diseases Dept, Manisa;

<sup>7</sup> Ondokuz Mayıs University Public Health Dept, Samsun;

<sup>8</sup> Firat University Pulmonary Diseases Dept., Elazig,

<sup>9</sup> Kocatepe University Pulmonary Diseases Dept, Afyon,

<sup>10</sup> Ataturk University Pulmonary Diseases Dept, Erzurum;

<sup>11</sup> Uludag University Pulmonary Diseases Dept, Bursa;

<sup>12</sup> Yuzuncuyil University Internal Medicine Dept., Van

<sup>13</sup> Pamukkale University Pulmonary Diseases Dept, Denizli;

<sup>14</sup> Acibadem Hospital, Istanbul

<sup>15</sup> State Hospital, Tarsus;

<sup>16</sup> Suleyman Demirel University Pulmonary Diseases Dept, Isparta;

\*Names from <sup>4</sup> to <sup>16</sup> were written by alphabetical order.

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**Correspondant author:** Emel Kurt, MD

Eskisehir Osmangazi University

Pulmonary Diseases-Allergy Department

26040 / Eskisehir-Turkey

Fax: 0 222 2394714

Mail adress: dremelkurt@yahoo.com

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## ABSTRACT

**Aim:** PARFAIT (Prevalence And Risk Factors of Allergies in Turkey) study was planned to evaluate prevalence and risk factors of asthma and allergic diseases in Turkey.

**Method:** This analysis used data from 25843 parents of primary school children obtained from cross sectional-questionnaire based study.

**Results:** 25843 questionnaires from 14 centers were evaluated. In rural area, the current prevalences and 95% confidence interval of asthma, wheezing, allergic rhinitis and eczema were as follows respectively; 8.5% (7.9-9.1), 13.5% (12.8-14.2), 17.5% (16.7-18.2), 10.8% (10.2-11.4) in men and 11.2% (10.9-11.8), 14.7% (14.3-15.1), 21.2% (20.4-22.0), 13.1% (12.4-13.8) in women. In urban area, they were 6.2% (5.8-6.6), 10.8% (10.3-11.3), 11.7% (11.4-12.0) and 6.6% (6.2-7.0) respectively in men and 7.5 % (7.9-7.1), 12.0% (11.7-12.3), 17.0% (16.4-17.6) and 7.3% (6.9-7.7) respectively in women. Having an atopic first degree relative and one of other atopic diseases had significant effects on the prevalence of allergic diseases. Housing conditions such as living in a shanty type house, visible molds at home and use of wood or biomass as heating or cooking material were associated with one or more of these diseases.

**Conclusion:** Although genetic susceptibility is strongly associated, country and population based environmental factors may contribute to increased prevalence rates of allergic diseases.

**Key words:** allergy, asthma, risk factors, prevalence, Turkey.

## INTRODUCTION

Prevalence of allergic diseases and related risk factors in adults were studied in a number of studies which were mainly focused on certain occupations in Turkey. Asthma or asthma like-symptom prevalence was 10.7% in automobile painters, 8.9% in furniture painters, 14.6% in hairdressers, 18.7% in furniture decoration students, 17.6% in rose cultivators and 14.1% in florists (1-5). A small number of study regarding prevalence of asthma and allergic diseases in general adult population has recently been conducted in Turkey. Current prevalence of asthma, wheezing and allergic rhinitis were reported as 2.1%, 6.9% and 12.7 in boys and 2.5%, 7.2% and 14.5% in girls respectively in university students in Ankara (6). In another study asthma like symptoms, rhinoconjunctivitis and dermatitis were reported as 17%, 10% and 5.9% respectively in university students (7). The reported current prevalence ranges from 3.1% to 9.4% for doctor diagnosed asthma (8-12) and from 19.3% to 20.9% for asthma symptoms (8, 9). Allergic rhinitis was reported as 27.7% in a population based study (11). As it is seen, data on adult allergic diseases is collected from different studies in which different methods were used within different time periods. The risk factors of allergic diseases in Turkish population are less evaluated. Risk factors associated with asthma and allergic diseases in adults include familial or personal atopy (6,7), female sex (9), personal or passive smoking at home (6,7), pet ownership in childhood (6) and living in rural area (8).

The present study regarding adult population, is a part of PARFAIT (Prevalence and Risk Factors of Allergies in Turkey) study which was planned to evaluate prevalence and risk factors of asthma and allergic diseases in Turkey within the same time period using the same questionnaire in all centers to obtain comparable data in different regions of the country.

## **METHODS**

Turkey is located in both Asia and Europe, has coasts on the Mediterranean, Black Sea and Aegean Sea, with a population of approximately 67 millions (result of the last census in 2000).

Study population:

Fourteen cities were selected for inclusion in the study from different geographical locations of the country (Figure 1). Schools were selected from rural and urban areas of each city randomly. In this cross sectional study questionnaires were distributed to children in the primary schools and completed by the parents at home. Teachers were also informed about the study and helped to increase the participation.

Questionnaire:

Questionnaire included questions on educational and social status of subjects and on current (during the last year) allergic diseases. Prevalence of current asthma, wheezing and allergic diseases were defined by the 'yes' response to the following:

Asthma: Have you ever had asthma, bronchitis, spastic bronchitis or allergic bronchitis during the last year?

Wheezing: Have you ever noticed a whistling sound or wheezing/rattle sound from your chest during the last year?

Allergic rhinitis: Did you have seasonal (hay fever) or perennial allergic rhinitis during the last year?

