

Original article

Rising trend of asthma prevalence among Turkish schoolchildren (ISAAC phases I and III)

Background: Asthma is a common chronic illness in childhood. The aim of the study was to examine time trends in the prevalence of asthma using the ISAAC questionnaire in 6- to 12-year-old schoolchildren in Istanbul and factors affecting asthma prevalence.

Methods: Two cross-sectional surveys were performed, 9 years apart (1995 and 2004) using the ISAAC protocol. The survey conducted in 1995 was repeated in 2004 using the same questionnaire in the same age group, in the same schools in the same season. The 2500 questionnaires were distributed to the children to be completed by their parents at home.

Results: A total of 2387 children (response rate 95.5%) in the 2004 study and 2216 children (response rate 94.3%) in 1995 were included in the final analysis. The overall lifetime prevalence of wheeze increased from 15.1% to 25.3%; prevalence odds ratio (POR) = 1.91, 95% confidence interval (95% CI) = 1.64–2.21, and $P < 0.001$. The overall 12-month prevalence of wheeze increased from 8.2% to 11.3%; POR = 1.43, 95% CI = 1.18–1.75, and $P < 0.001$. The prevalence of asthma increased significantly from 9.8% to 17.8%; POR = 1.99, 95% CI = 1.67–2.36, and $P < 0.001$. In both 1995 and 2004, family history of asthma, eczema diagnosed by a physician, food allergy diagnosed by a physician, frequent otitis, frequent sinusitis were associated significantly with high risk for asthma.

Conclusions: In the 9-year period from 1995 to 2004, the prevalence of asthma symptoms has increased in 6- to 12-year-old schoolchildren in Istanbul. Risk factors affecting asthma prevalence remained unchanged during the 9-year period.

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Asthma is a common chronic illness in childhood. In many studies, an increase in asthma prevalence has been reported (1–9), but in a few studies the prevalence was unchanged (10) or decreased (11). This discrepancy may be due to the use of a different methodology (12), diagnostic changes (classification bias) (9, 12), and/or increased awareness of symptoms and the willingness of doctors to diagnose asthma (information bias) (12, 13). Other factors affecting asthma prevalence may be increased awareness of asthma in the community (11), changes in diagnostic methods, and the use of health services for childhood asthma (14).

The aims of the International Study of Asthma and Allergies in Childhood (ISAAC) phase I were to describe the prevalence and severity of the symptoms of asthma and other allergic diseases in children living in different geographic centers; make comparisons within and between countries; obtain baseline measures for the assessment of future prevalence trends; provide a framework for future etiologic research into the

causation of these diseases (15, 16). ISAAC phase III was used to examine time trends in the prevalence of asthma and other allergic diseases in centers and countries that participated in ISAAC phase I. The time period between ISAAC phase I and phase III data collection must be at least 5 years (17).

Our study was conducted on 6- to 12-year-old schoolchildren in Istanbul in 1995 using the ISAAC questionnaire. The lifetime prevalence of asthma and wheeze was found to be 9.8% and 15.1% respectively (18). In this study, an atopic family history, food allergy, eczema, and frequent otitis media and sinusitis attacks were found to be important risk factors in asthma prevalence (18). To determine whether the prevalence of childhood asthma is changing in 6- to 12-year-old schoolchildren attending the same primary school, we compared the results from cross-sectional surveys held in 1995 and 2004 using the ISAAC questionnaire. Thus, this study is complementary to the previous report, and the second of a cross-sectional epidemiological survey in children.

Methods

To examine time trends in the prevalence of asthma, the survey was repeated with the same questionnaire in the same age group (6–12 years) of the same schools, in the same season (April and May) in 2004. We distributed 2500 questionnaires to the children to be completed by their parents at home.

As in the previous study, the definition of asthma was accepted as self-reporting of diagnosed asthma with a physician's confirmation (19) and terms of 'allergic bronchitis' or 'spastic bronchitis' (18). We use the term 'asthma' instead of the above-mentioned terms.

