

ENVIRONMENTAL DETERMINANTS

Prevalence of Self-Reported Asthma in Urban and Rural Areas of Turkey

AYDANUR EKICI, M.D., MEHMET EKICI, M.D.,* PINAR KOCYIGIT, M.D., AND ALI KARLIDAG, M.D.

Department of Pulmonary Medicine, Kirikkale University Faculty of Medicine, Kirikkale, Turkey.

Background and purpose. The risk factors for asthma in rural and urban population of Turkey are not well known. In this study we examined the effects of risk factors on the prevalence of asthma in adults living in rural and urban areas using data from a representative sample. **Methods.** Parents and grandparents of students from 20 randomly selected primary schools in urban and rural areas of Kirikkale, Turkey, were asked about respiratory diseases using the respiratory questionnaire, which were returned to us by their children. **Results.** Out of 13,225 parents and grandparents of primary school students 12,270 returned the questionnaires, for an overall response rate of 92.7%. The prevalence of asthma was more common in adults living in rural areas than in urban areas (10.8% vs. 6.2%, $p < .0001$, respectively). Asthma was more prevalent in women exposed to biomass smoke than those who were not exposed to it in rural areas (14.8% vs. 6.6%, $p = .0001$, respectively). Frequent childhood respiratory infections were more common in adults living in rural areas than in urban areas (18.2% vs. 10.9%, $p < .0001$, respectively). Exposure to biomass smoke and frequent childhood respiratory infections were associated with an increased risk of asthma, after adjusting for possible confounding factors in the logistic model for rural subjects. Chronic rhinitis ($p = .0001$) and frequent childhood respiratory infections ($p = .0001$) were associated with an increased risk of asthma, after adjusting for possible confounding factors in the logistic model for urban subjects. **Conclusions.** The prevalence of asthma in adults living in the rural areas of the Kirikkale Region in Central Turkey was significantly higher than that in the urban population. Exposure to biomass smoke and childhood respiratory infections were more common in adults living in rural areas. The higher rate of asthma in adults living in rural areas may be due to a higher frequency of childhood respiratory infections and exposure to biomass smoke.

Keywords asthma, biomass smoke, frequent childhood respiratory infection, rural and urban areas

INTRODUCTION

Bronchial asthma is the most frequent chronic respiratory disease in adults. The prevalence of asthma varies considerably between different world regions (1–3). Some studies showed a higher prevalence of asthma in rural areas (4–6), while others showed higher prevalence in urban areas (7–9). However, previous studies on the prevalence of asthma in Turkey have yielded different results. The prevalence of asthma in Sivas, a city in the central region of Anatolia in Turkey, was 4.5% (10). The current prevalence of asthma, allergic rhinitis, and atopy in Antalya, a city in Southern Anatolia, Turkey, were 9.4%, 27.7%, and 31.1%, respectively (11). The prevalence of asthma in five urban centers in Turkey was found to be 6.6%, and the difference in asthma prevalence between these urban centers was statistically insignificant (12). However, differences and the reasons for the prevalence of asthma in Turkey have not been studied sufficiently between rural and urban areas. In this study, we investigated whether the prevalence of asthma and its causes in rural and urban areas are different.

MATERIALS AND METHODS

Subjects

This study was carried out as part of an epidemiologic survey conducted to assess the characteristics of respira-

tory symptoms and other diseases in Kirikkale, Turkey, in 2004 (13). Questionnaires concerning respiratory symptoms were distributed to students from 20 randomly selected primary schools in Kirikkale (6 schools in rural areas and 14 schools in urban areas). Fifth, sixth, and seventh elementary school grade students were given questionnaires (11, 12, and 13 age groups). The students were asked to interview their parents and grandparents and return the completed questionnaires within a few days. All respondents signed informed consent form, and the study was approved by the local ethics committee.

The majority of families living in rural and urban areas of Kirikkale have stoves in their homes that are used as a heating system during the winter months. These, with good ventilation, usually use coal as fuel and do not produce indoor air pollution; other stoves use liquefied petroleum gas to cook food. On the other hand, some families living in rural Kirikkale area have stoves that use biomass fuel for cooking food in their kitchens. These kitchens are constructed as mud-walled chambers in the gardens of the dwellings; thus, the cooking work is conducted inside small enclosures filled with heavy smoke and with poor ventilation. Primarily wood, droppings, grass, crop, and animal dung are used as biomass fuel in these stoves.

