

The Trend of Change of Allergic Diseases over the Years: Three Repeated Surveys from 1994 to 2014

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Abstract

Background: Although it is known that there has been an increase in asthma and allergic diseases among school-aged children, results vary between countries. The aim of this study was to examine trends in the prevalence of these diseases in the city of Adana (south Turkey) over the last 20 years based on the results of 3 cross-sectional studies. **Methods:** Three cross-sectional surveys were performed 10 years apart in south Turkey. Here, we compare the surveys conducted among children between the ages of 6 and 14 years from 1994, 2004, and 2014. The participants were randomly chosen among children attending participating primary schools in Adana. The questionnaire in the first survey contained almost the same questions as the ISAAC. In the 2 latter surveys, we used the ISAAC questionnaire to investigate the prevalence of asthma and other allergic diseases. **Results:** A total of 2,334 children in 1994, 3,728 children in 2004, and 3,209 children in 2014 were included in the final analysis. The results showed a statistically significant increase in the prevalence of physician-diagnosed allergic diseases across the

years, respectively: asthma (5, 4.6, and 8.9%), allergic rhinitis (8.8, 11.4, and 15.6%), and atopic dermatitis (5, 9.9, and 7%). In contrast, the prevalence of parent-reported current wheeze (16.2, 13.2%) decreased in the last 10 years. **Conclusions:** Our findings were consistent with the increased prevalence of childhood asthma and other allergic diseases. However, this pattern did not occur in respiratory symptoms.

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Introduction

Childhood allergic diseases have become an increasingly significant public health problem worldwide, and have been responsible for high socioeconomic costs [1]. Epidemiologic studies report a global increase in recent years in the prevalence of asthma and other allergic diseases. However, the prevalence of these diseases may differ from country to country and even between different regions of the same country [2, 3]. The difference between regions cannot be explained merely by genetic factors, and interactions between genetic and environmental factors are largely held responsible [4].

One of the most important results obtained from epidemiological studies regarding allergic diseases is the op-

portunity to evaluate the differences between regions. According to the latest studies, the increase in the prevalence of allergic diseases has plateaued in developed countries, but is still continuing in developing countries [5, 6]. However, studies that evaluate the change in the prevalence of allergic diseases in the long term are limited within the literature [6–10].

We carried out 3 consecutive studies to evaluate the prevalence of asthma and other allergic diseases in primary schoolchildren over the last 20 years in Adana, a city with typical Mediterranean characteristics located in the southern part of Turkey.

Materials and Methods

The First Pediatric Allergic Disease Survey

The first pediatric allergic disease survey was performed in 1994 and the study is explained in the literature. The cross-sectional population-based study was carried out among 2,550 children between 6 and 14 years of age. The schools were selected randomly across Adana, including all regions of the city to fully represent its socioeconomic state. The parents were given a survey containing detailed questions regarding the existence of allergic symptoms, factors which could affect these symptoms, and physician-diagnosed allergic diseases [11].

The Other Pediatric Allergic Disease Surveys

The other studies were carried out in Adana in 2004 and 2014. The number of children included in these studies were 5,105 in 2004 and 3,500 in 2014. The survey was conducted using a translated ISAAC (International Study of Asthma and Allergies in Childhood) protocol. This questionnaire, which is translated into Turkish, has been previously used in another study conducted in Turkey [12]. The families filled out the surveys regarding asthma, allergic rhinitis (AR), and atopic eczema symptoms. The prevalence of the allergic diseases was evaluated using the results from these surveys. All studies were conducted by the same chief researcher, at the same schools, and in the same age groups.

Definitions

The special definitions used in the study were as follows.

- 1. Current wheeze: “Have you (has your child) had wheezing or whistling in the chest in the last 12 months?”
- 2. Ever physician-diagnosed asthma, AR, and atopic dermatitis (AD): “Has your child ever been diagnosed with asthma, AR, and AD by a physician?” [9, 12].