The return visit to the school was done within a 2-week period to try to collect data from children formerly absent. The questionnaire (ISAAC Phase III), was translated into Turkish and used unchanged from the previous study (ISAAC Phase I) (18). There have been quite a few studies carried out in Turkey using the ISAAC questionnaire (18, 20–22); therefore, it is well known and validated in Turkish studies. The questionnaire evaluating risk factors was also identical in both cross-sectional surveys. An additional questionnaire, to be filled in by the parents was prepared to identify potential risk factors, including sex, passive smoking at home, presence of domestic animals (cats, dogs, birds), stuffed toys, home dampness, lack of breast feeding, atopic family history, the presence of food allergy and eczema, frequent otitis media and sinusitis, and socioeconomic status (heating system, residence, education level of mother and father, number of people living at home, number of rooms in home, sharing bedroom, and annual family income). They were assessed by statistical analysis. Our present survey was approved by the ethics committee of Istanbul School of Medicine, Istanbul University.

Statistical analysis

Statistical analysis included percentages, odds ratios (OR), 95% confidence interval (95% CI), chi-squared test and backward logistic regression. Prevalence estimates were calculated by dividing positive responses to the given question by the total number of completed questionnaires. The 95% CI of these prevalence rates was also calculated. According to ISAAC policy, missing and inconsistent responses were included in the denominator for the prevalence calculations, but excluded from subsequent bivariate analysis (5, 8, 10, 23, 24). To compare the differences in prevalence rates between the two studies, chi-squared test and prevalence odds ratios (POR) with 95% CI were performed. The relation between risk factors and asthma prevalence was performed by univariate analysis using chi-squared tests and univariate odds ratio (uOR) and its 95% CI. $P < 0.05$ was considered significant. Risk factors significantly affecting asthma prevalence were sex, home dampness, asthma in first-degree relatives, eczema and food allergy diagnosed by a physician, history of frequent otitis and sinusitis, the number of people living at home and sharing a bedroom. These risk factors were tested in a backward logistic regression analysis with adjusted odds ratio (aOR) and its 95% CI. The SPSS software package version 12 for Windows (SPSS, Chicago, IL, USA) was used for all statistical analyses.

Results

In the 1995 study, 2232/2350 questionnaires were completed giving an overall response rate of 94.9% but 16 questionnaires were excluded because of illiteracy; 2216 questionnaire were included in the final analysis with an overall response of 94.3%. In the present study, 2500

questionnaires were distributed and 2387 children were included in the final analysis, an overall response rate of 95.5%.

The demographic characteristics of children were shown in Table 1. The age and sex distributions of the study groups (Table 2) were similar in the two surveys. The risk of asthma was 1.24 times higher in boys than in girls in the 2004 survey (uOR = 1.24, 95% CI = 1.00–1.53) but not in the 1995 survey (uOR = 1.03, 95% CI = 0.78–1.36). We found male gender to be a risk factor for asthma. The prevalence of asthma increased from 10.0% (1995 survey) to 19.4% (2004 survey) in males and from 9.7% (1995 survey) to 16.2% (2004 survey) in females (POR = 2.17, 95% CI = 1.70–2.77 and POR = 1.81, 95% CI = 1.40–2.33 respectively).

The prevalence of asthma, wheeze and other symptoms of asthma derived from the standard ISAAC questionnaire in 1995 and 2004 in Istanbul are compared in Table 3. The overall lifetime prevalence of wheeze increased from 15.1% to 25.3% (POR = 1.91, 95% CI = 1.64–2.21, and $P < 0.001$). The overall 12-month prevalence of wheeze increased from 8.2% to 11.3% (POR = 1.43, 95% CI = 1.18–1.75, and $P < 0.001$). Sleep disturbed by wheeze, and waking with cough in the previous 12 months were significantly higher in 2004 than in 1995 (POR = 0.67, 2.81, 95% CI = 1.30–2.15, 2.43–3.25, and $P < 0.001$, $P < 0.001$ respectively). In addition, the number of wheeze attacks in the previous 12 months in 2004 was significantly higher than in 1995 except for