Eczema: Did you have eczema over elbows and/or knees during the last year?

Family history of any of the above allergic diseases in a first degree relative was used to define atopic family history.

Housing characteristics were assessed by the following questions:

- a. What type of house do you live in? Apartment flat, single family house, shanty type
- b. What's the construction material of your house? Concrete, Brick, wood, .....
- c. How many rooms are there in your house?

- d. What's the flooring material of your house? Wood, concrete, etc...
- e. Amount of the carpets in your home: less than half of floor, more than half of floor
- f. Houseplants: yes, no
- g. Pets at home: yes, no
- h. Visible molds in your house: yes, no
- i. Smoking at home: Number of persons who smoke...., total number of cigarettes a day.
- j. Number of persons living in the house:....
- k. Type and material of heating: stove/central/other ..., natural gas/wood/coal/other ...
- l. Which material do you use for cooking: natural gas/wood/coal/other (biomass, lpg, ...)

The reliability and validity of the questionnaire had been tested and was appropriate in a previous study (6). The questionnaire in this study included additional questions on living conditions and personal characteristics.

*Statistical analysis:*

Each city was accepted as a sample group. Student's t-test for continuous variables was used to compare risk factors and chi-square test was used to compare prevalences in study group. Standardized prevalence rates of each allergic disease were calculated by taking study group as standardized population (Table 2). Basically age specific rates are computed for population by using direct standardization method. These rates are applied to the number of persons in the corresponding age group in the standard population and the results are summed to obtain the total number of cases that would have occurred in the standard population had it experienced the same age specific rates as the study population. The sum is divided by the total number of persons in the standard population and given an appropriate base to become the standardized rate in the study population (13).

Adjusted prevalence rates of each allergic disease in the centers were given with 95% confidence intervals (CI) (Table 3). Prevalence rates of allergic diseases in each center were

adjusted directly according to the ratios of age and rural/urban residence (14). Adjusted prevalence rates and their 95% CI were obtained the following logistic regression model was fitted:

$$\text{Logit}(\pi) = \beta_0 + \beta_1(\text{rural/urban residence}) + \beta_2(\text{age}) + \varepsilon$$

$\pi$  is the prevalence of a specific symptom for the city. Then the adjusted prevalence rates were estimated through the equation;  $\text{Prevalence} = \exp[\text{logit}(p)] / [1 + \exp[\text{logit}(p)]]$ . Where  $p$  is the estimation of  $\pi$  and ages, rural/urban residence were set equal to the overall mean or distribution, respectively.

Logistic regression analysis was used to assess the independent association between possible risk factors and allergic diseases in males and females separately. The strength of the relationship between risk factors and the diseases was evaluated by calculating odds ratios (OR) and their 99% CI for all the factors tested. Adjusted odds ratios and 99% confidence limits for risk factors were calculated with coefficients and standard errors obtained from logistic regression models for each of the allergic diseases. Univariate logistic regression analysis was used for calculation of odds ratios (Table 4 and 5); each univariate factor was then tested separately in a multiple logistic regression model with adjustment for age and centers. Variables included in multivariate logistic regression model were selected from these results which had a significance of less than 0.10 in univariate logistic regression analysis (Table 6 and 7). Age was analysed as continuous covariate. All other variables were coded as categorical covariates which were taken to the model dichotomously. The data was analysed with SPSS computer program for Windows version 11.0.

## RESULTS

### Demographic characteristics:

Questionnaires from 14 cities were analysed. Totally 30000 questionnaires were distributed in all centers. The overall response rate was 92.3%. Of the collected 27690 questionnaires, 25843 were appropriate for analysis. The questionnaires with missing responses which could affect the quality of the data were accepted as inappropriate. Of these 60.2% was from metros in accordance with the distribution of Turkey's population. Rural/urban distribution ranged from 0.43 to 1.02 (median 0.64) between the regions.

Prevalence rates of demographic characteristics and proposed risk factors in rural and urban residents are in Table 1. Living in a single family house, use of wood and brick as construction material in houses and the presence of pets and molds at home are more prevalent in rural area ( $p < 0.001$ ). Main heating material in houses is wood in rural area whereas it is coal in urban area. Smoking is more prevalent in women living in urban than those living in rural area whereas it is the opposite in men ( $p < 0.001$ ). Prevalence rates of asthma, allergic rhinitis and eczema were higher in people living in rural area (Table 2).

Adjusted prevalence rates of allergic diseases and wheezing standardized to age and rural/urban residence in each center are in Table 3.

#### **Univariate analysis:**

Allergic diseases in women and men were significantly associated with family history of any of these diseases and presence of other personal allergic disease in both rural and urban area (Table 4 and 5).

##### **1. Rural area:**

Results from univariate risk analysis adjusted to age and centers in rural area are presented in Table 4. Shanty type housing and presence of visible molds at home were strongly associated with higher prevalence rates for all allergic diseases. Use of wood and biomass for cooking material was strongly associated with increased risk of allergic diseases when compared with use of gas. Personal smoking was associated with the increased risk of wheezing, allergic rhinitis and eczema in men whereas it was associated with asthma,

wheezing and allergic rhinitis in women. All allergic diseases were associated with passive smoking at home except asthma in women which had a weak association. Living near an animal barn was associated with all allergic diseases except wheezing in men. Livestocking was strongly associated with asthma, allergic rhinitis and eczema in women although it was strongly associated with allergic rhinitis in men.