Statistical Analysis

The prevalence ratio was calculated by dividing the positive responses to a given question by the total number of completed questionnaires. The χ^2 test was used for the categorical data. The odds ratios (OR) at a 95% confidence interval (CI) were calculated. A *p* value <0.05 was considered statistically significant for all tests. The SPSS software package version 20 for Windows (SPSS, Chicago, IL, USA) was used for all statistical analyses.

Table 1. Descriptive features of the study population

	1994	2004	2014
Questionnaire, <i>n</i> (%)			
Invited	2,550	5,105	3,500
Participated	2,334 (88)	3,728 (73)	3,209 (91.7)
Gender, <i>n</i> (%)			
Male	1,132 (48.5)	1,896 (50.9)	1,572 (49)
Female	1,202 (52.1)	1,805 (48.8)	1,637 (51)
Race	Caucasian	Caucasian	Caucasian

Results

There were 2,334 participants in 1994, 3,728 participants in 2004, and 3,209 participants in 2014. The participation rates of the studies were 88% in 1994, 73% in 2004, and 91.7% in 2014 (Table 1). The age range was 6–14 years for each survey.

Table 2 presents the prevalence of current wheeze and physician-diagnosed allergic diseases. While no significant change was detected in the prevalence of physician-diagnosed asthma between 1994 and 2004, a considerable increase was determined between 2004 and 2014. A significant increasing trend between 1994 and 2014 was also detected for cumulative allergic diseases and physician-diagnosed rhinitis. In contrast, AD displayed a significant increasing trend in the first decade but showed a statistically significant decrease in the last decade. Nonetheless, when a period of 20 years was considered, the prevalence of physician-diagnosed AD, AR, asthma, and cumulative allergic diseases also revealed a statistically significant increase. However, when considering only the last decade, while the physician-diagnosed asthma prevalence had an increasing trend, the prevalence of current wheeze decreased (Fig. 1).

Discussion

This study shows that there was a significant increase in physician-diagnosed asthma, rhinitis, and AD prevalence between 1994 and 2014. The increase in the physician-diagnosed asthma and prevalence of other allergic diseases in our study is similar to many epidemiological studies conducted in different countries. Surprisingly, while the physician-diagnosed asthma prevalence had an increasing trend, the current wheeze prevalence decreased in the last 10 years.

Table 2. Prevalence of current wheeze and physician-diagnosed disease between 1994 and 2014

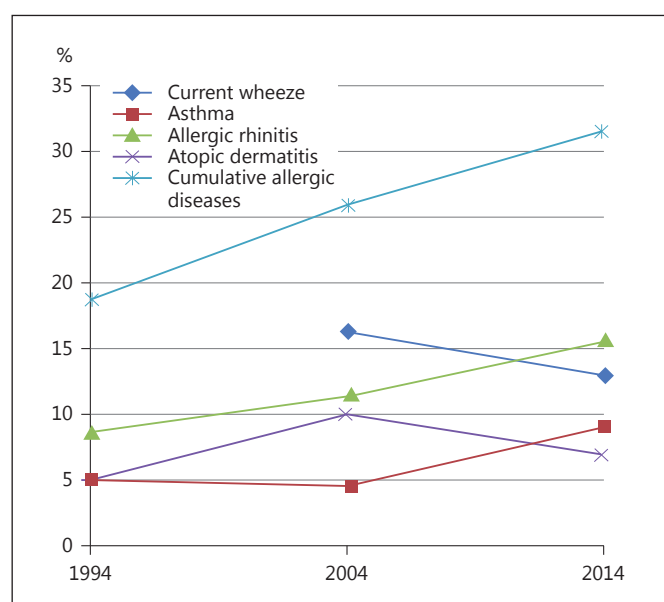
	Year, n (%)			Odds ratio (95% confidence interval)		
	1994 (n = 2,334)	2004 (n = 3,728)	2014 (n = 3,209)	1994 vs. 2004	1994 vs. 2014	2004 vs. 2014
Self-reported						
Current wheeze	–	604 (16.2)	423 (13.2)	–	–	0.8 (0.7–0.9)
Physician-diagnosed						
Asthma	116 (5.0)	171 (4.6)	288 (8.9)	0.9 (0.7–1.2) ^a	1.9 (1.5–2.4)	2.1 (1.7–2.5)
Allergic rhinitis	205 (8.8)	425 (11.4)	499 (15.6)	1.3 (1.1–1.6)	1.9 (1.6–2.3)	1.4 (1.2–1.6)
Atopic dermatitis	116 (5.0)	369 (9.9)	224 (7.0)	2.1 (1.7–2.6)	1.4 (1.2–1.8)	0.7 (0.6–0.8)
Cumulative allergic diseases	437 (18.8)	965 (25.9)	1,011 (31.5)	1.5 (1.3–1.7)	2.0 (1.8–2.2)	1.3 (1.2–1.5)

