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Prevalence and Risk Factors of Allergies in Turkey (PARFAIT): results of a multicentre cross-sectional study in adults

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ABSTRACT: The Prevalence and Risk Factors of Allergies in Turkey (PARFAIT) study was planned to evaluate the prevalence of and risk factors for asthma and allergic diseases in Turkey.

The present analysis used data from 25,843 parents of primary school children, obtained from a cross-sectional questionnaire-based study.

A total of 25,843 questionnaires from 14 centres were evaluated. In rural areas, the prevalences asthma, wheezing, allergic rhinitis and eczema in males were: 8.5% (95% confidence interval (CI) 7.9–9.1%), 13.5% (95% CI 12.8–14.2%), 17.5% (95% CI 16.7–18.2%) and 10.8% (95% CI 10.2–11.4%), respectively; and in females were: 11.2% (95% CI 10.9–11.8%), 14.7% (95% CI 14.3–15.1%), 21.2% (95% CI 20.4–22.0%) and 13.1% (95% CI 12.4–13.8%), respectively. In urban areas, the corresponding prevalences in males were: 6.2% (95% CI 5.8–6.6%), 10.8% (95% CI 10.3–11.3%), 11.7% (95% CI 11.4–12.0%) and 6.6% (95% CI 6.2–7.0%), respectively; and in females were: 7.5 % (95% CI 7.9–7.1%), 12.0% (95% CI 11.7–12.3%), 17.0% (95% CI 16.4–17.6%) and 7.3% (95% CI 6.9–7.7%), respectively. Having an atopic first-degree relative or any other atopic diseases had significant effects on the prevalence of allergic diseases. Housing conditions, such as living in a shanty-type house, visible moulds at home and use of wood or biomass as heating or cooking material were associated with one or more allergic diseases.

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

KEYWORDS: Allergy, asthma, prevalence, risk factors, Turkey

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STATEMENT OF INTEREST
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The prevalences of allergic diseases and related risk factors in adults in Turkey have been examined in a number of studies, which were mainly focused on certain occupations. 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 studies regarding prevalence of asthma and allergic diseases in the general adult population has recently been conducted in Turkey. The current prevalences of asthma, wheezing and allergic rhinitis, respectively, in university students in Ankara, were reported as: 2.1%, 6.9% and 12.7%, respectively, in males; and 2.5%, 7.2% and 14.5%, respectively, in females [6]. In another study, the prevalences of asthma-like symptoms, rhinoconjunctivitis and dermatitis were reported as 17%, 10% and 5.9%, respectively, in university students [7]. The reported current prevalences range 3.1–9.4% for doctor-diagnosed asthma [8–12] and 19.3–20.9% for asthma symptoms [8, 9]. The prevalence of allergic rhinitis was reported as 27.7% in a population-based study [11]. As can be seen, data on adult allergic diseases is available from different studies in which different methods were used within different time periods. The risk factors for allergic diseases in the Turkish population have been 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 a rural area [8].

The present study regarding the adult population forms part of the Prevalence and Risk Factors of

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Allergies in Turkey (PARFAIT) study, which was planned to evaluate the prevalence of and risk factors for asthma and allergic diseases in Turkey, within a single time period using a standard questionnaire in all centres, in order to obtain comparable data in different regions of the country.

METHODS

Study population

Turkey is located in both Asia and Europe, with coasts on the Mediterranean, Black and Aegean Seas. According to the last census, in 2000, it has a population of ~67 million.

For inclusion in the present study, 14 cities were selected from different geographical regions of the country (fig. 1). Schools were selected randomly from rural and urban areas of each city. In the current 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 participation.

