

The Prevalence of Asthma Diagnosis and Symptoms is Still Increasing in Early Adolescents in Turkey

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ABSTRACT

Background: This study was performed to evaluate the time trends in prevalence of asthma and related factors in Denizli, Turkey.

Methods: Two cross-sectional surveys were performed, 6 years apart (2002 and 2008) using the ISAAC protocol, in the 13-14 age groups and comparisons were made between the results.

Results: Lifetime prevalence of wheeze, 12 month prevalence of wheeze, and the prevalence of wheeze after exercise in the previous 12 months were significantly increased respectively from 10.2% to 13.4% (POR = 1.37, 95%CI = 1.18-1.58, $p < 0.001$), from 5.0% to 6.2% (POR = 1.26, 95%CI = 1.02-1.55, $p = 0.016$) and from 9% to 10.2% (POR = 1.15, 95%CI = 0.98-1.35, $p = 0.046$) in 2008 study. Doctor diagnosed asthma prevalence also increased significantly from 2.1% to 12.9 (POR = 6.80, 95%CI = 5.22-8.85, $p < 0.001$). Prevalence of sleep disturbed by wheeze in the last 12 months; but, never woken with wheezing (POR = 1.62, 95%CI = 1.26-2.09, $p < 0.001$) and less than one night per week (POR = 1.58, 95%CI = 1.06-2.36, $p = 0.013$) were significantly increased in 2008 study. Severe attacks of wheeze limiting speech in the last year was increased from 1.3% to 2.2% (POR = 1.67, 95%CI = 1.14-2.43, $p = 0.004$). The number of wheeze attacks in the previous 12 months was increased significantly for 4-to-12 attacks (POR = 1.54, 95%CI = 1.03-2.32, $p = 0.02$) in 2008 study. However, prevalence of waking with cough in the last 12 months did not change.

While history of family atopy and domestic animal at home were found as significant risk factors for asthma in 2002 study, male gender, history of family atopy and stuffed toys were found significant in 2008.

Conclusions: The prevalence of asthma symptoms were increased in Denizli. History of family atopy, male gender and stuffed toys were important risk factors for asthma in 2008.

KEY WORDS

adolescents, asthma, children, prevalence, risk factor

INTRODUCTION

Asthma is the most common chronic disorder of school-age children and youth, with an increasing prevalence all around the world.¹⁻⁴ But in a few studies there were different results about prevalence.^{5,6} This inconsistency between studies may be due to the use of different methodologies and diagnostic changes.⁷ 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 parts of the world and to make comparisons between them.⁸ 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 must be at least 5 years.⁸

The first study was conducted on 13-14 years old school children in 2002 using the ISAAC phase I methodology.⁹ The lifetime prevalence of wheeze and wheeze in the last 12 months were found to be 10.2% and 5% respectively. In this study, family history of

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atopy and presence of domestic animal at home were found as important risk factors in the asthma symptoms. The aims of current study were determine the change in the prevalence of asthma and to see potential risk factors for asthma. Results were compared with the results of 2002 study.

METHODS

PLACE OF STUDY

Denizli is a developing industrial city in the South-western part of Turkey, in the country's Aegean Region.¹⁰ Aegean Region has very hot summers, and a mild fall, winter and spring time. However, climate of Denizli does not have same features of Aegean climate because of the fact that, the city is located between seaside and inland areas; so, it has some differences. In the center, a terrestrial climate may be felt while the inland area is cooler. In addition, the land is open to winds coming from the sea. Furthermore, the winters are generally mild; but, it may be rarely very cold that is the temperature may be felt under 0 centigrade in spite of the high temperature of summers that sometimes may reach over 40 centigrade. Denizli is generally rainy in winters while dry in summers. Some years, snow can be observed in the urban areas. Springs and autumns are rainy, mild climate, warm.¹⁰ The average annual rainfall is 551.1 mm. The amount of rain is changeable in the city that is the average amount of rainfall in the winters is 78.53 mm while in the summers it is 16.76 mm. Then, 51.9 mm is the average amount of rainfall during springs while in the autumns it is 36.5 mm.¹¹

STUDY POPULATION

The current study was performed in 13-to-14 years old children, in the same schools of 2002 study with 5427 questionnaires. For the participation to the study a consent form was signed and confirmed by the children or their parents. The study was conducted between April 2008 and June 2008.