Table 1. Demographic data in the 1995 and 2004 surveys

	1995 survey (phase I)	2004 survey (phase III)
Sex		
Male	1101 (49.7%)	1166 (49.6%)
Female	1115 (50.3%)	1185 (50.4%)
Age		
Range	6- to 12-year olds	6- to 12-year olds
Mean	8 years 7 months	8 years 8 months
Race	Caucasian	Caucasian
Number of schools	6	6

Table 2. Age and sex distribution of children participating in the 1995 and 2004 surveys

Age (years)	1995 survey (phase I)			2004 survey (phase III)		
	Girls, n (%)	Boys, n (%)	Total, n (%)	Girls, n (%)	Boys, n (%)	Total, n (%)
6	109 (9.3)	96 (8.7)	205 (9.3)	102 (9.1)	106 (8.6)	208 (8.8)
7	204 (18.3)	196 (17.8)	400 (18.1)	206 (17.4)	204 (17.5)	410 (17.4)
8	248 (22.2)	234 (21.3)	482 (21.8)	247 (20.8)	253 (21.7)	500 (21.3)
9	208 (18.7)	206 (18.7)	414 (18.7)	241 (20.3)	223 (19.1)	464 (19.7)
10	197 (17.7)	210 (19.1)	407 (18.4)	208 (17.6)	210 (18.0)	418 (17.8)
11	137 (12.3)	133 (12.1)	270 (12.2)	145 (12.2)	145 (12.4)	290 (12.3)
12	12 (1.1)	26 (2.4)	38 (1.7)	36 (3.0)	25 (2.1)	61 (2.6)
Total	1115 (50.3)	1101 (49.7)	2216 (100)	1185 (50.4)	1166 (49.6)	2351 (100)

Table 3. Time trends of prevalence of wheeze, asthma, and other symptoms

Questions	1995 survey (n = 2216)		2004 survey (n = 2387)		Prevalence odds ratio (95%)	P-value
	n (%)	95% CI	n (%)	95% CI		
Wheeze ever	334 (15.1)	13.6–16.6	603 (25.3)	23.6–27.0	1.91 (1.64–2.21)	<0.001
Wheeze in last year	181 (8.2)	7.1–9.3	270 (11.3)	10.0–12.6	1.43 (1.18–1.75)	<0.001
Attacks of wheeze in last year						
1–3	117 (5.2)	4.2–6.0	160 (6.7)	5.7–7.7	1.29 (1.01–1.65)	0.042
4–12	49 (2.2)	1.6–2.8	68 (2.8)	2.1–3.5	1.30 (0.89–1.88)	0.170
>12	15 (0.7)	0.4–1.0	42 (1.8)	1.3–2.3	2.63 (1.46–4.76)	<0.001
Sleep disturbed by wheeze in last year	103 (4.6)	3.8–5.4	172 (7.2)	6.7–7.7	1.67 (1.30–2.15)	<0.001
Severe attacks of wheeze limiting speech in last year	89 (4.0)	3.2–4.8	101 (4.2)	3.8–5.0	1.06 (0.79–1.41)	0.72
Asthma	218 (9.8)	8.6–11.0	425 (17.8)	16.3–19.3	1.99 (1.67–2.36)	<0.001
Wheeze after exercise in last year	277 (12.5)	11.2–13.8	182 (7.6)	6.5–8.7	0.58 (0.48–0.70)	<0.001
Waking with cough in last year	322 (14.5)	13.1–15.9	772 (34.4)	32.5–36.3	2.81 (2.43–3.25)	<0.001

4–12 attacks. However, wheeze after exercise in the previous 12 months in 1995 was higher than that in 2004 (POR = 0.58; 95% CI = 0.48–0.70, and $P < 0.001$).

The prevalence of asthma increased significantly from 9.8% to 17.8% (POR = 1.99, 95% CI = 1.67–2.36, and $P < 0.001$).