Questionnaire

The questionnaire included questions on the educational and social status of subjects and on current (during the previous year) allergic diseases. The prevalence of current asthma, wheezing and allergic diseases were defined by ''yes'' responses to the following questions: ''Have you had asthma, bronchitis, spastic bronchitis or allergic bronchitis during the past year?''; ''Have you noticed a whistling sound or wheezing/rattle sound from your chest during the past year?''; ''Did you have seasonal (hayfever) or perennial allergic rhinitis during the past year?''; and ''Did you have eczema over your 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. 1) What type of house do you live in? Apartment flat, single family house, shanty type. 2) What is the construction material of your house? Concrete, brick, wood, *etc.* 3) How many rooms are there in your house? 4) What is the flooring material of your house? Wood, concrete, *etc.* 5) How much of your home is carpeted? Less than half of the floor/more than half of the floor. 6) Do you have houseplants? Yes/no. 7) Do you have pets at home? Yes/no. 8) Are there visible moulds in your house? Yes/no. 9) Smoking at home: number of persons who smoke; total number of cigarettes per day. 10) Number of persons living in the house. 11) Type and material of heating: stove/central/other; natural gas/wood/coal/other. 12) What fuel do you use for cooking? Natural gas/wood/coal/other (*e.g.* biomass, liquefied petroleum gas).

The reliability and validity of the questionnaire had been tested and found to be appropriate in a previous study [6]. The questionnaire in the present study included additional questions on living conditions and personal characteristics.

Statistical analysis

Each city was accepted as a sample group. The t-test for continuous variables (unpaired) was used to compare risk factors and the Chi-squared test was used to compare prevalences in the study group. Standardised prevalence rates for each allergic disease were calculated by taking the study group as a standardised population. Basically, age-specific rates were computed for the population by using a direct standardisation method. These rates were applied to the number of persons in the corresponding age-group in the standard population and the results were 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 was divided by the

FIGURE 1. Map showing the 14 study locations.

total number of persons in the standard population and given an appropriate base to become the standardised rate in the study population [13].

Adjusted prevalence rates for each allergic disease in the centres are presented with 95% confidence intervals (CI). Prevalence rates of allergic diseases in each centre were adjusted directly according to the ratios of age and rural/urban residence. Adjusted prevalence rates and their 95% CIs were obtained by fitting the following logistic regression model:

$$\text{Logit}(\pi) = \beta_0 + \beta_1 \text{ (rural/urban residence)} + \beta_2 \text{ (age)} + \varepsilon \quad (1)$$

π is the prevalence of a specific symptom for the city. The adjusted prevalence rates were estimated through the following equation, where p is the estimation of π. Ages and rural/urban residence were set equal to the overall mean or distribution, respectively [14].

$$\text{Prevalence} = \exp[\text{logit}(p)] / (1 + \exp[\text{logit}(p)]) \quad (2)$$

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% CIs for all the factors tested. Adjusted ORs and 99% CIs 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 ORs; each univariate factor was then tested separately in a multiple logistic regression model with adjustment for age and centres. Variables included in the multivariate logistic regression model were selected from these results which had a significance of <0.10 in univariate logistic regression analysis. Age was analysed as continuous covariate. All other variables were coded as categorical covariates which were taken into the model dichotomously.

RESULTS

Demographic characteristics

Questionnaires from 14 cities were analysed. Overall, 30,000 questionnaires were distributed. The response rate was 92.3%. Of the 27,690 questionnaires collected, 25,843 were appropriate for analysis. Questionnaires with missing responses that could affect the quality of the data were excluded as inappropriate. Of these, 60.2% were from metropolitan areas, in accordance with the distribution of Turkey's population. The rural/urban ratio ranged 0.43–1.02 (median 0.64) between regions.

Prevalences of demographic characteristics and proposed risk factors in rural and urban residents are presented in table 1. Living in a single-family house, use of wood and brick as construction materials in houses and the presence of pets and moulds at home were more prevalent in rural areas ($p<0.001$). The main heating fuel in houses was wood in rural area, whereas it was coal in urban areas. Smoking was more prevalent among females living in urban areas than those living in rural areas, whereas the opposite was true in males ($p<0.001$). The prevalences of asthma, allergic rhinitis and eczema were higher among people living in rural areas (table 2).

Adjusted prevalences of allergic diseases and wheezing standardised to age and rural/urban residence in each centre are shown in table 3.

Univariate analysis

Allergic diseases in females and males were significantly associated with family history of any of these diseases and presence of other personal allergic disease in both rural and urban areas (tables 4 and 5).