QUESTIONNAIRE

The standardized core symptom questionnaire of ISAAC for 13-14 years old children was composed of eight questions related with asthma symptoms.^{8,9}

The definition of asthma was accepted as self-reporting of diagnosed asthma with a physician's confirmation.¹² Turkish doctors usually use the terms allergic bronchitis or spastic bronchitis instead of asthma.¹³ We used the Turkish translation of original ISAAC questionnaire; however, for only question 6 (Have you ever had asthma), we have added "with doctor's confirmation (spastic bronchitis, allergic bronchitis)". The sentence was revised and the modified version of ISAAC added to the text. There have been many studies conducted in Turkey using this modified version of ISAAC questionnaire¹³⁻¹⁵ therefore it is well known and used in Turkish studies.

Table 1 Demographic data in the 2002 and 2008 surveys

	2002 survey (phase I)	2008 survey (phase III)
Sex		
Male (n%)	1505 (50.1)	2175 (53.3)
Female (n%)	1499 (49.9)	1903 (46.7)
Age (year)	13-14	13-14
Race	Caucasian	Caucasian
Number of schools	16	16

The schools were visited after 2 weeks to fill in questionnaires by formerly absent children. An additional questionnaire which was identical to that of 2002 study (include: sex; atopic family history; passive and active smoking at home; presence of domestic animals, cats, dogs, birds; stuffed toys; socioeconomic status, education level of mother and father; number of people living at home; sharing bedroom; heating system and bathed in sunlight house) was also prepared to assess potential risk factors for asthma symptoms. The study was approved by the ethics committee of Pamukkale University, School of Medicine.

DATA ANALYSIS AND DEFINITIONS

Statistical analysis included percentages, odds ratios (OR), 95% confidence interval (95% CI) and chi-squared test. 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.¹⁴ To compare the differences in prevalent rates between the two studies, chi-squared test and prevalence odds ratios (POR) with 95% CI were performed. The relation between risk factors and doctor diagnosed 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. Then, risk factors were taken into multivariate logistic regression analysis to assess the independent effects of risk factors on doctor diagnosed asthma 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 2002 study, of 3200 children, 196 children were not included to the study. Because 156 of them were not in the age group, 21 of them did not accept participating and 19 of them were absent. Three thousand and four questionnaires were completed with an overall 93.8% response. In the 2008 study, of 5427 questionnaires, 4078 questionnaires were completed

Table 2 Time trends of asthma symptoms

Questions	2002 survey (n: 3004)		2008 survey (n: 4078)		Prevalence odds ratio (95%)	p-value
	n (%)	95% CI	n (%)	95% CI		
Wheeze ever	307 (10.2)	9.1-11.3	550 (13.4)	12.4-14.5	1.37 (1.18-1.58)	<0.001*
Wheeze in last year	151 (5.0)	4.3-5.8	255 (6.2)	5.5-7.0	1.26 (1.02-1.55)	0.016*
Attacks of wheeze in last year						
1-3	97 (3.2)	2.6-3.9	139 (3.4)	2.9-4.0	1.05 (0.81-1.37)	0.36
4-12	35 (1.1)	0.8-1.6	73 (1.7)	1.4-2.2	1.54 (1.03-2.32)	0.02*
>12	19 (0.6)	0.4-0.9	34 (0.8)	0.5-1.1	1.32 (0.75-2.32)	0.20
Sleep disturbed by wheeze in last year						
One or more nights per week	24 (0.8)	0.5-1.1	37 (0.9)	0.6-1.2	1.13 (0.67-1.90)	0.36
Never woken with wheezing	91 (3.0)	2.4-3.7	197 (4.8)	4.2-5.5	1.62 (1.26-2.09)	<0.001*
Less than one night per week	36 (1.2)	0.8-1.6	77 (1.8)	1.5-2.3	1.58 (1.06-2.36)	0.013*
Severe attacks of wheeze limiting speech in last year	40 (1.3)	0.9-1.8	90 (2.2)	1.8-2.7	1.67 (1.14-2.43)	0.004*
Doctor-diagnosed asthma	64 (2.1)	1.6-2.7	526 (12.9)	11.9-13.9	6.80 (5.22-8.85)	<0.001*
Wheeze after exercise in last year	271 (9.0)	8-10	418 (10.2)	9.3-11.2	1.15 (0.98-1.35)	0.046*
Waking with cough in last year	688 (22.9)	21-24	981 (24.0)	22.7-25.4	1.06 (0.95-1.19)	0.13