In both surveys, a family history of asthma, eczema, food allergy diagnosed by a physician, frequent otitis, and frequent sinusitis were significant factors for increased risk for asthma (Table 4). Home dampness increased the risk of asthma (uOR = 1.35, 95% CI = 1.06–1.72) in 2004, but not in 1995 (uOR = 1.17, 95% CI = 0.82–1.67). Risk factors such as smoking at home, domestic animals at home, stuffed toys, lack of breast feeding did not significantly influence the prevalence of asthma in both surveys.

Most of the risk factors related to socio-economic status did not significantly affect the prevalence of asthma, in both surveys (Table 5).

In the present survey, the risk factors significantly affecting asthma were tested in a backward logistic

regression analysis. Sex (aOR = 1.30, 95% CI = 1.03–1.65), home dampness (aOR = 1.32, 95% CI = 1.01–1.70), family history of asthma (aOR = 1.72, 95% CI = 1.20–2.40), food allergy diagnosed by a physician (aOR = 2.00, 95% CI = 1.42–2.83), frequent otitis (aOR = 2.39, 95% CI = 1.84–3.10), frequent sinusitis (aOR = 2.40, 95% CI = 1.67–3.45) were identified as independent risk factors for asthma; the exception was physician-diagnosed eczema (aOR = 1.66, 95% CI = 0.93–2.99) (Table 6).

Discussion

Two cross-sectional surveys were performed with the same questionnaire on the same age group (6–12 years) in the same schools in Istanbul, at the same time of year.

This study shows that the prevalence of asthma symptoms has increased significantly in 2004 compared with those in 1995, except only the prevalence of current exercise-induced wheeze. The increasing trend of asthma

Table 4. Risk factors affecting prevalence of asthma in the two surveys

Factors	1995 survey			2004 survey		
	Asthmatics	Nonasthmatics	uOR (95% CI)	Asthmatics	Nonasthmatics	uOR (95% CI)
Sex						
Male	50.4	49.5	1.03 (0.78–1.36)	53.6	48.2	1.24 (1.00–153)*
Female	49.6	50.5	1.0	46.4	51.8	1.0
Smoking at home	63.2	69.1	0.76 (0.57–1.02)	60.4	56.2	1.18 (0.96–1.48)
Domestic animals at home	21.7	26.4	0.77 (0.55–1.08)	19.6	17.5	1.15 (0.88–1.50)
Stuffed toys	22.3	25.9	0.82 (0.58–1.14)	51.5	52.9	0.95 (0.76–1.17)
Home dampness	20.6	18.1	1.17 (0.82–1.67)	29.3	23.4	1.35 (1.06–1.72)*
Breast feeding	90.7	91.6	0.89 (0.54–1.45)	87.9	89.1	1.15 (0.80–1.55)
Asthma in first-degree relatives	15.6	6.9	2.49 (1.66–3.73)*	15.8	7.8	2.21 (1.61–3.04)*
Eczema diagnosed by physician	5.9	2.9	2.08 (1.12–3.86)*	5.4	2.8	2.00 (1.19–3.35)*
Food allergy diagnosed by physician	12.8	4.2	3.31 (2.10–5.21)*	16.0	7.8	2.25 (1.64–3.09)*
Frequent otitis history	13.3	7.6	1.86 (1.21–2.85)*	26.2	13.0	2.39 (1.84–3.10)*
Frequent sinusitis history	22.9	6.2	4.49 (3.12–6.47)*	16.1	7.3	2.45 (1.78–3.37)*

* $P < 0.05$. uOR, univariate odds ratio.

Table 5. Comparison of the relationships between socioeconomic status and asthma prevalence in the two surveys