Rural areas

The results of the univariate risk analysis adjusted for age and centre in rural areas are presented in table 4. Shanty-type housing and presence of visible mould at home were strongly

TABLE 1 Demographic characteristics and proposed risk factors in rural and urban residents

Variable	Rural	Urban	p-value
Respondents n	10289	15554	
Females age yrs	35.1±5.9	35.1±5.3	0.802
Males age yrs	40.5±7.6	39.4±6.0	<0.001
Occupation of females			<0.001
Housewife	94.4	78.9	
Worker	3.9	4.2	
Official	0.6	11.1	
Other	1.1	5.8	
Occupation of males			<0.001
Farmer	31.3	20.8	
Worker	37.6	26.6	
Official	9.4	40.1	
Merchant	21.7	12.5	
Familial atopy in females	29.9	28.9	0.10
Familial atopy in males	24.5	24.3	0.715
Any other allergic disease in females	23.0	21.0	<0.001
Any other allergic disease in males	20.8	17.7	<0.001
House type			<0.001
Apartment	14.2	71.1	
Single-family house	78.0	26.4	
Shanty	7.8	2.5	
Construction material of the house			<0.001
Concrete	72.6	95.1	
Wood	9.9	1.9	
Brick	17.5	3.0	
Plants at home	57.6	65.8	<0.001
Pets at home	17.6	9.5	<0.001
Moulds at home	17.1	10.7	<0.001
Home heating fuel			<0.001
Natural gas	0.2	26.3	
Wood	71.7	22.4	
Coal	23.4	44.6	
LPG	0.2	0.7	
Other (biomass)	4.5	6.0	
Use of natural gas as cooking fuel	2.0	21.1	<0.001
Use of natural gas + LPG as cooking fuel	81.3	98.0	
Smoking in females	12.4	26.6	<0.001
Smoking in males	57.4	49.6	<0.001
Living near an animal barn	37.0		
Livestocking	37.2		

Data are presented as mean±SD or %, unless otherwise stated. LPG: liquefied petroleum gas.

TABLE 2 Standardised prevalences of allergic diseases and wheezing in rural and urban areas in all adults

	Males		Females	
	Rural	Urban	Rural	Urban
Asthma	8.5 (7.9–9.1)	6.2 (5.8–6.6)	11.2 (10.9–11.8)	7.5 (7.9–7.1)
Wheezing	13.5 (12.8–14.2)	10.8 (10.3–11.3)	14.7 (14.3–15.1)	12.0 (11.7–12.3)
Allergic rhinitis	17.5 (16.7–18.2)	11.7 (11.4–12.0)	21.2 (20.4–22.0)	17.0 (16.4–17.6)
Eczema	10.8 (10.2–11.4)	6.6 (6.2–7.0)	13.1 (12.4–13.8)	7.3 (6.9–7.7)

Data are presented as standardised % prevalence (95% confidence interval).

associated with higher prevalence rates for all allergic diseases. The use of wood and biomass for cooking was strongly associated with increased risk of allergic diseases when compared with use of gas. Personal smoking was associated with increased risk of wheezing, allergic rhinitis and eczema in males, whereas in females it was associated with asthma, wheezing and allergic rhinitis. All allergic diseases were associated with passive smoking at home except for asthma in females, which had a weak association. Living near an animal barn was associated with all allergic diseases except wheezing in males. Livestocking was strongly associated with asthma, allergic rhinitis and eczema in females although it was strongly associated with allergic rhinitis in males.

Urban areas

ORs and 99% CIs of risk factors after adjustment for age and centre in urban areas are shown in table 5. Living in a single-family house, living in a shanty-type house, visible mould at home and use of wood as heating fuel were all strongly associated with increased prevalence of all diseases in males and females. Use of wood and biomass for cooking were strongly associated with respiratory diseases in males, although it was associated with allergic rhinitis and eczema in females. Personal smoking and passive smoking were related to wheezing in both sexes.

Multivariate analysis

Multiple logistic regression analyses of risk factors for rural and urban areas are presented in tables 6 and 7, respectively. Among all variables, having an atopic first-degree relative and another atopic disease had significant effects on the prevalence of allergic diseases in both rural and urban areas for both sexes.

Rural areas

Housing conditions that had strong associations with allergic diseases in males were as follows. For asthma: visible mould at home; for allergic rhinitis: living in a shanty-type house and mould at home; for eczema: visible mould at home and exposure to passive smoking. Wheezing in males was strongly

TABLE 3 Adjusted prevalences of allergic diseases with respect to age and rural/urban residence

City	Respondents	Males				Females			
		Asthma	Wheezing	Allergic rhinitis	Eczema	Asthma	Wheezing	Allergic rhinitis	Eczema
Afyon	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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)

Data are presented as n or adjusted % prevalence (95% confidence interval).