## 2. Urban area:

Odds ratios and 99% confidence intervals of risk factors after adjustment for age and centers in urban area are in Table 5. Living in a single family house, living in a shanty type house, visible molds at home and use of wood as heating material were all strongly associated with increased prevalence of all diseases in men and women. Use of wood and biomass for cooking were strongly associated with respiratory diseases in men although it was associated with allergic rhinitis and eczema in women. Personal smoking and passive smoking were related with wheezing in both gender.

### **Multivariate analysis:**

Multiple logistic regression analysis of risk factors are presented in Table 6 and Table 7 for rural and urban area, respectively. Among all variables having an atopic first degree relative and one of other atopic diseases had significant effects on the prevalence of allergic diseases in both rural and urban area for both sex.

## 1. Rural area

Housing conditions which have strong association with allergic diseases in men followed as; for asthma; visible molds at home, for allergic rhinitis; living in a shanty type house and molds at home, for eczema; visible molds at home and exposure to passive smoking. Wheezing in men was strongly associated with molds at home, personal and passive smoking.



Housing conditions which have increased risk of allergic diseases in women followed as; for asthma; visible molds at home, for wheezing; molds at home and personal smoking, for allergic rhinitis; passive smoking at home, for eczema; molds at home.

House plants were associated with decreased risk of asthma and wheezing in women.

## 2. Urban area:

Environmental factors with an increased risk of allergic diseases in men followed as; for wheezing; living in a shanty type house, molds at home, personal and passive smoking, for allergic rhinitis; living in a shanty type house and use of wood and biomass as cooking material, for eczema; visible molds at home.

Environmental risk factors strongly associated with women's diseases followed as; for asthma; shanty type housing, for wheezing; shanty type housing, molds at home, personal and passive smoking, for allergic rhinitis; living in a shanty type house, visible molds at home, use of biomass and wood for heating, for eczema; living in a shanty type house and molds at home.

## **DISCUSSION**

This is the first multicenter study evaluating the risk factors on prevalence of allergic diseases in general adult population in Turkey. Family history of atopy and the presence of other atopic disease were significantly associated with all allergic diseases. This study revealed that in addition to familial predisposition some microenvironmental characteristics such as indoor factors also play an important role in the occurrence of allergic diseases in adulthood. There is evidence that allergic diseases are modified by genetic background and affected by exposure to environmental agents. Association of allergic diseases with genetic predisposition was well documented in children (15). Familial factors could have higher impact on prevalence of allergic diseases not because of genetic transmission of atopy but also sharing the same environmental risks by family members. Epidemiological studies on environmental risk factors mostly focused on microenvironmental characteristics such as

housing and life style which are more preventable. Although, the exact role of indoor exposures' in allergic diseases has yet to be clarified, it is suggested that there are a lot of factors which could be linked to allergic diseases. One of these factors, indoor dampness causes infestation of homes with house dust mites and growth of molds and associated with asthma and respiratory symptoms in adults (16). Our study confirmed positive association between allergic diseases and visible molds at home. Living in a house with visible molds increased respiratory problems such as asthma and wheezing especially in rural areas in both men and women. Living in a shanty type house was strongly associated with allergic diseases especially in urban areas. These type of houses are exceptional to the architectural regulations and are constructed in the periphery of cities with poor life conditions such as lack of water, gas and sewer system from the city municipality network. Previous studies confirmed that houses with basement floors which have higher frequency of house dust mites cause respiratory symptoms when compared with flats (17, 18). Our study supported that respiratory allergic diseases and respiratory symptoms could be increased in those persons living in shanty type houses as compared with those living in flats.

Materials such as wood and biomass which are used for heating and cooking in houses of rural and peripheral district of urban areas accounted for the higher prevalence of allergic diseases in univariate analysis. However multivariate analysis showed that use of wood and biomass as heating or cooking material had significant effect on allergic rhinitis when compared with use of gas only in urban areas. The houses which use wood and biomass for cooking probably use the same materials for heating as well. So some accompanying factors may mask the effects of each other in the analysis. Use of wood for heating and cooking has been shown to be related with higher prevalence of allergic diseases in previous studies (19). In addition, people use dung for heating and cooking in some parts of Turkey, which is a different risk factor characteristic to Turkey.

Tobacco smoke causes inflammation of the airways by activation of inflammatory cells, enhances proinflammatory mediator release and neurogenic inflammation (20). It is well known that household tobacco smoke increase asthma and allergic diseases in children. In the adult population it is less documented. In an adult population Greer et al. showed that asthma development was related with environmental tobacco smoke (21) Although our univariate analysis showed more association between smoking and allergic diseases, multivariate analysis confirmed an association between wheezing and personal smoking. In addition, nonsmokers exposed to household tobacco smoke had higher risk of wheezing in our adult population confirming that smoke exposure increases asthma symptoms in adults rather than contributing its occurrence.

Although, some previous studies in Europe reported higher prevalence of asthma and allergic diseases in urban area than rural area, we did not find such an association (22,23). Some studies outside Europe did not report the protective effect of rural life (24-26). Discrepancies for the rural risk factors could be explained by differences in cultures between countries or the characteristics of rural/urban population studied. In fact, the term “rural” is also variable. For example, in Turkey rural area is accepted as a settlement which has a population of less than 10,000 and urban area has a population of more than this regardless of other factors (water supply, electricity, etc.). In our study, some of urban population consisted farmers which is a feature of rural residency. However urban and rural farmers showed different characteristics. Indoor occupations such as workers, officials and merchants showed decreasing effect on asthma, wheezing and eczema in urban residents when compared with farming (Table 7). Probably other rural risk factors might show differences in Turkey and account for the disease development. Confirming this suggestion our results showed that adults living in rural area had higher risk ratios for all allergic diseases than those living in urban area. About 37% of rural residents were livestock farmers and had an animal barn near their houses. Living near an animal barn and livestocking weakly associated with wheezing

and allergic rhinitis in women within this 99% CI limits (Table 6). It is probable that women spend more time in houses and in those barns near houses which causes more symptoms as a result of increased exposure of a lot of livestocking products in rural areas.