* $p < 0.05$: significant.

by children, with an overall response rate of 75%. Because of the refusal (39) and absenteeism (1311), 1350 children did not participate to the current study. One thousand five hundred and five (50.1%) and 2175 (53.3%) children were boys in 2002 and in 2008 studies respectively.

The demographic characteristics of children are shown in Table 1. There was no significant difference in age and sex distributions of children between the two study groups.

The prevalence of asthma, wheeze and other symptoms of asthma in 2002 and 2008 studies are compared in Table 2. The overall lifetime prevalence of wheeze, the overall 12 month prevalence of wheeze, and the prevalence of wheeze after exercise in the previous 12 months were increased respectively from 10.2% to 13.4% (POR = 1.37, 95%CI = 1.18-1.58, $p < 0.001$), from 5.0% to 6.2% (POR = 1.26, 95%CI = 1.02-1.55, $p = 0.016$) and from 9% to 10.2% (POR = 1.15, 95%CI = 0.98-1.35, $p = 0.046$) in 2008 study. In addition, doctor diagnosed asthma prevalence was increased significantly from 2.1% to 12.9 (POR = 6.80, 95%CI = 5.22-8.85, $p < 0.001$). However, prevalence of waking with cough in the last 12 months was similar in the both studies ($p = 0.13$). Prevalence of sleep disturbed by wheeze in the last 12 months for one or more nights per week was similar in the both studies ($p = 0.36$), but never woken with wheezing (POR = 1.62, 95%CI = 1.26-2.09, $p = <0.001$) and less than one night per week (POR = 1.58, 95%CI = 1.06-2.36, $p = 0.013$) were significantly increased in 2008 study. Severe attacks of wheeze limiting speech in last year was increased from 1.3% to 2.2% (POR = 1.67, 95%CI = 1.14-2.43, $p = 0.004$). The number of attacks of wheeze in the previous 12 months was increased significantly

for 4-to-12 attacks (POR = 1.54, 95%CI = 1.03-2.32, $p = 0.02$) in 2008 study, but this difference was not significant for 1-to-3 attacks and >12 attacks (respectively; $p = 0.36$, and $p = 0.20$).

RISK FACTORS FOR ASTHMA

Detailed results for the risk factors affecting prevalence of doctor diagnosed asthma are given in Table 3.

In multivariate analysis, history of family atopy and domestic animal at home were found as significant risk factors for asthma in 2002 study, while male gender, history of family atopy and stuffed toys were found significant in 2008.

Gender, active and passive smoking, stuffed toys and risk factors related to socioeconomic status (education level of mother and father, number of people living in home, sharing bedroom, heating system and bathed in sunlight house) were not found as significant risk factors for asthma in both 2002 and 2008 studies.

DISCUSSION

PREVALENCE RESULTS

The difference of participation between 2002 survey (93.8%) and 2008 survey (75%) was important. The education system and examination calendar has changed in 2008 and there was a high school entrance exam for schoolchildren during this time. So, high rate of absenteeism may be arisen from this reason. The current study in 2008 showed that the prevalence of wheeze ever, the 12 month prevalence of wheeze and the prevalence of doctor diagnosed asthma increased significantly in 2008 compared with the first study in 2002. These two cross-sectional