TABLE 4 Odds ratios for risk factors after adjustment for age and centre in rural areas

Variable	Males				Females			
	Asthma	Wheezing	Allergic rhinitis	Eczema	Asthma	Wheezing	Allergic rhinitis	Eczema
Age	1.02 (0.99–1.05)	1.01 (0.99–1.04)	1.01 (0.99–1.03)	1.00 (0.97–1.03)	1.03 (1.02–1.04)#	1.03 (1.02–1.04)#	0.99 (0.99–1.01)	1.04 (1.03–1.05)#
Occupation of females								
Housewife					1	1	1	1
Worker					0.86 (0.54–1.40)	0.83 (0.54–1.27)	0.83 (0.63–1.09)	0.78 (0.55–1.11)
Official					0.56 (0.15–2.19)	0.52 (0.16–1.74)	0.15 (0.04–0.55)¶	0.23 (0.06–0.92)+
Other					1.32 (0.64–2.72)	1.16 (0.59–2.27)	1.07 (0.68–1.69)	1.20 (0.70–2.06)
Occupation of males								
Farmer	1	1	1	1				
Worker	0.94 (0.75–1.19)	0.84 (0.70–1.02)	0.93 (0.79–1.10)	0.79 (0.65–0.96)+				
Official	0.99 (0.70–1.40)	0.85 (0.64–1.14)	0.88 (0.68–1.14)	0.65 (0.47–0.91)#				
Merchant	1.07 (0.83–1.39)	1.00 (0.81–1.23)	0.89 (0.74–1.08)	0.78 (0.62–0.98)¶				
Familial atopy	7.89 (6.39–9.74)#	9.38 (7.71–11.41)#	14.98 (12.36–18.15)#	13.43(10.79–16.73)#	5.04 (4.17–6.08)#	8.32 (6.87–10.08)#	12.45(10.40–14.91)#	13.0 (10.53–15.85)#
Having other allergic disease	11.18 (8.87–14.10)#	7.57 (6.42–8.94)#	5.99 (5.16–6.94)#	5.32 (4.46–6.35)#	7.96 (6.49–9.65)#	6.80 (5.77–8.01)#	4.93 (4.29–5.65)#	5.31 (4.45–6.22)#
House type								
Apartment	1	1	1	1	1	1	1	1
Single-family house	1.11 (0.83–1.49)	1.10 (0.87–1.38)	1.04 (0.85–1.28)	1.16 (0.90–1.51)	1.05 (0.80–1.34)	0.99 (0.79–1.24)	1.09 (0.90–1.31)	1.28 (0.99–1.62)¶
Shanty	1.97 (1.34–2.90)#	1.70 (1.24–2.34)#	1.56 (1.17–2.09)#	1.55 (1.08–2.23)¶	1.76 (1.22–2.45)#	1.74 (1.28–2.36)#	1.54 (1.16–2.01)#	1.83 (1.28–2.53)#
Plants at home	0.84 (0.69–1.01)+	0.94 (0.81–1.10)	1.05 (0.91–1.21)	1.04 (0.88–1.24)	0.81 (0.68–0.95)#	0.79 (0.68–0.92)#	1.05 (0.92–1.20)	1.03 (0.87–1.20)