This is the first multicentric epidemiological study on the prevalences and risk factors of allergic diseases and wheezing in Turkey. Limitations exist, due to its questionnaire-based design. Although the response rate was good for our study, information bias could not be completely ruled out. In other words we could not control for all potential individual risk factors, because allergic diseases can be affected by several factors that were not examined at that time. In the present study there were multiple comparisons between variables and the diseases which might cause false positive results. To avoid this, we made some allowance for having multiple comparisons by calculating 99% confidence intervals for risk factors. Other factors could also have contributed to our findings. For example, there may be some personal tendencies such as avoidance from smoking in allergic persons. In addition some measures could be taken by allergic families at home such as removing carpets or plants. In accordance with this suggestion having plants at home showed decreasing effect on asthma and wheezing in women (Table 6).

In conclusion, this study have suggested that household and country-specific environmental factors are associated with increased asthma, wheezing, allergic rhinitis and eczema risk in adult population of Turkey. Considering these risk factors, some measures could be offered to prevent allergic diseases in the country or population specific basis. We also suggest that population or country specific risk factors have to be regarded in the evaluation of allergic diseases and asthma.

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**Table 1:** Percentages of prevalence rates of demographic characteristics and proposed risk factors in rural and urban residents.

<b>Variable</b>	<b>Rural</b>	<b>Urban</b>	<b>P</b>
<b>Number</b>	10289	15554	
<b>Mean age of women (SD)</b>	35.1(5.9)	35.1 (5.3)	0.802
<b>Mean age of men (SD)</b>	40.5 (7.6)	39.4 (6.0)	<0.001
<b>Occupation of women (%)</b>			<0.001
Housewife	94.4	78.9	
Worker	3.9	4.2	
Official	0.6	11.1	
Other	1.1	5.8	
<b>Occupation of men (%)</b>			<0.001
Farmer	31.3	20.8	
Worker	37.6	26.6	
Official	9.4	40.1	
Merchant	21.7	12.5	
<b>Familal atopy in women (%)</b>	29.9	28.9	0.10
<b>Familial atopy in men (%)</b>	24.5	24.3	0.715
<b>Any other allergic disease in women (%)</b>	23.0	21.0	<0.001
<b>Any other allergic disease in men (%)</b>	20.8	17.7	<0.001
<b>House type(%)</b>			<0.001
Apartment	14.2	71.1	
Single family house	78.0	26.4	
Shanty	7.8	2.5	
<b>Construction material of the house (%)</b>			<0.001
Concrete	72.6	95.1	
Wood	9.9	1.9	
Brick	17.5	3.0	
<b>Plants at home (%)</b>	57.6	65.8	<0.001
<b>Pets at home (%)</b>	17.6	9.5	<0.001
<b>Molds at home (%)</b>	17.1	10.7	<0.001
<b>Heating material of the house (%)</b>			<0.001
Natural gas	0.2	26.3	
Wood	71.7	22.4	
Coal	23.4	44.6	
LPG	0.2	0.7	
Other (ie.Biomass)	4.5	6.0	
<b>Using natural gas as cooking material (%)</b>	2.0	21.1	<0.001
<b>Using natural gas+lpg as cooking material (%)</b>	81.3	98.0	
<b>Smoking in women (%)</b>	12.4	26.6	<0.001
<b>Smoking in men (%)</b>	57.4	49.6	<0.001
<b>Living near an animal barn (%)</b>	37.0	-	
<b>Livestocking(%)</b>	37.2	-	

**Table 2:** Standardized prevalence rates of allergic diseases and wheezing in rural and urban areas in all adults.

	<b>Men, (95% CI)</b>		<b>Women, (95%CI)</b>	
	Rural	Urban	Rural	Urban
<b>Asthma</b>	8.5 (7.9-9.1)	6.2 (5.8-6.6)	11.2 (10.9-11.8)	7.5 (7.9-7.1)
<b>Wheezing</b>	13.5 (12.8-14.2)	10.8 (10.3-11.3)	14.7 (14.3-15.1)	12.0 (11.7-12.3)
<b>Allergic rhinitis</b>	17.5 (16.7-18.2)	11.7 (11.4-12.0)	21.2 (20.4-22.0)	17.0 (16.4-17.6)
<b>Eczema</b>	10.8 (10.2-11.4)	6.6 (6.2-7.0)	13.1 (12.4-13.8)	7.3 (6.9-7.7)



**Table 3:** Adjusted rates and 95% confidence intervals of allergic diseases in respect to age and rural/urban residence.