Table 3 Time trends of factors affecting asthma in 2002 and 2008 studies

Factors	2002 survey (phase I)				2008 survey (phase III)			
	Asthmat-ics	Nonasth-matics	uOR	aOR	Asthmat-ics	Nonasth-matics	uOR	aOR
Sex								
Female	33 (2.2)	1466 (97.8)	1.07 (0.65-1.76)	1.35 (0.78-2.32)	240 (13.0)	1602 (87.0)	0.94 (0.78-1.13)	0.69 (0.55-0.87)*
Male	31 (2.1)	1474 (97.9)	1.00	1.00	286 (13.7)	1802 (86.3)	1.00	1.00
Family history of atopy*								
Yes	27 (3.4)	769 (96.6)	1.95 (1.18-3.22)*	2.19 (1.30-3.69)*	293 (20.2)	1160 (79.8)	2.52 (2.09-3.05)*	2.59 (2.09-3.21)*
No	37 (1.8)	2054 (98.2)	1.00	1.00	218 (9.1)	2176 (90.9)	1.00	1.00
Passive smoking at home								
Yes	36 (2.2)	1598 (97.8)	1.06 (0.64-1.75)	1.14 (0.68-1.91)	285 (13.4)	1849 (86.6)	1.04 (0.86-1.26)	1.10 (0.89-1.36)
No	28 (2.1)	1321 (97.9)	1.00	1.00	210 (12.9)	1420 (87.1)	1.00	1.00
Active smoking								
Yes	4 (3.1)	127 (96.9)	1.46 (0.52-4.09)	1.48 (0.52-4.24)	11 (14.7)	64 (85.3)	1.11 (0.58-2.13)	0.69 (2.89-1.64)
No	60 (2.1)	2787 (97.9)	1.00	1.00	494 (13.4)	3205 (86.6)	1.00	1.00
Domestic animals at home*								
Yes	31 (3.3)	901 (96.7)	2.10 (1.28-3.45)*	2.05 (1.23-3.42)*	158 (14.7)	917 (85.3)	1.16 (0.95-1.42)	1.17 (0.94-1.47)
No	33 (1.6)	2012 (98.4)	1.00	1.00	362 (12.9)	2447 (87.1)	1.00	1.00
Stuffed toys								
Yes	26 (1.9)	1365 (98.1)	0.78 (0.47-1.28)	0.60 (0.35-1.05)	293 (14.7)	1696 (85.3)	1.32 (1.09-1.60)*	1.44 (1.15-1.81)*
No	38 (2.4)	1548 (97.6)	1.00	1.00	204 (11.5)	1563 (88.5)	1.00	1.00
Education level of mother								
High school or university	4 (1.8)	215 (98.2)	0.83 (0.30-2.31)	0.98 (0.30-3.22)	60 (13.4)	389 (86.6)	1.00 (0.75-1.33)	1.12 (0.77-1.63)
Primary school	60 (2.2)	2687 (97.8)	1.00	1.00	447 (13.4)	2889 (86.6)	1.00	1.00
Education level of father								
Primary school	8 (1.7)	450 (98.3)	0.78 (0.37-1.64)	0.70 (0.29-1.69)	89 (12.7)	611 (87.3)	0.92 (0.72-1.17)	0.86 (0.62-1.19)
High school or university	56 (2.2)	2445 (97.8)	1.00	1.00	429 (13.7)	2706 (86.3)	1.00	1.00
Number of people living in home								
4 or fewer	59 (2.2)	2565 (97.8)	1.54 (0.61-3.87)	1.96 (0.69-5.50)	340 (13.5)	2175 (86.5)	1.04 (0.86-1.27)	1.11 (0.87-1.42)
5 or more	5 (1.5)	335 (98.5)	1.00	1.00	178 (13.0)	1189 (87.0)	1.00	1.00
Sharing bedroom								
2 or fewer	36 (2.3)	1507 (97.7)	1.23 (0.74-2.03)	1.24 (0.74-2.09)	417 (12.9)	2815 (87.1)	0.79 (0.60-1.03)*	0.84 (0.59-1.19)
3 or more	27 (1.9)	1388 (98.1)	1.00	1.00	77 (15.8)	410 (84.2)	1.00	1.00
Heating system								
Stove	42 (1.9)	2117 (98.1)	0.75 (0.44-1.28)	0.78 (0.44-1.40)	296 (13.7)	1859 (86.3)	1.07 (0.89-1.29)	1.12 (0.89-1.40)
Central heating	21 (2.6)	799 (97.4)	1.00	1.00	222 (13.0)	1491 (87.0)	1.00	1.00
Bathed in sunlight house								
Yes	5 (3.1)	150 (96.8)	1.56 (0.62-3.95)	1.49 (0.58-3.82)	31 (16.1)	162 (83.9)	1.26 (0.85-1.87)	1.31 (0.81-2.11)
No	59 (2.1)	2766 (97.9)	1.00	1.00	491 (13.2)	3223 (86.8)	1.00	1.00