Pets at home	1.36 (1.07–1.72)#	1.21 (1.01–1.48)¶	1.16 (0.97–1.39)+	1.42 (1.15–1.75)#	1.15 (0.92–1.41)	1.20 (0.99–1.45)+	1.03 (0.87–1.23)	1.28 (1.04–1.54)¶
Moulds at home	1.81 (1.45–2.26)#	1.77 (1.47–2.12)#	1.63 (1.38–1.93)#	1.67 (1.37–2.04)#	1.84 (1.51–2.25)#	1.96 (1.64–2.34)#	1.54 (1.31–1.81)#	1.76 (1.47–2.14)#
Heating fuel								
Natural gas + LPG	1	1	1	1	1	1	1	1
Wood	0.56 (0.18–1.77)	0.79 (0.27–2.31)	0.65 (0.27–1.60)	1.22 (0.31–4.73)	1.10 (0.28–4.27)	1.25 (0.36–4.25)	0.96 (0.36–2.55)	1.93 (0.41–8.98)
Coal	0.45 (0.14–1.44)	0.69 (0.24–2.04)	0.59 (0.24–1.47)	0.95 (0.24–3.72)	0.91 (0.23–3.58)	1.05 (0.30–3.62)	0.90 (0.34–2.42)	1.52 (0.32–7.13)
Other (biomass)	0.95 (0.29–3.14)	1.16 (0.38–3.53)	0.99 (0.39–2.53)	1.89 (0.47–7.61)	2.10 (0.50–8.19)	2.30 (0.63–7.86)	1.25 (0.45–3.42)	3.69 (1.09–12.70)+
Cooking fuel								
LPG + natural gas	1	1	1	1	1	1	1	1
Wood + biomass	1.55 (1.24–1.94)#	1.34 (1.11–1.61)#	1.41 (1.20–1.67)#	1.45 (1.19–1.78)#	1.52 (1.23–1.84)#	1.44 (1.19–1.70)#	1.38 (1.17–1.61)#	1.50 (1.23–1.79)#
Smoking	1.15 (0.95–1.40)	1.91 (1.62–2.25)#	1.41 (1.23–1.63)#	1.19 (1.01–1.41)¶	1.53 (1.02–1.05)#	2.26 (1.86–2.74)#	1.43 (1.20–1.72)#	1.20 (0.97–1.53)
Passive smoking	1.35 (1.04–1.76)¶	1.49 (1.21–1.83)#	1.30 (1.07–1.58)#	1.40 (1.11–1.77)#	1.16 (0.98–1.38)+	1.41 (1.21–1.65)#	1.38 (1.21–1.58)#	1.27 (1.08–1.49)#
Living near an animal barn	1.22 (1.01–1.48)¶	1.12 (0.96–1.31)	1.26 (1.10–1.45)#	1.32 (1.11–1.57)#	1.32 (1.10–1.56)#	1.31 (1.12–1.52)#	1.32 (1.15–1.50)#	1.27 (1.08–1.48)#
Livestocking	1.12 (0.92–1.36)	1.14 (0.97–1.34)+	1.17 (1.01–1.35)¶	1.18 (0.99–1.40)+	1.25 (1.04–1.47)¶	1.35 (1.15–1.56)#	1.12 (0.98–1.29)+	1.20 (1.04–1.39)¶