City	Men			Women				
	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema
Afyon n=1234	5.9 (4.6-7.2)	9.8 (8.1-11.4)	12.1 (10.3-13.9)	8.3 (6.7-9.8)	7.2 (5.8-8.7)	7.9 (6.4-9.4)	16.2 (14.2-18.3)	10.0 (8.3-11.7)
Bursa n=3956	5.8 (5.0-6.6)	11.0 (10.0-12.1)	13.5 (12.4-14.6)	7.6 (6.7-8.3)	7.5 (6.6-8.3)	13.1 (12.0-14.3)	17.9 (16.6-19.1)	8.7 (7.8-9.6)
Denizli n=1399	8.5 (6.9-10.1)	13.2 (11.3-15.1)	13.5 (11.6-15.4)	9.2 (7.6-10.9)	11.1 (9.4-12.8)	11.5 (9.8-13.2)	19.7 (17.5-21.9)	10.9 (9.2-12.7)
Elazığ n=1731	9.8 (8.4-11.2)	15.8 (14.0-17.5)	16.3 (14.6-18.1)	7.8 (6.6-9.11)	11.1 (9.6-12.6)	14.7 (13.0-16.3)	21.6 (19.7-23.6)	11.4 (9.9-12.9)
Erzurum n=1202	7.4 (5.9-8.9)	11.6 (9.8-13.4)	12.3 (10.5-14.2)	6.7 (5.3-8.2)	10.9 (9.1-12.6)	15.6 (13.6-17.7)	18.6 (16.4-20.8)	10.6 (8.8-12.3)
Eskişehir n=1884	5.7 (4.7-6.8)	11.2 (9.7-12.6)	12.0 (10.5-13.4)	6.0 (4.9-7.1)	7.3 (6.1-8.5)	12.2 (10.7-13.7)	17.8 (16.0-19.5)	7.3 (6.1-8.5)
Isparta n=2139	5.7 (4.7-6.6)	8.2 (7.0-9.3)	10.7 (9.4-12.0)	4.7 (3.8-5.6)	7.6 (6.5-8.8)	7.7 (6.6-8.8)	16.4 (14.8-17.9)	6.6 (5.6-7.7)
Tarsus n=1772	8.4 (7.1-9.7)	15.1 (13.4-16.7)	15.1 (13.4-16.7)	9.5 (8.13-10.8)	11.1 (9.6-12.6)	16.0 (14.3-17.8)	20.5 (18.6-22.3)	11.0 (9.6-12.5)
İstanbul n=1241	5.2 (3.9-6.4)	7.4 (5.9-8.8)	8.0 (6.5-9.6)	6.7 (5.3-8.1)	7.3 (5.8-8.8)	9.9 (8.2-11.6)	11.5 (9.8-13.3)	7.4 (6.0-8.9)
Kocaeli n=1840	7.2 (6.0-8.4)	12.1 (10.6-13.6)	13.1 (11.5-14.7)	9.4 (8.1-10.8)	8.9 (7.6-10.2)	14.2 (12.6-15.8)	18.5 (16.7-20.2)	9.3 (8.0-10.7)
Manisa n=1911	8.0 (6.7-9.3)	13.7 (12.1-15.3)	15.8 (14.1-17.5)	10.6 (9.1-12.0)	9.6 (8.3-11.0)	14.3 (12.7-16.0)	20.6 (18.8-22.5)	11.3 (9.8-12.7)
Samsun n=1971	9.5 (8.0-10.9)	14.0 (12.3-15.6)	17.6 (15.8-19.4)	11.4 (9.9-12.9)	11.2 (9.7-12.7)	16.5 (14.8-18.3)	22.8 (20.9-24.8)	11.6 (10.1-13.1)
Van n=1551	9.4 (8.0-10.9)	15.3 (13.5-17.1)	21.9 (19.8-23.9)	9.5 (8.1-11.0)	10.7 (9.1-12.2)	18.6 (16.7-20.6)	21.7 (19.6-23.7)	10.2 (8.7-11.7)
Düzce n=2032	5.4 (4.4-6.4)	9.4 (8.11-10.7)	13.2 (11.7-14.7)	8.6 (7.4-9.8)	7.8 (6.7-9.0)	11.8 (10.4-13.2)	17.5 (15.8-19.1)	9.0 (7.7-10.2)
TOTAL n=25843	7.1 (6.8-7.4)	11.9 (11.7-12.1)	14.0 (13.8-14.2)	8.2 (8.5-7.9)	9.0 (8.6-9.4)	13.1 (12.7-13.5)	18.7 (18.2-19.2)	9.6 (9.2-10.0)

**Table 4:** Odds ratios and 99% confidence intervals of risk factors after adjustment for age and centers in rural area.