		1995 survey		2004 survey	
		Asthma rate (%)	uOR (95% CI)	Asthma rate (%)	uOR (95% CI)
Heating system	Stove	10.4	1.20 (0.88–1.65)	18.8	0.96 (0.77–1.19)
	Central heating system	8.8	1.00	19.5	1.00
Residence	Lodger	8.7	0.81 (0.60–1.10)	20.1	1.08 (0.87–1.35)
	Owner	10.5	1.00	18.8	1.00
Education level of mother	Primary school	9.1	0.87 (0.62–1.20)	19.7	0.83 (0.52–1.32)
	University	10.3	1.00	22.9	1.00
Education level of father	Primary school	8.8	0.82 (0.60–1.17)	19.7	1.13 (0.79–1.60)
	University	10.5	1.00	17.9	1.00
Number of people living at home	4 or fewer	9.0	0.83 (0.63–1.10)	20.7	1.22 (0.98–1.52)
	5 or more	10.6	1.00	17.6	1.00
Number of rooms in home	1–2	11.6	1.28 (0.93–1.76)	18.7	0.94 (0.74–1.20)
	3 or more	9.3	1.00	19.6	1.00
Sharing bedroom	No	10.3	1.29 (0.86–1.91)	16.7	0.79 (0.61–1.03)
	Yes	9.3	1.00	20.2	1.00
Annual family income	<3000	10.6	1.15 (0.86–1.53)	19.7	1.18 (0.92–1.50)
	>3000	9.3	1.00	17.2	1.00

uOR, univariate odds ratio.

Table 6. Risk factors significantly affecting asthma prevalence by multivariate analyses in 2004 survey

Factors	aOR	95% CI
Sex*		
M	1.30	1.03–1.65
F	1.0	
Home dampness*	1.32	1.01–1.70
Asthma in first-degree relatives*	1.72	1.20–2.40
Eczema diagnosed by physician	1.66	0.93–2.99
Food allergy diagnosed by physician*	2.00	1.42–2.83
Frequent otitis history*	2.39	1.84–3.10
Frequent sinusitis history*	2.40	1.67–3.45

* $P < 0.05$. aOR, adjusted odds ratio.

prevalence in our study is similar to many epidemiological studies conducted in different parts of the world (1–9). The reasons for this rising trend could be increased community awareness of asthma among the general population and medical personnel, environmental changes caused by rapid westernization, rapid economic development, or increased air pollution.

Istanbul is the biggest city in Turkey with 10,033,478 inhabitants (according to the 2000 national census) (25). It includes one-seventh of the Turkish population. Statistics show that the number of inhabitants in Istanbul increased 50% from 1990 to 2000 (25). The characteristic weather is a somewhat cooler version of the Mediterranean climate: a short spring, ideal summer temperatures, a long autumn, and a rainy winter. Remarkable economic changes took place in Turkey between 1995 and 2003, e.g. average gross wages per capita increased from \$2759 to \$3383 (25). The annual exports and imports increased threefold from 1995 to 2003 (25). The rapid economic development and increased awareness of community and

medical personnel, the willingness of doctors to diagnose asthma, and use of new diagnostic techniques in the field of asthma may explain this rising trend in the prevalence of asthma.

The increase in the number of wheezy attacks in the last year may be due to the increase in asthma prevalence.

Asthma education programs in Istanbul and in the other parts of Turkey have been increased. Summer camps for asthmatic children have been organized annually since 1996. These educational programs made people more aware about the management of asthma and hence exercise-induced asthma. Asthma constituted 59.5% of exercise-induced wheeze in the present survey, which is lower than that in the 1995 survey. This difference may be explained by increased asthma knowledge and the attitude of the families of asthmatic children and, hence their intervention with preventive treatment in exercise-induced asthma.

Epidemiologic studies suggested that male gender was a risk factor for asthma in children (26). Asthma prevalence in males is as twice as much in girls (27, 28). As age increases, however, the difference between the genders narrows. Before the age of 14 years, males have been shown to have smaller airways for a given lung size and higher airway resistance than girls (29, 30). This difference in airway anatomy could predispose boys to more wheeze and lower respiratory rate (26). Gender differences in asthma prevalence in our study were similar to those reported by other authors (31–33).

Moisture-related problems in buildings are a risk factor for asthma and allergic symptoms among preschool children (34). Although home dampness was found to be an important risk factor for asthma in the present study, it was not found to be a risk factor in the 1997

survey. This might be due to the increased number of asthmatic children in the recent survey.

In both these 1995 and 2004 studies, we found family history of asthma, eczema diagnosed by a physician, food allergy diagnosed by a physician, frequent otitis, frequent sinusitis to be important risk factors for the prevalence of asthma. Thus, the risk factors remained unchanged, which re-emphasizes their importance.