**p* < 0.05: significant; uOR, univariate odds ratio; aOR, adjusted odds ratio; CI, confidence interval.

Table 4 Results in wheeze prevalence from different studies

Country	Study Year ISAAC Phase 1 (n)	Study Year ISAAC Phase 3 (n)	Age (year)	Lifetime prevalence of wheeze Phase 1 vs Phase 3 (%)	12 month prevalence of wheeze Phase 1 vs Phase 3 (%)	Doctor diagnosed asthma
Current study	2002 (3004)	2008 (4078)	13-14	10.2 vs 13.4	5 vs 6.2	
Istanbul, Turkey ³	1995 (2216)	2004 (2387)	6-12	9.8 vs 17.8	8.2 vs 11.3	-
South Africa ¹⁷	1995 (5178)	2002 (5037)	13-14	22.7 vs 33.1	16% vs 20.3%	13.1 vs 14.4
Norway ¹⁸	1995 (4456)	2008 (4150)	7-14	12.3 vs 17.6	4.8 vs 9.9	-
United Kingdom ²⁰	1999 (1196)	2009 (1196)	9-12	24.3 vs 22.1	27.9 vs 22.9	-
Sweeden ²¹	1996-2000 (3430)	2006 (2704)	7-8 to 11-12	21 vs 34.7	11.7 vs 9.4	5.7 vs 7.7
Sweeden ²²	1996 (2148)	2006 (1700)	7-8	-	11.9 vs 12.4	-
Austria ²⁴	1995-97 (1516)	2001-03 (1443)	12-14	19.7 vs 28	11.7 vs 15	5.4 vs 7.1
Croatia ²⁵	2001-2 (2194)	2009-10 (1181)	13-14	-	8.4 vs 14	5.2 vs 6.9

studies were performed with the same ISAAC questionnaire on the same age group (13-14 years) in the same schools in Denizli, at the same time of year.

In an Ireland study,¹⁶ rising prevalence trends of asthma was seen in teenage children from 1995 to 2002-2003. According to the study conducted on South African adolescents,¹⁷ the 12-month prevalence of wheezing, exercise-induced wheeze and nocturnal cough increased significantly between 1995 and 2002. The prevalence of asthma ever and current asthma increased between 1995 and 2008 in Norway.¹⁸ In our study, similar to former studies, the lifetime prevalence of wheeze, the 12 month prevalence of wheeze and the prevalence of wheeze after exercise in the previous 12 months were increased. In contrast to the study from South Africa,¹⁷ the prevalence of waking with cough in the last 12 months did not change from 2002 to 2008 in our study. In the South Africa study,¹⁷ sleep disturbance because of wheeze, or severe wheeze increased significantly from 1995 to 2002. Prevalence of sleep disturbed by wheeze in the last 12 months for one or more nights per week was similar in the both 2002 and 2008 studies, but never woken with wheezing and less than one night per week, severe wheeze (severe attacks of wheeze limiting speech in last year) and the number of wheeze attacks in the previous 12 months for 4-to-12 attacks were significantly increased in 2008 study. Despite the increase of asthma prevalence, the ratio of “never woken with wheezing” and “Less than one night per week” were significantly increased in 2008 study according to 2002 study. This shows that the prevalence of mild asthma was increased more. A pediatric allergist has begun to work in Denizli after 2002. Since there is a doctor specialized in pediatric aller-

gies, the patients with mild asthma were easily diagnosed by this doctor. This may be another reason for the increase in patients with this disease. In contrast, in some studies it was found that, the prevalence of asthma symptoms decreased in Israel¹⁹ from 1997 to 2003, in United Kingdom²⁰ from 1999 to 2009 and in Sweden.²¹ In another study from Sweden,²² there was no significant increase in the prevalence of current wheeze in schoolchildren from 1996 to 2006.