In this study, questions related to biomass fuel exposure included “the period of cooking with biomass fuel (in years)” and “the frequency (times per week) of cooking in the kitchen.” However, in analysis, only biomass smoke exposure was assessed in the form of presence or absence. Smokers were defined as current smokers and ex-smokers.

*Corresponding author: Mehmet Ekici, M.D., Department of Pulmonary Medicine, Kirikkale University Faculty of Medicine, Ziya Gökalp cad. Fabrikalar mah. Umut sitesi D blok. Daire 1., 71000 Kirikkale, Turkey; Tel: +90-532-6419801; Fax: +90-318-2252819; E-mail: mehmetekici@hotmail.com

Definitions

Current asthma was defined as positive responses to all of the following three questions (ATS questions 20A, 20B, and 20C3): (1) "Have you ever had asthma?," (2) "Do you still have it?," and (3) "Was it confirmed by a doctor?" (14).

Frequent respiratory infections during childhood were defined as a positive response to the question: "Have you had frequent respiratory infections during childhood?" (Almost every year in which respiratory disease was reported during childhood was defined as a retrospective report of frequent childhood respiratory infection.) Subjects with a negative response were included in the control group.

Chronic rhinitis was defined by a "yes" response to the following question: "Did you have hay fever or rhinitis?"

Statistical Analysis

Statistical analyses were performed using a statistical software (SPSS for Windows, version 10.01; SPSS, Chicago, IL, USA).

The chi-square test was used for testing differences in the prevalence of symptoms between groups. The differences between groups were assessed with Student's *t*-test and Mann-Whitney *U*-test as appropriate for continuous variables. Prevalence odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated using the Mantel-Haenszel method.

Logistic regression was used to calculate ORs and 95% CIs for the associations between asthma with age, gender, body mass index (BMI) ($<30 \text{ kg/m}^2 = 0$; $\geq 30 \text{ kg/m}^2 = 1$), income ($>\$200$ or $\text{€}155$ monthly = 0; $\leq \$200$ or $\text{€}155$ monthly = 1), education (none = 0; primary school = 1; secondary school = 2; high school = 3), smoking, exposure to smoking during childhood, and frequent respiratory infections during childhood.

Data are presented as mean $\pm$ standard deviation, unless otherwise indicated. The value of $p < .05$ was assumed to be statistically significant.

RESULTS

Out of 13,225 parents and grandparents of primary school students 12,270 returned the questionnaires for an overall

response rate of 92.7%. However, complete data for all analyses were obtained from 12,074 subjects (13).

Subjects in Rural Areas

Out of 3001 parents and grandparents of primary school students 2784 returned the questionnaires, giving an overall response rate of 92.7%. A total of 346 further subjects were excluded from the study because of their responses "do not know" and/or "not sure" to the questions related to asthma and because of incomplete responses to other questions. All analyses were performed on 2438 (81.2%) subjects.

Subjects in Urban Areas

Out of 10,224 parents and grandparents of primary school students 9986 returned the questionnaires, for an overall response rate of 97.7%. A total of 350 subjects were further excluded from the study because of their responses "do not know" and/or "not sure" to the questions related to asthma and because of incomplete responses to other questions. All analyses were performed on 9636 subjects. The higher exclusion rate in rural areas, which is more than three times that of urban subjects (12.4% vs. 3.5%), may be attributed to the lower level of education in rural areas.

Table 1 shows the characteristics of the subjects from urban and rural Kirikkale areas. Smoking was more prevalent in adults living in urban than in rural areas. The education level in rural areas was lower than that in urban areas.

Asthma and frequent childhood respiratory infections were more prevalent in adults living in rural areas than in urban areas (Table 2). Chronic rhinitis prevalence in both regions is similar.

Asthma was more prevalent in women exposed to biomass smoke than those in rural areas who were not exposed to it (14.8% vs. 6.6%, OR: 2.4 [95% CI 1.9–3.0], $p = .0001$, respectively).