Data are presented as odds ratio (99% confidence interval). LPG: liquefied petroleum gas. #: $p \leqslant 0.001$; ¶: $p \leqslant 0.01$; +: $p \leqslant 0.05$.

TABLE 5 Odds ratios for risk factors after adjustment for age and centre in urban areas

Variable	Males				Females			
	Asthma	Wheezing	Allergic rhinitis	Eczema	Asthma	Wheezing	Allergic rhinitis	Eczema
Age yrs	1.02 (0.99–1.06)	1.03 (1.01–1.06)#	1.00 (0.98–1.03)	1.01 (0.97–1.06)	1.02 (1.015–1.04)¶	1.00 (0.99–1.02)+	0.98 (0.97–0.99)¶	1.01 (0.99–1.02)+
Occupation of females					1	1	1	1
Housewife								
Worker					0.82 (0.53–1.28)	1.08 (0.78–1.48)	1.11 (0.85–1.46)	0.78 (0.50–1.23)
Official					0.69 (0.57–0.91)¶	0.66 (0.52–0.83)¶	0.72 (0.60–0.89)¶	0.47 (0.33–0.65)¶
Other					0.68 (0.45–0.99)#	0.79 (0.58–1.06)+	0.86 (0.67–1.12)	0.67 (0.44–0.98)#
Occupation of males								
Farmer	1	1	1	1				
Worker	0.74 (0.58–0.94)¶	0.81 (0.67–0.99)#	0.73 (0.61–0.89)¶	0.73 (0.58–0.93)¶				
Official	0.64 (0.51–0.81)¶	0.78 (0.65–0.93)¶	0.77 (0.65–0.91)¶	0.75 (0.60–0.93)¶				
Merchant	0.61 (0.44–0.84)¶	0.89 (0.71–1.13)	0.75 (0.59–0.94)¶	0.70 (0.52–0.95)#				
Familial atopy	5.27 (4.36–6.37)¶	7.40 (6.29–8.70)¶	11.66 (9.88–13.77)¶	14.08(11.43–17.35)¶	3.49 (2.94–4.16)¶	5.08 (4.36–5.95)¶	7.99 (6.93–9.20)¶	10.73 (8.79–13.08)¶
Having other allergic disease	15.68 (12.66–19.40)¶	8.35 (7.22–9.66)¶	5.52 (4.80–6.36)¶	4.19 (3.52–4.99)¶	10.97 (9.06–13.31)¶	6.80 (5.92–7.82)¶	4.08 (3.61–4.63)¶	3.42 (2.89–4.04)¶
House type								
Apartment	1	1	1	1	1	1	1	1
Single-family house	1.35 (1.11–1.64)¶	1.29 (1.11–1.51)¶	1.60 (1.39–1.84)¶	1.41 (1.17–1.70)¶	1.34 (1.12–1.61)¶	1.33 (1.15–1.54)¶	1.25 (1.10–1.42)¶	1.42 (1.19–1.70)¶
Shanty	2.87 (1.93–4.25)¶	2.02 (1.42–2.88)¶	1.88 (1.32–2.68)¶	1.83 (1.17–2.86)¶	2.48 (1.69–3.65)¶	2.17 (1.55–3.03)¶	1.51 (1.09–2.10)¶	2.51 (1.70–3.70)¶
Plants at home	0.96 (0.80–1.15)	0.95 (0.83–1.10)	0.90 (0.78–1.03)	0.85 (0.71–1.01)+	0.82 (0.70–0.98)#	0.84 (0.74–0.97)¶	0.92 (0.82–1.04)	0.79 (0.67–0.94)¶
Pets at home	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)
Moulds at home	1.74 (1.37–2.22)¶	2.07 (1.72–2.49)¶	1.65 (1.36–1.98)¶	2.31 (1.85–2.87)¶	1.64 (1.31–2.06)¶	2.28 (1.92–2.72)¶	1.68 (1.43–1.98)¶	2.43 (1.97–3.00)¶
Heating fuel								
Natural gas + LPG	1	1	1	1	1	1	1	1
Wood	2.17 (1.67–2.83)¶	1.93 (1.58–2.36)¶	1.74 (1.44–2.11)¶	1.65 (1.29–2.11)¶	1.86 (1.46–2.37)¶	1.94 (1.60–2.35)¶	1.54 (1.30–1.82)¶	1.69 (1.34–2.13)¶
Coal	1.34 (1.04–1.73)#	1.24 (1.03–1.49)#	1.05 (0.88–1.26)	1.01(0.80–1.28)	1.38 (1.11–1.73)¶	1.16 (0.97–1.40)+	1.14 (0.98–1.33)+	0.86 (0.69–1.07)
Other (biomass)	1.81 (1.23–2.66)¶	1.53 (1.13–2.06)¶	1.20 (0.89–1.62)	0.97 (0.64–1.47)	1.32 (0.91–1.93)	1.25 (0.92–1.70)	1.18 (0.91–1.53)	0.98 (0.67–1.45)
Cooking fuel								
LPG + natural gas	1	1	1	1	1	1	1	1
Wood + biomass	2.54 (1.61–4.00)¶	1.93 (1.28–2.89)¶	2.20 (1.51–3.21)¶	1.57 (0.93–2.64)+	1.36 (0.79–2.29)	1.41 (0.92–2.16)+	1.46 (1.01–2.14)#	2.38 (1.54–3.69)¶
Smoking	1.08 (0.90–1.28)	2.03 (1.76–2.34)¶	1.05 (0.92–1.20)	1.05 (0.88–1.24)	1.09 (0.91–1.31)	1.98 (1.73–2.26)¶	1.01 (0.89–1.15)	0.93 (0.77–1.12)
Passive smoking	1.14 (0.94–1.38)	1.55 (1.34–1.79)¶	1.01 (0.87–1.17)	1.01 (0.83–1.23)	1.15 (0.98–1.35)+	1.45 (1.27–1.66)¶	1.07 (0.96–1.20)	1.12 (0.95–1.32)

Data are presented as odds ratio (99% confidence interval). LPG: liquefied petroleum gas. #: $p \leqslant 0.01$; ¶: $p \leqslant 0.001$; +: $p \leqslant 0.05$.