There have been a few studies in Turkey that evaluated time trend of asthma prevalence among school children, but not in the age group of 13-14. In one study conducted by Ones *et al.*,³ using same ISAAC questionnaire in Istanbul, the most crowded city in Turkey, the lifetime prevalence of wheeze, the 12-month prevalence of wheeze and the prevalence of asthma increased significantly from 1995 to 2004 in 6-12 years old children. We also found similar results for asthma symptoms in 13-14 year old adolescents. But in another study from Ankara, capital of Turkey,²³ the lifetime and last 12 months prevalences of asthma and wheezing has been found stabilized during a 5-year period from 1992 to 1997 in 6-13 years age group.

The increasing trend of asthma prevalence in our study is similar to many epidemiological studies conducted in different parts of the world.^{3,4} Doctor diagnosed asthma prevalence increased significantly from 2.1% to 12.9 (more than 6 times) from 2002 to 2008 similar to the studies conducted on adolescent children from Austria²⁴ and Croatia²⁵ and on the lower age group in Sweden.²¹ No significant difference was found in the percentage of children diagnosed with asthma between two studies from Africa.¹⁷ Comparison of current study with other studies for results of

asthma prevalence is shown in Table 4.

Denizli is a developing industrial city of Turkey.¹⁰ Due to its rapid pace of economic development in the last decades, the population has increased almost 1.5 times in the last 5 years. For heating needs, fossil fuels are used in Denizli. The most important causes of air pollution are fossil fuels (coal, fuel-oil and diesel). The reasons for rising trend of asthma in Denizli could be environmental changes caused by rapid westernization, rapid economic development, or increased air pollution. In addition, pediatric allergy department was established in the university hospital in Denizli in 2006. Allergy laboratory was established and diagnostic methods increased since then. And also, pediatric allergist increased the community awareness by organizing seminars to the patients, people and health personals. Diagnosis of asthma had become simpler and considered more frequently according to the previous years. This may also explain the increase in the prevalence of asthma in Denizli.

RISK FACTORS

In the current study in 2008, history of family atopy, male gender and stuffed toys were found as important risk factors for asthma.

In the current study in 2008, the risk of asthma was found higher in boys than in girls, but in 2002 this difference was not significant. There have been different results about sex-specific trends in asthma in different parts of the world.²⁶⁻²⁹ There was no reliable explanation for this situation yet. In the study of Bjerg *et al.*,³⁰ asthma was seen more in boys than girls, and severe symptoms (sleep-disturbing wheeze) and medication use of asthma, increased in boys. But in another studies performed in Germany,² United Kingdom,^{26,28} Brazil,³¹ and Iran,³² opposite results were reported, that asthma symptoms were seen more in girls than in boys. In the studies from Turkey,^{33,34} and in one study from Iran,³⁵ gender differences were not associated with asthma symptoms. Different results in different parts of the world about gender may be due to hormonal factors, environmental factors or lifestyle differences. More studies should be done on gender for risk factor of asthma.

As expected, we found family history of atopy to be an important risk factor for asthma in both 2002 and 2008 studies similar to many other studies.^{31,36-38} It was suggested that, if the number of people living in the same home increases, asthma risk also increases;³⁹ but, we did not find this association in both studies.

Studies have demonstrated a higher degree of sensitization in individuals who are exposed to higher levels of allergens such as house dust mite (HDM).^{40,41} For the management of allergic sensitization, and prevention of asthma, one of the basic approaches is the avoidance of materials including HDM such as stuffed toys from child's bedroom.^{42,43}

In 2008 study, stuffed toys were found as a risk factor for asthma, but this association was not found in our previous study in 2002.

In the studies,^{31,38,39,44} pets currently in the home represented a significant risk for allergic sensitization. But, Hesselmar *et al.*⁴⁵ found that exposure to cat or dog during the first year of life was associated with a lower prevalence of asthma in school children. In our studies, although having pets at home was a significant risk factor for asthma in the 2002 study, this was not associated with asthma in 2008.

Environmental tobacco smoke aggravates airways inflammation and increases severity of asthma.⁴⁶ However some authors^{33,38} reported that it was not associated with asthma. In our 2002 and 2008 studies, similar to previous studies, we did not find any association between asthma and smoking.