Exposure to biomass smoke and frequent childhood respiratory infections were associated with an increased risk of asthma, after adjusting for gender, age, BMI, income, and education in the logistic model in rural subjects (Table 3).

TABLE 1.—The characteristics of the subjects included in the study from urban and rural areas of Kirikkale.

Characteristics	Subjects from urban (n = 9636)	Subjects from rural (n = 2438)	P-value
Age (year)	44.1 $\pm$ 11.6	46.6 $\pm$ 13.1	.0001
Female gender: n (%)	5065 (52.6)	1308 (53.7)	.3
Education: n (%)			
None	1134 (11.8)	689 (28.3)	.0001
Primary school	5416 (56.2)	1179 (48.2)	.0001
Secondary school	2232 (23.2)	547 (22.4)	.6
High school	854 (8.9)	26 (1.1)	.1
Monthly income: n (%)			
$\leq \$200$ or $\text{€}155$	7963 (82.6)	1898 (77.9)	.0001
Smoking: n (%)	3448 (35.8)	817 (33.5)	.03
Body mass index (kg/m ²)	26.5 $\pm$ 4.3	26.0 $\pm$ 4.9	.0001
Biomass exposure: n (%)	—	903 (32.4)	783 (32.1)

Note: Data are given as mean $\pm$ standard deviation or n (%).

TABLE 2.—The prevalence of asthma, FCRI, and chronic rhinitis of the subjects included in the study from urban and rural areas of Kirikkale.

	Subjects from urban	Subjects from rural	OR	<i>P</i> -value
Asthma: <i>n</i> (%)	602/9636 (6.2)	263/2438 (10.8)	1.8 (1.5–2.1)	.0001
FCRI: <i>n</i> (%)	1052/9621 (10.9)	443/2432 (18.2)	1.8 (1.6–2.0)	.0001
Chronic rhinitis: <i>n</i> (%)	3028/9607 (31.5)	741/2431 (30.5)	0.9 (0.8–1.0)	.3

Note: FCRI, frequent childhood respiratory infections.

TABLE 3.—The risk factors for asthma in adult life after adjusting for possible confounding factors in logistic regression model for rural group.

	Asthma	
	OR (95% CI)	<i>P</i> -value
Male gender	0.7 (0.4–1.1)	.1
Higher age	2.0 (1.4–2.9)	.0001
Lower income	0.6 (0.4–0.8)	.009
Higher education	0.8 (0.7–1.1)	.3
Smoking	1.1 (0.8–1.7)	.3
Exposure to biomass smoke	1.5 (1.0–2.2)	.02
Body mass index	1.0 (0.7–1.4)	.9
FCRI	3.7 (2.7–5.0)	.0001
Chronic rhinitis	1.8 (1.4–2.5)	.0001

Note: FCRI, frequent childhood respiratory infections.

TABLE 4.—The risk factors for asthma in adult life after adjusting for possible confounding factors in logistic regression model for urban group.

	Asthma	
	OR (95% CI)	<i>P</i> -value
Male gender	0.5 (0.4–0.6)	.0001
Higher age	2.0 (1.6–2.6)	.0001
Lower income	1.2 (0.9–1.6)	.1
Higher education	0.8 (0.7–0.9)	.001
Smoking	1.3 (1.0–1.6)	.007
Body mass index	1.6 (1.3–1.9)	.0001
FCRI	5.5 (4.5–6.7)	.0001
Chronic rhinitis	1.9 (1.6–2.3)	.0001

Note: FCRI, frequent childhood respiratory infections.

Chronic rhinitis and frequent childhood respiratory infections were associated with an increased risk of asthma, after adjusting for gender, age, BMI, income, and education in the logistic model. BMI was a risk factor for asthma in urban subjects (Table 4).

Table 5 indicated the risk factors for asthma in adult life after adjusting for possible confounding factors in logistic regression model for all subjects. Chronic rhinitis and frequent childhood respiratory infections were associated with an increased risk of asthma for all subjects.

DISCUSSION

This study revealed that asthma was more common among subjects living in rural areas than among those living in urban areas. The higher rate of asthma in adults living in rural areas may be attributed to a higher frequency of childhood respiratory infections and exposure to biomass smoke.