Although asthma was frequently found in children with eczema, no significant association could be found between asthma and doctor-diagnosed eczema by multi-variant analysis. This might be due to the low number of children ($n = 70$) with eczema.

Decreased household size was associated with an increased risk of asthma, which is a classical finding of hygiene hypothesis (35, 36). However, household size and sharing a bedroom were not significant risk factors for asthma in either of our surveys.

In conclusion, the prevalence of asthma symptoms have increased significantly in 2004 when compared with the previous study in 1995. A family history of asthma, food allergy diagnosed by a physician, frequent history of otitis, and frequent history of sinusitis were reconfirmed as the important risk factors. Further studies are required to determine other risk factors related to the increase in asthma prevalence.

References

- Senthilselvan A. Prevalence of physician-diagnosed asthma in Saskatchewan, 1981 to 1990. *Chest* 1998;**114**:388–392.
- Wollmer WM, Osborne ML, Buist AS. 20-year trends in the prevalence of asthma and chronic airflow obstruction in an HMO. *Am J Respir Crit Care Med* 1998;**157**:1079–1084.
- Hong SJ, Lee MS, Sohn MH, Shim JY, Han YS, Park KS et al. Self-reported prevalence and risk factors of asthma among Korean adolescents: 5-year follow-up study, 1995–2000. *Clin Exp Allergy* 2004;**34**:1556–1562.
- Maziak W, Behrens T, Brasky TM, Duhme H, Rzehak P, Weiland SK et al. Are asthma and allergies in children and adolescents increasing? Results from ISAAC phase I and phase III surveys in Munster, Germany. *Allergy* 2003;**58**:572–579.
- Downs SH, Marks GB, Sporik R, Belosouva EG, Car NG, Peat JK. Continued increase in the prevalence of asthma and atopy. *Arch Dis Child* 2001;**84**:20–23.
- Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality. *Pediatrics* 2002;**110**:315–322.
- Burney P. The changing prevalence of asthma. *Thorax* 2002;**57**:II36–II39.
- Annus T, Riikjarv MA, Rahu K, Bjorksten B. Modest increase in seasonal allergic rhinitis and eczema over 8 years among Estonian schoolchildren. *Pediatr Allergy Immunol* 2005;**16**:315–320.
- Nystad W, Magnus P, Gulsvik A, Skarpaas IJ, Carlsen KH. Changing prevalence of asthma in school children: evidence for diagnostic changes in asthma in two surveys 13 yrs apart. *Eur Respir J* 1997;**10**:1046–1051.
- Lee SL, Wong W, Lau YL. Increasing prevalence of allergic rhinitis but not asthma among children in Hong Kong from 1995 to 2001 (Phase 3 International Study of Asthma and Allergies in Childhood). *Pediatr Allergy Immunol* 2004;**15**:72–78.
- Wong GW, Leung TF, Ko FW, Lee KKM, Lam P, Hui DSC et al. Declining asthma prevalence in Hong Kong Chinese schoolchildren. *Clin Exp Allergy* 2004;**34**:1550–1555.
- Magnus P, Jaakkola JJ. Secular trend in the occurrence of asthma among children and young adults: critical appraisal of repeated cross sectional surveys. *BMJ* 1997;**314**:1795–1799.
- Barracough R, Devereux G, Hendrick DJ, Stenton SC. Apparent but not real increase in asthma prevalence during the 1990s. *Eur Respir J* 2002;**20**:826–833.
- Strachan DP. The epidemiology of childhood asthma. *Allergy* 1999;**54**:7–11.
- Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *Eur Respir J* 1995;**8**:483–491.
- The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J* 1998;**12**:315–335.
- Asher MI, Weiland SK. The International Study of Asthma and Allergies in Childhood (ISAAC). ISAAC Steering Committee. *Clin Exp Allergy* 1998;**28**:52–66; discussion 90–91.
- Ones U, Sapan N, Somer A, Disci R, Salman N, Guler N, Yalcin I. Prevalence of childhood asthma in Istanbul, Turkey. *Allergy* 1997;**52**:570–575.
- Gergen PT, Weiss KB. Epidemiology in asthma. In: Busse WW, Holtage ST, editors. *Asthma and rhinitis*. Taunton MA: Blackwell Science, 1995:15–31.
- Ece A, Ceylan A, Saraclar Y, Saka G, Gurkan F, Haspolat K. Prevalence of asthma and other allergic disorders among schoolchildren in Diyarbakir, Turkey. *Turk J Pediatr* 2001;**43**:286–292.
- Bayram I, Guneser-Kendirli S, Yilmaz M, Altintas DU, Alparslan N, Bingol-Karakoc G. The prevalence of asthma and allergic diseases in children of school age in Adana in southern Turkey. *Turk J Pediatr* 2004;**46**:221–225.
- Tomac N, Demirel F, Acun C, Ayoglu F. Prevalence and risk factors for childhood asthma in Zonguldak, Turkey. *Allergy Asthma Proc* 2005;**26**:397–402.
- Kaur B, Anderson HR, Austin J, Burr M, Harkins LS, Strachan DP et al. Prevalence of asthma symptoms, diagnosis, and treatment in 12–14 year old children across Great Britain (international study of asthma and allergies in childhood, ISAAC UK). *BMJ* 1998;**316**:118–124.
- ISAAC Phase One. Section 6.1 Data quality and handling section. <http://isaac.auckland.ac.nz/PhaseOne/Manual/> (Accessed 9 August 2006).
- Republic of Turkey, Prime Ministry Turkish Statistical Institute (TURKSTAT). <http://www.die.gov.tr/> (Accessed 23 March 2006).
- Erika AT, Denise GW, Jonathan MS. Epidemiology of asthma and allergic disease. In: Adkinson NF, Yunginger JW, Busse WB, Bochner BS, Holgate ST, Simons FE, editors. *Middleton's allergy principles and practice*. USA: Mosby, 2003:1127–1168.
- Horwood LJ, Fergusson DM, Shannon FT. Social and familial factors in the development of early childhood asthma. *Pediatrics* 1985;**75**:859–868.