^a Not significant ($p > 0.05$). All other p values < 0.001 .

Over the past few decades, a significant increase in the prevalence of asthma and other allergic diseases has been reported [1, 4, 7, 13–17]. Furthermore, this increase is also revealed in the repeated prevalence studies completed within the same region [8]. In our region, our results matter in terms of presenting the courses of physician-diagnosed allergic diseases. We have shown in our study that there has been a significant increase in the prevalence of physician-diagnosed asthma, AR, and AD in the last 2 decades. This is similar to previous reports submitted by other European countries [1, 4, 7, 13–17].

Regarding the increase in the prevalence of allergic diseases, some factors, including hygiene and lifestyle changes, have been considered as important factors [18, 19]. Measuring the temporal trend of asthma and allergic diseases is also important to understanding the epidemiology of these diseases. Furthermore, the data of asthma and allergic disease prevalence is an important guide in forming health policies [20]. When compared to the previous decade, physician-diagnosed asthma and rhinitis prevalence in our region has shown a nearly 2-fold increase in the last 10 years. The reasons for this increasing trend might include lifestyle and environmental changes due to the rapid population growth and industrialization experienced in our region, and increased personal awareness of allergic diseases. For instance, asthma training programs and summer camps for children with asthma have been organized in Adana since 2005. However, there is little data on trends in childhood asthma and other allergic diseases in other European countries or the other regions of Turkey [9, 10]. This situation limits us in terms of making any further comments on our results.

A wide variance has been observed in the prevalence of allergic diseases, not only internationally, but also in

**Fig. 1.** Temporal trends in the prevalence of allergic diseases, 1994–2014.

different regions of the same country. This variation cannot be explained solely with genetic factors. Genetic and geographical factors and interaction between changes in life and nutrition styles are also influential [19, 21–23]. It has also been reported that this variation does not occur at the same rate when the allergic diseases are evaluated separately.

There has been a decline in AD prevalence in school-children in recent years [24]. The prevalence of AD increased between 1994 and 2004, but the results showed

that it started decreasing between 2004 and 2014. This shows that an atopic march should be considered when the prevalence of allergic diseases is being evaluated.

Additionally, the parent-reported current wheeze prevalence showed a decrease in the last decade, which is in contrast with the physician-diagnosed asthma prevalence. This may be because of easy access to health services, an increased prevalence of medical diagnosis, and effective management.

When interpreting the results of these 3 consecutive studies, there are certain limitations that we have to consider. Firstly, the ISAAC survey was not used in the first cross-sectional epidemiologic study. This may have caused a bias in interpreting the trends of allergic diseases. Epidemiological studies of allergic diseases rely substantially on parent-reported data via surveys. However, parent-reported data results may seriously be affected by a family's awareness of allergic diseases. Finally, there are limited studies on the prevalence trend of allergic diseases in our country. Turkey is a geographically large country displaying interregional socioeconomic, cultural, and meteorological differences. As Adana has typical Mediterranean characteristics, to enlighten the epidemiology of allergic diseases, our data should be supported with similar studies carried out in the other regions of our country.