Variable	Men					Female						
	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema
<b>Age</b>	1.02 (0.99-1.05)	1.01 (0.99-1.04)	1.01 (0.99-1.03)	1.00 (0.97-1.03)	<b>1.03 (1.02-1.04)<sup>c</sup></b>	<b>1.03 (1.02-1.04)<sup>c</sup></b>	0.99 (0.99-1.01)	<b>1.04 (1.03-1.05)<sup>c</sup></b>				
<b>Women occupation</b>												
Housewife												
Worker												
Official												
Other												
<b>Men occupation</b>												
Farmer												
Worker												
Official												
Merchant												
<b>Familial atopy</b>												
	<b>7.89 (6.39-9.74)<sup>c</sup></b>	<b>9.38 (7.71-11.41)<sup>c</sup></b>	<b>14.98 (12.36-18.15)<sup>c</sup></b>	<b>13.43(10.79-16.73)<sup>c</sup></b>	<b>5.04 (417-6.08)<sup>c</sup></b>	<b>8.32 (6.87-10.08)<sup>c</sup></b>	<b>12.45(10.40-14.91)<sup>c</sup></b>	<b>13.0 (10.53-15.85)<sup>c</sup></b>				
<b>Having other allergic disease</b>												
	<b>11.18 (8.87-14.10)<sup>c</sup></b>	<b>7.57 (6.42-8.94)<sup>c</sup></b>	<b>5.99 (5.16-6.94)<sup>c</sup></b>	<b>5.32 (4.46-6.35)<sup>c</sup></b>	<b>7.96 (6.49-9.65)<sup>c</sup></b>	<b>6.80 (5.77-8.01)<sup>c</sup></b>	<b>4.93 (4.29-5.65)<sup>c</sup></b>	<b>5.31 (4.45-6.22)<sup>c</sup></b>				
<b>House type</b>												
Apartment flat												
Single family house												
Shanty												
<b>Plants at home</b>												
	<b>1.11 (0.83-1.49)</b>	<b>1.10 (0.87-1.38)</b>	<b>1.04 (0.85-1.28)</b>	<b>1.16 (0.90-1.51)</b>	<b>1.05 (0.80-1.34)</b>	<b>0.99 (0.79-1.24)</b>	<b>1.09 (0.90-1.31)</b>	<b>1.28 (0.99-1.62)<sup>b</sup></b>				
<b>Pets at home</b>												
	<b>1.97 (1.34-2.90)<sup>c</sup></b>	<b>1.70 (1.24-2.34)<sup>c</sup></b>	<b>1.56 (1.17-2.09)<sup>c</sup></b>	<b>1.55 (1.08-2.23)<sup>b</sup></b>	<b>1.76 (1.22-2.45)<sup>c</sup></b>	<b>1.74 (1.28-2.36)<sup>c</sup></b>	<b>1.54 (1.16-2.01)<sup>c</sup></b>	<b>1.83 (1.28-2.53)<sup>c</sup></b>				
<b>Molds at homes</b>												
	<b>0.84 (0.69-1.01)<sup>a</sup></b>	<b>0.94 (0.81-1.10)</b>	<b>1.05 (0.91-1.21)</b>	<b>1.04 (0.88-1.24)</b>	<b>0.81 (0.68-0.95)<sup>c</sup></b>	<b>0.79 (0.68-0.92)<sup>c</sup></b>	<b>1.05 (0.92-1.20)</b>	<b>1.03 (0.87-1.20)</b>				
<b>Heating material</b>												
Natural gas+lpg												
Wood												
Coal												
Other (ie. Biomass)												
<b>Cooking material</b>												
LPG+Natural gas												
Wood+biomass												
<b>Smoking</b>												
	<b>1.55 (1.24-1.94)<sup>c</sup></b>	<b>1.34 (1.11-1.61)<sup>c</sup></b>	<b>1.41 (1.20-1.67)<sup>c</sup></b>	<b>1.45 (1.19-1.78)<sup>c</sup></b>	<b>1.52 (1.23-1.84)<sup>c</sup></b>	<b>1.44 (1.19-1.70)<sup>c</sup></b>	<b>1.38 (1.17-1.61)<sup>c</sup></b>	<b>1.50 (1.23-1.79)<sup>c</sup></b>				
<b>Passive smoking</b>												
	<b>1.15 (0.95-1.40)</b>	<b>1.91 (1.62-2.25)<sup>c</sup></b>	<b>1.41 (1.23-1.63)<sup>c</sup></b>	<b>1.19 (1.01-1.41)<sup>b</sup></b>	<b>1.53 (1.02-1.05)<sup>c</sup></b>	<b>2.26 (1.86-2.74)<sup>c</sup></b>	<b>1.43 (1.20-1.72)<sup>c</sup></b>	<b>1.20 (0.97-1.53)</b>				
<b>Living near an animal barn</b>												
	<b>1.35 (1.04-1.76)<sup>b</sup></b>	<b>1.49 (1.21-1.83)<sup>c</sup></b>	<b>1.30 (1.07-1.58)<sup>c</sup></b>	<b>1.40 (1.11-1.77)<sup>c</sup></b>	<b>1.16 (0.98-1.38)<sup>a</sup></b>	<b>1.41 (1.21-1.65)<sup>c</sup></b>	<b>1.38 (1.21-1.58)<sup>c</sup></b>	<b>1.27 (1.08-1.49)<sup>c</sup></b>				
<b>Livestocking</b>												
	<b>1.22 (1.01-1.48)<sup>b</sup></b>	<b>1.12 (0.96-1.31)</b>	<b>1.26 (1.10-1.45)<sup>c</sup></b>	<b>1.32 (1.11-1.57)<sup>c</sup></b>	<b>1.32 (1.10-1.56)<sup>c</sup></b>	<b>1.31 (1.12-1.52)<sup>c</sup></b>	<b>1.32 (1.15-1.50)<sup>c</sup></b>	<b>1.27 (1.08-1.48)<sup>c</sup></b>				
	<b>1.12 (0.92-1.36)</b>	<b>1.14 (0.97-1.34)<sup>a</sup></b>	<b>1.17 (1.01-1.35)<sup>b</sup></b>	<b>1.18 (0.99-1.40)<sup>a</sup></b>	<b>1.25 (1.04-1.47)<sup>b</sup></b>	<b>1.35 (1.15-1.56)<sup>c</sup></b>	<b>1.12 (0.98-1.29)<sup>a</sup></b>	<b>1.20 (1.04-1.39)<sup>b</sup></b>				