TABLE 6 Odds ratios for risk factors in multivariate analysis in rural areas

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

Data are presented as odds ratio (99% confidence interval). #: $p \leqslant 0.05$; ¶: $p \leqslant 0.001$; +: $p \leqslant 0.01$.

TABLE 7 Odds ratios for risk factors in multivariate analysis in urban areas

Variable	Males				Females			
	Asthma	Wheezing	Allergic rhinitis	Eczema	Asthma	Wheezing	Allergic rhinitis	Eczema
Age yrs					1.04 (1.02–1.05)#	1.02 (1.01–1.04)#	0.98 (0.96–0.99)#	
Occupation of females					0.92 (0.82–1.002)¶	0.88 (0.80–0.96)#		0.84 (0.74–0.95)#
Occupation of males	0.88 (0.78–0.97)#							
Familial atopy	3.28 (2.67–4.05)#	5.68 (4.77–6.85)#	9.61 (8.09–11.50)#	11.74 (9.86–14.48)#	2.51 (2.10–3.05)#	4.01 (3.37–4.77)#	7.02 (6.07–8.16)#	8.86 (7.21–10.90)#
Having other allergic disease	12.3 (9.78–15.41)#	7.04 (6.00–8.26)#	4.33 (3.66–5.11)#	3.30 (2.67–4.02)#	9.50 (7.74–11.70)#	6.17 (5.27–7.21)#	3.33 (2.86–3.82)#	2.57 (2.12–3.11)#
House type	1.21 (0.98–1.43)¶	1.15 (0.96–1.31)#	1.43 (1.27–1.70)#		1.31 (1.01–1.54)#	1.22 (1.05–1.40)#	1.16 (1.01–1.29)+	1.23 (1.02–1.45)+
Plants at home								
Pets at home								
Moulds at home		1.42 (1.12–1.79)#		1.75 (1.30–2.23)#		1.57 (1.26–1.95)#	1.27 (1.03–1.54)+	1.69 (1.31–2.19)#
Heating fuel	1.12 (1.01–1.25)¶	1.10 (0.99–1.19)¶		0.91 (0.82–1.01)¶		1.08 (1.01–1.18)¶	1.08 (1.02–1.16)+	0.90 (0.82–1.01)¶
Cooking fuel			2..06 (1.36–3.32)#					1.64 (0.94–2.76)¶
Smoking		1.99 (1.68–2.38)#				2.10 (1.79–2.51)#		
Passive smoking		1.29 (1.05–1.51)#				1.20 (1.02–1.41)+		

Data are presented as odds ratio (99% confidence interval). #: $p \leqslant 0.001$; ¶: $p \leqslant 0.05$; +: $p \leqslant 0.01$.

associated with moulds at home as well as personal and passive smoking.

Housing conditions that had strong associations with allergic diseases in females were as follows. For asthma: visible mould at home; for wheezing: mould at home and personal smoking; for allergic rhinitis: passive smoking at home; for eczema: mould at home. House plants were associated with decreased risk of asthma and wheezing in females.

Urban areas

Environmental factors that had strong associations with allergic diseases in males were as follows. For wheezing: living in a shanty-type house, molds at home and personal and passive smoking; for allergic rhinitis: living in a shanty-type house and use of wood and biomass as cooking fuel; for eczema: visible mould at home.

Environmental factors that had strong associations with allergic diseases in females were as follows. For asthma: shanty-type housing; for wheezing: shanty-type housing, mould at home and personal and passive smoking; for allergic rhinitis: living in a shanty-type house, visible mould at home and use of biomass and wood for heating; for eczema: living in a shanty-type house and mould at home.