TABLE 5.—The risk factors for asthma in adult life after adjusting for possible confounding factors in logistic regression model for all subjects.

	Asthma	
	OR (95% CI)	<i>P</i> -value
Male gender	0.5 (0.4–0.6)	.0001
Higher age	2.0 (1.6–2.5)	.0001
Lower income	0.9 (0.7–1.1)	.3
Higher education	0.7 (0.6–0.8)	.0001
Smoking	1.3 (1.0–1.5)	.004
Body mass index	1.0 (1.0–1.0)	.0002
FCRI	5.0 (4.2–5.9)	.0001
Chronic rhinitis	1.9 (1.6–2.2)	.0001

Note: FCRI, frequent childhood respiratory infections.

Frequent childhood respiratory infections were more common among subjects from rural areas than those from urban areas. In addition, some women in rural areas were exposed to biomass smoke. The prevalent rate of asthma in women exposed to biomass smoke in rural areas was found to be higher than that in those who were not exposed to it in the same region, which supports this thesis. In the logistic model, important associations between asthma and exposure to biomass smoke and frequent childhood respiratory infections provide additional evidence for the proposed relationship. Studies, from population sample, indicated that frequent respiratory infections during childhood might play an important role in the occurrence of asthma during adult life (15–19). However, little is known about exposure to biomass smoke as a risk factor for asthma. Biomass fuel included primarily wood, droppings, grass, crop, and animal dung. Epidemiological data suggest that there is a causal relationship between the amount of increased wood smoke and health effects (20, 21). Wood smoke is known to contain such compounds as carbon monoxide, nitrogen oxide, sulfur oxide, aldehydes, polycyclic aromatic hydrocarbons, and fine, inhaled, particulate matter (22). Toxicological studies on animals show that wood smoke can disrupt cellular membranes, depress macrophage activity, destroy ciliated and secretory, respiratory, and epithelial cells, and cause some changes at the level of biochemical enzymes (23). The health effects are similar because tobacco and biomass smoke contain many of the same toxic substances. It is plausible that exposure to cooking smoke can impair pulmonary defense mechanisms and increase the risk of developing asthma or increase the frequency and severity of attacks in asthmatic people (24). These findings should be supported by further prospective longitudinal studies.

Previous studies on asthma prevalence in rural and urban groups have yielded conflicting results. Some studies showed a higher prevalence of asthma in rural areas (4–6) while others showed a higher prevalence in urban areas (7–9). In a multicenter study evaluating the prevalence of allergic diseases in the general adult population in Turkish rural areas the prevalence of asthma was 8.5% in males and 11.2% in females. In urban areas, the corresponding prevalence in males was 6.2% and that in females was 7.5%. This study indicated that adults living in rural areas were at higher risk for all allergic diseases than those living in urban areas (25). In line with present data, in a study of the adult population in Eastern Turkey, the prevalence of doctor-diagnosed asthma in adults living in rural and urban areas was 5.5% and 3.1%, respectively (26). As shown in the above studies, the prevalence of asthma in Turkish rural areas is higher than in urban areas. According to the present data, a low level of education in rural areas can lead to inadequate or incorrect treatment of infections in childhood; this can play an important role in the development of asthma in adult age. Although there is a significant relationship between rhinitis and asthma, the prevalence of rhinitis in both regions is similar, suggesting that it does not play a role in regional differences.

In this study, the biomass smoke in rural areas and smoking in cities were risk factors for asthma according to multivariate analysis. Furthermore, several studies indicated that active smoking may play an important role in the development of asthma among adults (27–29). The different levels of exposure to irritants in different populations may be important in asthma.

Potential limitations of our study, as in some other epidemiological studies, were that the presence of asthma was determined from self-reports by subjects. People more likely report symptoms if they have an abnormal psychological condition, such as anxiety or depression (30, 31). Furthermore, the people themselves could not remember their childhood respiratory diseases, but their parents gave their children information about childhood diseases. Subjects may not have realized their coughing or other chronic lung disease. However, there are weaknesses in the study design for assessing frequent childhood respiratory infections, which are likely subject to recall bias. It is very difficult to define “definite asthma” in this study. However, all epidemiological studies on the basis of the questionnaire can be seen in the similarity of errors.