a= p≤0.05, b= p≤0.01, c= p≤0.001

**Table 5:** Odds ratios and 99% confidence intervals of risk factors after adjustment for age and centers in urban area

Variable	Men					Female						
	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema
<b>Age</b>	1.02 (0.99-1.06)	<b>1.03 (1.01-1.06)<sup>b</sup></b>	1.00 (0.98-1.03)	1.01 (0.97-1.06)	<b>1.02 (1.015-1.04)<sup>c</sup></b>	<b>1.00 (0.99-1.02)<sup>a</sup></b>	<b>0.98 (0.97-0.99)<sup>c</sup></b>	<b>1.01 (0.99-1.02)<sup>a</sup></b>				
<b>Women occupation</b>												
Housewife												
Worker												
Official												
Other												
<b>Men occupation</b>												
Farmer												
Worker												
Official												
Merchant												
<b>Familial atopy</b>												
	<b>5.27 (4.36-6.37)<sup>c</sup></b>	<b>7.40 (6.29-8.70)<sup>c</sup></b>	<b>11.66 (9.88-13.77)<sup>c</sup></b>	<b>14.08(11.43-17.35)<sup>c</sup></b>	<b>3.49 (2.94-4.16)<sup>c</sup></b>	<b>5.08 (4.36-5.95)<sup>c</sup></b>	<b>7.99 (6.93-9.20)<sup>c</sup></b>	<b>10.73 (8.79-13.08)<sup>c</sup></b>				
<b>Having other allergic disease</b>												
	<b>15.68 (12.66-19.40)<sup>c</sup></b>	<b>8.35 (7.22-9.66)<sup>c</sup></b>	<b>5.52 (4.80-6.36)<sup>c</sup></b>	<b>4.19 (3.52-4.99)<sup>c</sup></b>	<b>10.97 (9.06-13.31)<sup>c</sup></b>	<b>6.80 (5.92-7.82)<sup>c</sup></b>	<b>4.08 (3.61-4.63)<sup>c</sup></b>	<b>3.42 (2.89-4.04)<sup>c</sup></b>				
<b>House type</b>												
Apartment flat												
Single family house												
Shanty												
<b>Plants at home</b>												
	0.96 (0.80-1.15)	0.95 (0.83-1.10)	0.90 (0.78-1.03)	<b>0.85 (0.71-1.01)<sup>a</sup></b>	<b>0.82 (0.70-0.98)<sup>b</sup></b>	<b>0.84 (0.74-0.97)<sup>c</sup></b>	0.92 (0.82-1.04)	<b>0.79 (0.67-0.94)<sup>c</sup></b>				
<b>Pets at home</b>												
	1.18 (0.89-1.56)	1.08 (0.86-1.35)	0.99 (0.80-1.25)	0.94 (0.70-1.27)	0.86 (0.64-1.15)	1.03 (0.82-1.28)	1.13 (0.94-1.37)	1.06 (0.81-1.40)				
<b>Molds at homes</b>												
	<b>1.74 (1.37-2.22)<sup>c</sup></b>	<b>2.07 (1.72-2.49)<sup>c</sup></b>	<b>1.65 (1.36-1.98)<sup>c</sup></b>	<b>2.31 (1.85-2.87)<sup>c</sup></b>	<b>1.64 (1.31-2.06)<sup>c</sup></b>	<b>2.28 (1.92-2.72)<sup>c</sup></b>	<b>1.68 (1.43-1.98)<sup>c</sup></b>	<b>2.43 (1.97-3.00)<sup>c</sup></b>				
<b>Heating material</b>												
Natural gas+lpg												
Wood												
Coal												
Other (Biomass vb)												
<b>Cooking material</b>												
LPG+Natural gas												
Wood+biomass												
<b>Smoking</b>												
	1.08 (0.90-1.28)	<b>2.03 (1.76-2.34)<sup>c</sup></b>	1.05 (0.92-1.20)	1.05 (0.88-1.24)	1.09 (0.91-1.31)	<b>1.98 (1.73-2.26)<sup>c</sup></b>	1.01 (0.89-1.15)	0.93 (0.77-1.12)				
<b>Passive smoking</b>												
	1.14 (0.94-1.38)	<b>1.55 (1.34-1.79)<sup>c</sup></b>	1.01 (0.87-1.17)	1.01 (0.83-1.23)	<b>1.15 (0.98-1.35)<sup>a</sup></b>	<b>1.45 (1.27-1.66)<sup>c</sup></b>	1.07 (0.96-1.20)	1.12 (0.95-1.32)				