DISCUSSION

The present study is the first multicentre study evaluating the risk factors for prevalence of allergic diseases in the general adult population in Turkey. Family history of atopy and the presence of other atopic disease were significantly associated with all allergic diseases. The present 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. The association of allergic diseases with genetic predisposition has been well documented in children [15]. Familial factors could have a higher impact on the prevalence of allergic diseases, not because of genetic transmission of atopy but also owing to sharing of environmental risks by family members. Epidemiological studies on environmental risk factors have focused mostly on microenvironmental characteristics such as housing and lifestyle, which are more modifiable. Although the exact role of indoor exposures in allergic diseases has yet to be clarified, it is suggested that there are many factors that could be linked to allergic diseases. One of these factors, indoor dampness, causes infestation of homes with house dust mites and growth of moulds and is associated with asthma and respiratory symptoms in adults [16]. The present study confirmed a positive association between allergic diseases and visible mould at home. Living in a house with visible mould increased the likelihood of respiratory problems such as asthma and wheezing, especially in rural areas, in both males and females. Living in a shanty-type house was strongly associated with allergic diseases, especially in urban areas. Such houses do not conform to architectural regulations and are constructed in the periphery of cities, with poor living conditions such as lack of water, gas and sewerage systems from the municipal network. Previous studies have confirmed that houses with basement floors that have higher frequency of house dust mites are associated with respiratory symptoms when compared with apartments [17, 18]. The present study supported the argument that respiratory allergic diseases and respiratory symptoms could be increased among people living in shanty-type houses as compared with those living in apartments.

Materials such as wood and biomass, which are used for heating and cooking in houses of rural and peripheral urban districts, accounted for the higher prevalence of allergic diseases in univariate analysis. However, multivariate analysis showed that the use of wood and biomass as heating or cooking material had a significant effect on allergic rhinitis when compared with use of gas only in urban areas. Houses that use wood and biomass for cooking probably use the same materials for heating as well, so some accompanying factors may mask each other's effects in the analysis. The use of wood for heating and cooking has been shown to be related to 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 and enhances proinflammatory mediator release and neurogenic inflammation [20]. It is well known that household tobacco smoke increases asthma and allergic diseases in children. In the adult population, it is less documented. GREER *et al.* [21] showed in an adult population that asthma development was related to environmental tobacco smoke. Although the current 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 the current adult population, confirming that smoke exposure increases asthma symptoms in adults rather than contributing to their occurrence.

Although some previous studies in Europe have reported higher prevalences of asthma and allergic diseases in urban than rural areas, the current authors did not find such an association [22, 23]. Some studies outside Europe did not report the protective effect of rural life [19, 24, 25]. Discrepancies for the rural risk factors could be explained by differences in cultures between countries or the characteristics of the rural/urban populations studied. In fact, the term ''rural'' is also variable. For example, in Turkey a rural area is accepted as a settlement which has a population of $<$10,000 and an urban area has a population of more than this, regardless of other factors (water supply, electricity, *etc.*). In the present study, some of the urban population comprised farmers, which is a feature of rural residency. However urban and rural farmers showed different characteristics. Indoor occupations such as worker, official and merchant showed decreasing effects on asthma, wheezing and eczema in urban residents when compared with farming (table 7). It is probable that other rural risk factors might show differences in Turkey and account for the disease development. Confirming this suggestion, the present results showed that adults living in rural areas had higher risk ratios for all allergic diseases than those living in urban areas. About 37% of rural residents were

livestock farmers and had an animal barn near their houses. Living near an animal barn and livestocking were weakly associated with wheezing and allergic rhinitis in females within 99% CI limits (table 6). It is probable that females spend more time in houses and in those barns near houses, which causes more symptoms as a result of increased exposure to livestocking products in rural areas.

The current study is the first multicentre 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, information bias could not be completely ruled out. In other words, it was not possible to control for all potential individual risk factors, because allergic diseases can be affected by several factors that were not examined. In the present study, there were multiple comparisons between variables and the diseases that might cause false-positive results. To avoid this, some allowance was made for having multiple comparisons by calculating 99% CIs for risk factors. Other factors could also have contributed to the present findings. For example, there may be some personal tendencies such as avoidance of 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 a decreasing effect on asthma and wheezing in females (table 6).

In conclusion, the results of the present study suggest that household- and country-specific environmental factors are associated with increased asthma, wheezing, allergic rhinitis and eczema risk in the adult population of Turkey. Considering these risk factors, some measures could be put in place to prevent allergic diseases on the country- or population-specific basis. The present authors also suggest that population- or country-specific risk factors have to be taken into account in the evaluation of allergic diseases and asthma.

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