28. Schachter EN, Doyle CA, Beck GJ. A prospective study of asthma in a rural community. *Chest* 1984;**85**:623–630.
29. Taussig LM. Maximal expiratory flows at functional residual capacity: a test of lung function for young children. *Am Rev Respir Dis* 1977;**116**:1031–1038.
30. Doershuk CF, Fisher BJ, Matthews LW. Specific airway resistance from the perinatal period into adulthood. Alterations in childhood pulmonary disease. *Am Rev Respir Dis* 1974;**109**:452–457.
31. Manfreda J, Becker AB, Wang PZ, Roos LL, Anthonisen NR. Trends in physician-diagnosed asthma prevalence in Manitoba between 1980 and 1990. *Chest* 1993;**103**:151–157.
32. Rona RJ, Chinn S, Burney PG. Trends in the prevalence of asthma in Scottish and English primary school children 1982–92. *Thorax* 1995;**50**:992–993.
33. Skobeloff EM, Spivey WH, St Clair SS, Schoffstall JM. The influence of age and sex on asthma admissions. *JAMA* 1992;**268**:3437–3440.
34. Bornehag CG, Sundell J, Hagerhed-Engman L, Sigsggagd T, Janson S, Aberg N et al. 'Dampness' at home and its association with airway, nose, and skin symptoms among 10,851 preschool children in Sweden: a cross-sectional study. *Indoor Air* 2005;**15**:48–55.
35. Hesselmar B, Aberg N, Aberg B, Eriksson B, Bjorksten B. Does early exposure to cat or dog protect against later allergy development? *Clin Exp Allergy* 1999;**29**:611–617.
36. Cardoso MR, Cousens SN, de Goes Siqueira LF, Alves FM, D'Angelo LA. Crowding: risk factor or protective factor for lower respiratory disease in young children? *BMC Public Health* 2004;**4**:19.