a= p≤ 0.05, b= p≤ 0.01, c= p≤ 0.001

**Table 6:** Odds ratios and 99% confidence intervals of risk factors in multivariate analysis in rural area.

Variable	Men				Female			
	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema
Age					1.17 (1.04-1.33) <sup>a</sup>	1.03 (1.01-1.04) <sup>c</sup>		1.03 (1.01-1.04) <sup>a</sup>
Women occupation				0.92 (0.84-1.03) <sup>a</sup>			0.80 (0.64-1.02) <sup>a</sup>	
Men occupation								
Familial atopy	5.27 (4.17-6.65) <sup>c</sup>	6.53 (5.23-8.19) <sup>c</sup>	12.30 (9.88-14.98) <sup>c</sup>	10.35 (8.13-13.14) <sup>c</sup>	3.66 (2.98-4.50) <sup>c</sup>	5.96 (4.79-7.38) <sup>c</sup>	11.80 (9.64-14.24) <sup>c</sup>	10.40 (8.33-12.95) <sup>c</sup>
Having other allergic disease	8.58 (6.61-11.00) <sup>c</sup>	6.55 (5.33-7.86) <sup>c</sup>	4.75 (3.85-5.52) <sup>c</sup>	4.08 (3.30-5.07) <sup>c</sup>	6.60 (5.27-8.14) <sup>c</sup>	5.62 (4.61-6.74) <sup>c</sup>	4.22 (3.52-4.92) <sup>c</sup>	4.17 (3.34-4.95) <sup>c</sup>
House type	1.24 (0.96-1.55) <sup>a</sup>		1.18 (0.98-1.44) <sup>b</sup>		1.18 (0.97-1.45) <sup>a</sup>			
Plants at home	0.79 (0.64-1.02) <sup>a</sup>				0.80 (0.66-0.99) <sup>b</sup>	0.76 (0.63-0.93) <sup>c</sup>		
Pets at home	1.31 (0.98-1.73) <sup>a</sup>							
Molds at homes	1.50 (1.13-1.93) <sup>c</sup>	1.42 (1.12-1.78) <sup>c</sup>	1.37 (1.12-1.73) <sup>c</sup>	1.45 (1.22-1.86) <sup>c</sup>	1.31 (1.04-1.66) <sup>b</sup>	1.46 (1.18-1.83) <sup>c</sup>		1.38 (1.06-1.69) <sup>c</sup>
Heating material								
Cooking material				1.28 (0.94-1.59) <sup>a</sup>				1.28 (0.96-1.57) <sup>a</sup>
Smoking		1.79 (1.45-2.18) <sup>b</sup>				2.05 (1.63-2.67) <sup>c</sup>	1.23 (0.97-1.57) <sup>a</sup>	
Passive smoking		1.34 (1.05-1.79) <sup>c</sup>	1.23 (0.96-1.60) <sup>a</sup>	1.41 (1.08-1.95) <sup>c</sup>		1.17 (0.06-1.41) <sup>a</sup>	1.19 (1.03-1.40) <sup>b</sup>	
Living near an animal barn						1.19 (0.99-1.46) <sup>a</sup>	1.20 (0.98-1.38) <sup>a</sup>	
Livestocking						1.05 (0.93-1.12) <sup>a</sup>		

a= p≤ 0.05, b= p≤ 0.01, c= p≤ 0.001

**Table 7:** Odds ratios and 99% confidence intervals of risk factors in multivariate analysis in urban area.

Variable	Men				Female			
	Asthma	Wheezing	A.rhinitis	Eczema	Asthma	Wheezing	A.rhinitis	Eczema
Age					1.04 (1.02-1.05) <sup>c</sup>	1.02 (1.01-1.04) <sup>c</sup>	0.98 (0.96-0.99) <sup>c</sup>	
Women occupation					0.92 (0.82-1.002) <sup>a</sup>	0.88 (0.80-0.96) <sup>c</sup>		0.84 (0.74-0.95) <sup>c</sup>
Men occupation	0.88 (0.78-0.97) <sup>c</sup>							
Familial atopy	3.28 (2.67-4.05) <sup>c</sup>	5.68 (4.77-6.85) <sup>c</sup>	9.61 (8.09-11.50) <sup>c</sup>	11.74 (9.86-14.48) <sup>c</sup>	2.51 (2.10-3.05) <sup>c</sup>	4.01 (3.37-4.77) <sup>c</sup>	7.02 (6.07-8.16) <sup>c</sup>	8.86 (7.21-10.90) <sup>c</sup>
Having other allergic disease	12.3 (9.78-15.41) <sup>c</sup>	7.04 (6.00-8.26) <sup>c</sup>	4.33 (3.66-5.11) <sup>c</sup>	3.30 (2.67-4.02) <sup>c</sup>	9.50 (7.74-11.70) <sup>c</sup>	6.17 (5.27-7.21) <sup>c</sup>	3.33 (2.86-3.82) <sup>c</sup>	2.57 (2.12-3.11) <sup>c</sup>
House type	1.21 (0.98-1.43) <sup>a</sup>	1.15 (0.96-1.31) <sup>c</sup>	1.43 (1.27-1.70) <sup>c</sup>		1.31 (1.01-1.54) <sup>c</sup>	1.22 (1.05-1.40) <sup>c</sup>	1.16 (1.01-1.29) <sup>b</sup>	1.23 (1.02-1.45) <sup>b</sup>
Plants at home								
Pets at home								
Molds at home		1.42 (1.12-1.79) <sup>c</sup>		1.75 (1.30-2.23) <sup>c</sup>		1.57 (1.26-1.95) <sup>c</sup>	1.27 (1.03-1.54) <sup>b</sup>	1.69 (1.31-2.19) <sup>c</sup>
Heating material	1.12 (1.01-1.25) <sup>a</sup>	1.10 (0.99-1.19) <sup>a</sup>		0.91 (0.82-1.01) <sup>a</sup>		1.08 (1.01-1.18) <sup>a</sup>	1.08 (1.02-1.16) <sup>b</sup>	0.90 (0.82-1.01) <sup>a</sup>
Cooking material			2.06 (1.36-3.32) <sup>c</sup>					1.64 (0.94-2.76) <sup>a</sup>
Smoking		1.99 (1.68-2.38) <sup>c</sup>				2.10 (1.79-2.51) <sup>c</sup>		
Passive smoking		1.29 (1.05-1.51) <sup>c</sup>				1.20 (1.02-1.41) <sup>b</sup>		

a= p≤ 0.05, b= p≤ 0.01, c= p≤ 0.001