CONCLUSIONS

The prevalent rates for asthma in adults living in the rural areas of Kirikkale Region in Central Turkey were significantly higher than the rates of the region’s urban population. Exposure to biomass smoke and childhood respiratory infections were associated with an increased risk for asthma. The higher incidence of asthma in adults living in rural areas may be due to a higher frequency of childhood respiratory infections and exposure to biomass smoke.

DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

REFERENCES

- Nafti S, Taright S, El Ftouh M, Yassine N, Benkheder A, Bouacha H, Fakhfakh H, Ali-Khoudja M, Texier N, El Hasnaoui A. Prevalence of asthma in North Africa: the Asthma Insights and Reality in the Maghreb (AIRMAG) study. *Respir Med* 2009; 103(2):2–11.
- Ekerljung L, Andersson A, Sundblad BM, Rönmark E, Larsson K, Ahlstedt S, Dahlén SE, Lundbäck B. Has the increase in the prevalence of asthma and respiratory symptoms reached a plateau in Stockholm, Sweden? *Int J Tuberc Lung Dis* 2010; 14(6):764–771.
- McHugh MK, Symanski E, Pompeii LA, Delclos GL. Prevalence of asthma among adult females and males in the United States: results from the National Health and Nutrition Examination Survey (NHANES), 2001–2004. *J Asthma* 2009; 46(8):759–766.
- Lewis S, Hales S, Slater T, Pearce N, Crane J, Beasley R. Geographical variation in the prevalence of asthma symptoms in New Zealand. *N Z Med J* 1997; 110(1049):286–289.
- Woods RK, Burton DL, Wharton C, McKenzie GH, Walters EH, Comino EJ, Abramson MJ. Asthma is more prevalent in rural New South Wales than metropolitan Victoria, Australia. *Respirology* 2000; 5(3):257–263.
- Mistry R, Wickramasingha N, Ogston S, Singh M, Devasiri V, Mukhopadhyay S. Wheeze and urban variation in South Asia. *Eur J Pediatr* 2004; 163(3):145–147.
- Chan-Yeung M, Zhan LX, Tu DH, Li B, He GX, Kauppinen R, Nieminen M, Enarson DA. The prevalence of asthma and asthma-like symptoms among adults in rural Beijing, China. *Eur Respir J* 2002; 19(5):853–858.
- Kilpeläinen M, Terho EO, Helenius H, Koskenvuo M. Farm environment in childhood prevents the development of allergies. *Clin Exp Allergy* 2000; 30(2):201–208.
- Riedler J, Eder W, Oberfeld G, Schreuer M. Austrian children living on a farm have less hay fever, asthma and allergic sensitization. *Clin Exp Allergy* 2000; 30(2):194–200.
- Akkurt I, Sümer H, Özşahin SL, Gönllüğü U, Özdemir L, Doğan O, Demir DA, Seyfikli Z. Prevalence of asthma and related symptoms in Sivas, Central Anatolia. *J Asthma* 2003; 40(5):551–556.
- Dinmez S, Ogus C, Erengin H, Cilli A, Ozbudak O, Ozdemir T. The prevalence of asthma, allergic rhinitis, and atopy in Antalya, Turkey. *Allergy Asthma Proc* 2005; 26(5):403–409.
- Emri S, Turnagöl H, Başoğlu S, Bacanlı S, Guven GS, Aslan D. Asthma-like symptoms prevalence in five Turkish urban centers. *Allergol Immunopathol (Madr)* 2005; 33(5):270–276.
- Ekici M, Ekici A, Keles H, Akin A, Karlidag A, Tunckol M, Kocyigit P. Risk factors and correlates of snoring and observed apnea. *Sleep Med* 2008; 9(3):290–296.
- Enright PL, McClelland RL, Newman AB, Gottlieb DJ, Lebowitz MD. Underdiagnosis and undertreatment of asthma in the elderly. Cardiovascular Health Study Research Group. *Chest* 1999; 116(3):603–613.
- Ekici M, Ekici A, Akin A, Altinkaya V, Bulcun E. Chronic airway diseases in adult life and childhood infections. *Respiration* 2008; 75(1):55–59.
- Lange P, Parner J, Prescott E, Vestbo J. Chronic bronchitis in an elderly population. *Age Ageing* 2003; 32(6):636–642.
- Ding DJ. Follow-up study of the effect of acute lower respiratory tract infection during childhood on chronic bronchitis in adults. *Zhonghua Jie He He Hu Xi Za Zhi* 1992; 15(6):341–343, 379.
- Barker DJ, Osmond C. Childhood respiratory infection and adult chronic bronchitis in England and Wales. *Br Med J (Clin Res Ed)* 1986; 293(6557):1271–1275.
- Ferrari M, Tardivo S, Zanolin ME, Olivieri M, Lampronti G, Biasin C, Poli A, Balestreri F, de Marco R, Lo Cascio V. Serious childhood respiratory infections and asthma in adult life. A population based