In conclusion, these 3 successive studies found a similar increase in the prevalence of allergic diseases in children in this part of Turkey as that reported in the literature. It is interesting that the symptoms of wheezing in the last decade did not increase despite an increase in the prevalence of physician-diagnosed asthma. Advanced diagnostic procedures might have contributed to a higher prevalence of asthma as well as rhinitis in 2014. Today, a proven method of preventing the development of allergic diseases remains lacking. Further studies are needed to elucidate the reasons for the increases in allergic diseases, including an assessment of risk factors. Our results can provide insight to future studies to help in the planning of healthcare services for asthma and allergic diseases.

Statement of Ethics

All study participants or their parents provided informed consent, and the study design was approved by the appropriate ethics review board.

Disclosure Statement

The authors have no conflicts of interest to declare.

References

- ▶ 1 Wilmer FA, Maurici R, Nazário CA, Nazário KC, Pássaro PF, Piazza HE, Bertoldi RA, Pizzichini E, Pizzichini MM: Temporal trends in the prevalence of asthma and rhinoconjunctivitis in adolescents. *Rev Saude Publica* 2015; 49:94.
- ▶ 2 Wanlapakorn N, Sritippayawan S, Deerajanawong J: Prevalence of asthma, level of control and factors associated with asthma control in Thai elementary school students in Bangkok. *Asian Pac J Allergy Immunol* 2014; 32:287–292.
- ▶ 3 Pols DH, Wartna JB, van Alphen EI, Moed H, Rasenberg N, Bindels PJ, Bohnen AM: Interrelationships between atopic disorders in children: a meta-analysis based on ISAAC questionnaires. *PLoS One* 2015; 10:e0131869.
- ▶ 4 Chereches-Panta PCS, Dumitrescu D, Marshall M, Mirestean I, Muresan M, Iacob D, Farcau M, Ichim GE, Nanulescu MV: Epidemiological survey 6 years apart: increased prevalence of asthma and other allergic diseases in schoolchildren aged 13–14 years in Cluj-Napoca, Romania (based on ISAAC questionnaire). *Maedica* 2011; 6:10–16.
- ▶ 5 Singh S, Sharma BB, Salvi S, Chhatwal J, Jain KC, Kumar L, Joshi MK, Pandramajal SB, Awasthi S, Bhawe S, Rego S, Sukumaran TU, Khatav VA, Singh V, Sharma SK, Sabir M: Allergic rhinitis, rhinoconjunctivitis, and eczema: prevalence and associated factors in children. *Clin Respir J* 2016, Epub ahead of print.
- ▶ 6 Solé D, Rosário Filho NA, Sarinho ES, Camello-Nunes IC, Barreto BA, Medeiros ML, Franco JM, Camargos PA, Mallol J, Gurgel R, Andrade DM, Furlan FP, Silva AR, Cardozo C, Andrade C: Prevalence of asthma and allergic diseases in adolescents: nine-year follow-up study (2003–2012). *J Pediatr* 2015; 91: 30–35.
- ▶ 7 Bjerg A, Sandström T, Lundbäck B, Rönmark E: Time trends in asthma and wheeze in Swedish children 1996–2006: prevalence and risk factors by sex. *Allergy* 2010; 65:48–55.
- ▶ 8 Brozek G, Lawson J, Szumilas D, Zejda J: Increasing prevalence of asthma, respiratory symptoms, and allergic diseases: four repeated surveys from 1993–2014. *Respir Med* 2015; 109:982–990.
- ▶ 9 Ones U, Akcay A, Tamay Z, Guler N, Zencir M: Rising trend of asthma prevalence among Turkish schoolchildren (ISAAC phases I and III). *Allergy* 2006; 61:1448–1453.
- ▶ 10 Demir E, Tanaç R, Can D, Gülen F, Yenigün A, Aksakal K: Is there an increase in the prevalence of allergic diseases among schoolchildren from the Aegean region of Turkey? *Allergy Asthma Proc* 2005; 26:410–414.
- ▶ 11 Kendirli GS, Altıntaş DU, Alparslan N, Akmanlar N, Yurdakul Z, Bolat B: Prevalence of childhood allergic diseases in Adana, Southern Turkey. *Eur J Epidemiol* 1998; 14:347–350.
- ▶ 12 Bayram I, Güneşer-Kendirli S, Yılmaz M, Altıntaş DU, Alparslan N, Bingöl-Karakoç 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.
- ▶ 13 Banac S, Rožmanić V, Manestar K, Korotaj-Rožmanić Z, Lah-Tomulić K, Vidović I, Serer M, Svraka N, Petrić T: Rising trends in the prevalence of asthma and allergic diseases among school children in the north-west coastal part of Croatia. *J Asthma* 2013; 50: 810–814.