There are conflicting results regarding the relation between the SES and symptoms of asthma. Studies from different parts of the world^{31,37,47-49} suggested that currently prevalence of asthma was higher with lower SES. We didn't found any relationship in our study. In the study of Ones *et al.*⁴⁹ from Istanbul, Turkey, no association was found between SES and asthma. SES such as education, bathed in sunlight house and in contrast to hygiene hypothesis,^{45,50} sharing bedroom and number of people living in home were not found as risk factors for asthma in both surveys.

In the study from south Bavaria,⁵¹ bronchial hyperresponsiveness was reported significantly lower in children living in coal or wood heated homes than in children living in homes with other heating systems (such as gas, oil, or a central heating system. Such exposure may increase the risk of early childhood infections.⁵¹ And it was reported that, early childhood exposure to infectious diseases had a protective role for the development of atopic sensitization.⁵² But, we did not find any association between heating system and asthma symptoms in both studies. Comparison of current study with other studies for risk factors for asthma is shown in the Table 5.

In the last decades, a worldwide increase in the prevalence of asthma was reported with a numerous risk factors that being associated to this increase. In the current literatures, a strong association was found between asthma symptoms and both overweight and obesity in adolescents.^{53,54} Heavy physical activity, viewing television for five or more hours per day, exclusive breastfeeding <6 months and absence of fish in the diet were found important risk factors for asthma symptoms.^{31,54} In China,⁵⁵ infantile eczema, no breastfeeding, air-conditioning and allergic rhinitis were found as the risk factors for asthma in children. Exposure to higher levels of NO(2) and O(3) was also found as the risk factor for asthma in children.⁵⁶

There have been limitations of this study. Schools were not randomly selected due to the population

Table 5 Risk factors for asthma symptoms in different studies

Studies	Study Area	Year	Age (year)	Risk factors for asthma symptoms
Current study	Denizli, Turkey	2008	13-14	Family history of atopy Male gender Stuffed toys
Maziak <i>et al.</i> ²	Germany	2003	6-7 and 13-14	Girls
Lee <i>et al.</i> ⁵	Hong Kong	2006	6-7	Smoking
Devenny <i>et al.</i> ²⁶	Aberdeen	2004	9-12	Girls
Venn <i>et al.</i> ²⁸	Nottingham	1998	4-11	Girls
Bjerg <i>et al.</i> ³⁰	Sweeden	2010	7-8	Boys
Jucá <i>et al.</i> ³¹	Brazil	2012	13-14	Family history of atopy Smoking during pregnancy Exclusive breastfeeding <6 months Lower SES Female gender Pets currently in the home Absence of fish in the diet
Zobeiri <i>et al.</i> ³²	Iran	2011	13-14	Girls Passive smoking
Abramidze <i>et al.</i> ³⁶	Georgian	2012	9-11	Family history of atopy
Talay <i>et al.</i> ³⁷	Bolu, Turkey	2008	7-14	Family history of atopy Lower SES
Bayram <i>et al.</i> ³⁸	Adana, Turkey	2004	6-18	Family history of atopy
Van Gysel <i>et al.</i> ⁴²	Belgium	2007	Range: 3.4-14.8	Stuffed toys
Yazicioğlu <i>et al.</i> ⁴³	Edirne, Turkey	1998	6-12	Stuffed toys
Litonjua <i>et al.</i> ⁴⁷	Boston	1999	Range: 1.1-23.9	Lower SES
Basagana <i>et al.</i> ⁴⁸	Multi-center, multi-country	2004	20-44	Lower SES
von Mutius <i>et al.</i> ⁵¹	Bavaria	1996	9-11	Central heating
Kajbaf <i>et al.</i> ⁵³	Iran	2011	7-11	Overweight, obesity
Mitchell EA <i>et al.</i> ⁵⁴	Multi-center, multi-country	2011	13-14	Overweight, obesity Viewing television for five or more hours/day Heavy physical activity
Xiong <i>et al.</i> ⁵⁵	China	2013	Range: 0-14	Infantile eczema No breastfeeding Air-conditioning Allergic rhinitis

grew significantly during this period and the schools included were not the best representative sample.

In conclusion, the prevalence of asthma symptoms has increased significantly from 2002 to 2008. A family history of asthma, male gender, stuffed toys were found as the important risk factors for asthma symptoms. Further studies are required to determine other risk factors related to the increase in asthma prevalence.

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