- study. ECRHS Italy. European Community Respiratory Health Survey. *Ann Allergy Asthma Immunol* 1999; 83(5):391–396.
20. Tesfaigzi Y, Singh SP, Foster JE, Kubatko J, Barr EB, Fine PM, McDonald JD, Hahn FF, Mauderly JL. Health effects of subchronic exposure to low levels of wood smoke in rats. *Toxicol Sci* 2002; 65(1):115–125.
 21. Ellegard A. Cooking fuel smoke and respiratory symptoms among women in low-income areas in Maputo. *Environ Health Perspect* 1996; 104:980–985.
 22. Pierson WE, Koenig JQ, Bardana EJ Jr. Potential adverse health effects of wood smoke. *West J Med* 1989; 151(3):339–342.
 23. Larson TV, Koenig JQ. Wood smoke: emissions and noncancer respiratory effects. *Annu Rev Public Health* 1994; 15:133.
 24. Mishra V. Effect of indoor air pollution from biomass combustion on prevalence of asthma in the elderly. *Environ Health Perspect* 2003; 111(1):71–78.
 25. Kurt E, Metintas S, Basyigit I, Bulut I, Coskun E, Dabak S, Deveci F, Fidan F, Kaynar H, Kunt Uzaslan E, Onbasi K, Ozkurt S, Pasaoglu Karakis G, Sahan S, Sahin U, Oguzulgen K, Yildiz F, Mungan D, Yorgancioglu A, Gemicioglu B, Fuat Kalyoncu A, PARFAIT Study of the Turkish Thoracic Society Asthma and Allergy Working Group. Prevalence and Risk Factors of Allergies in Turkey (PARFAIT): results of a multicentre cross-sectional study in adults. *Eur Respir J* 2009; 33(4):724–733.
 26. Tug T, Acik Y. Prevalence of asthma, asthma-like and allergic symptoms in the urban and rural adult population in Eastern Turkey. *Asian Pac J Allergy Immunol* 2002; 20(4):209–215.
 27. Kim YK, Kim SH, Tak YJ, Jee YK, Lee BJ, Kim SH, Park HW, Jung JW, Bahn JW, Chang YS, Choi DC, Chang SI, Min KU, Kim YY, Cho SH. High prevalence of current asthma and active smoking effect among the elderly. *Clin Exp Allergy* 2002; 32(12):1706–1712.
 28. Abramson M, Kutin JJ, Raven J, Lanigan A, Czarny D, Walters EH. Risk factors for asthma among young adults in Melbourne, Australia. *Respirology* 1996; 1:291–297.
 29. Ghosh S, Pahwa P, Rennie DC, Janzen B. Gender-related interactive effect of smoking and rural/urban living on asthma prevalence: a longitudinal Canadian NPHS study. *J Asthma* 2009; 46(10):988–994.
 30. Dales RE, Spitzer WO, Schechter MT, Suissa S. The influence of psychological status on respiratory symptom reporting. *Am Rev Respir Dis* 1989; 139:1459–1463.
 31. Speckens AE, van Hemert AM, Spinoven P, Hawton KE, Bolk JH, Rooijmans HG. Cognitive behavioural therapy for medically unexplained physical symptoms: a randomised controlled trial. *BMJ* 1995; 311:1328–1332.

Copyright of Journal of Asthma is the property of Taylor & Francis Ltd and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.