- ▶14 Kim SY, Jung JY, Park MS, Kang YA, Kim EY, Kim SK, Chang J, Kim YS: Increased prevalence of self-reported asthma among Korean adults: an analysis of KNHANES I and IV data. *Lung* 2013;191:281–288.
- ▶15 Pearce N, Ait-Khaled N, Beasley R, Mallol J, Keil U, Mitchell E, Robertson C; ISAAC Phase Three Study Group: Worldwide trends in the prevalence of asthma symptoms: phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2007;62:758–766.
- ▶16 Asher MI: Recent perspectives on global epidemiology of asthma in childhood. *Allergol Immunopathol* 2010;38:83–87.
- ▶17 Lin R, Guan R, Liu X, Zhao B, Guan J, Lu L: Significant rise of the prevalence and clinical features of childhood asthma in Qingdao China: cluster sampling investigation of 10,082 children. *BMC Public Health* 2014;14:1002.
- ▶18 Herrant M, Loucoubar C, Boufkhed S, Bassène H, Sarr FD, Baril L, Mercereau-Puijalon O, Mécheri S, Sakuntabhai A, Paul R: Risk factors associated with asthma, atopic dermatitis and rhinoconjunctivitis in a rural Senegalese cohort. *Allergy Asthma Clin Immunol* 2015;11:24.
- ▶19 Saadeh D, Salameh P, Caillaud D, Charpin D, De Blay F, Kopferschmitt C, Lavaud F, Annesi-Maesano I, Baldi I, Raherison C: Prevalence and association of asthma and allergic sensitization with dietary factors in schoolchildren: data from the French Six Cities study. *BMC Public Health* 2015;15:993.
- ▶20 Lødrup Carlsen KC, Haahtela T, Carlsen K-H, Smith A, Bjerke M, Wickman M, Keil T, Ballereau S, Bedbrook A, Bergström A, Nawjin MC, Pinart M, Skrindo I, Xu CJ, De Carlo G, Anto JM, Bousquet J: Integrated allergy and asthma prevention and care: report of the MeDALL/AIRWAYS ICPs meeting at the Ministry of Health and Care Services, Oslo, Norway. *Int Arch Allergy Immunol* 2015;167:57–64.
- ▶21 Torres-Borrego J, Molina-Terán AB, Montes-Mendoza C: Prevalence and associated factors of allergic rhinitis and atopic dermatitis in children. *Allergol Immunopathol* 2008;36:90–100.
- ▶22 Batllés-Garrido J, Torres-Borrego J, Rubí-Ruiz T, Bonillo-Perales A, González-Jiménez Y, Momblán De Cabo J, Aguirre-Rodríguez J, Losillas-Maldonado A, Torres-Daza M: Prevalence and factors linked to atopy in 10- and 11-year-old children in Almería, Spain. *Allergol Immunopathol* 2010;38:13–19.
- ▶23 Jenerowicz D, Silny W, Dańczak-Pazdrowska A, Polańska A, Osmola-Mańkowska A, Olek-Hrab K: Environmental factors and allergic diseases. *Ann Agric Environ Med* 2012;19:475–481.
- ▶24 Yoo B, Park Y, Park K, Kim H: A 9-year trend in the prevalence of allergic disease based on national health insurance data. *J Prev Med Public Health* 2015;48:301–309.