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## International Journal of Pediatric Otorhinolaryngology

journal homepage: [www.elsevier.com/locate/ijporl](http://www.elsevier.com/locate/ijporl)



# Rising trend of allergic rhinitis prevalence among Turkish schoolchildren

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### ARTICLE INFO

#### Article history:

Received 8 March 2013

Received in revised form 25 May 2013

Accepted 29 May 2013

Available online xxx

#### Keywords:

Allergic rhinitis

Cross-sectional study

ISAAC

Prevalence

Risk factors

Trend

### ABSTRACT

**Objectives:** To assess the time trends and possible risk factors associated with allergic rhinitis symptoms in schoolchildren from Denizli, Turkey.

**Method:** Two identical cross-sectional surveys were performed in the 13- to 14-yr age group at intervals of six years using ISAAC questionnaire. Possible risk factors were also asked and the children completed questionnaires by self.

**Results:** A total of 4078 children (response rate 75%) in the 2008 and 3004 children (response rate, 93.8%) in 2002 were included. The lifetime prevalence of rhinitis, 12-month prevalence of rhinitis, prevalence of associated itchy eye in the previous 12 months and doctor diagnosed allergic rhinitis prevalence were increased from 34.2% to 49.4% (POR = 1.87, 95% CI = 47.8–50.9 and  $p \leq 0.001$ ), from 23.5.0% to 32.9% (POR = 1.59, 95% CI = 31.4–34.3 and  $p \leq 0.001$ ), from 9.6% to 14.9% (POR = 1.64, 95% CI = 13.8–16.0 and  $p \leq 0.001$ ), and from 4.3% to 7% (POR = 1.67, 95% CI = 6.2–7.8 and  $p \leq 0.001$ ) respectively. Severe interference with daily activity in the previous 12 months did not change. In multivariate analysis, history of family atopy, stuffed toys, high annual family income, presence of allergy in mother, father and accompaniment of children to their parents after school hours in textile industry were found as risk factors in 2008 study.

**Conclusion:** The prevalence of allergic rhinitis increased significantly in 2008. Family history of atopy, stuffed toys, high annual family income and accompaniment of children to their parents in textile industry were found as risk factors for doctor diagnosed allergic rhinitis.

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## 1. Introduction

Allergic rhinitis (AR) is one of the most common and of chronic diseases in all age groups [1–3]. It is an allergic inflammation of the nasal airways and characterized by sneezing, itchy and watery eyes, swelling and inflammation of the nasal mucosa [4]. Symptoms between individuals vary severely. There is no worldwide accepted criterion for the diagnosis of AR [5]. ISAAC phase 1 was designed to evaluate and to compare prevalence and risk factors for AR and other allergic diseases in children from different countries and centers of

countries throughout the world. ISAAC phase 3 was designed to analyze time trends in the prevalence of these allergic diseases in countries and centers of countries which were participated to ISAAC phase 1 [5,6]. The ISAAC study showed that there was variability in the prevalence of AR between countries and between regions of the same country. Differences may be due to environmental and socioeconomic factors and/or may be related to awareness of the disease [7,8]. Children in the 13- to 14-yr age group from 155 centers in 56 countries were participated to the ISAAC Phase I, and variations in the prevalence of symptoms of AR between centers worldwide were more than 20-times (ranged from 3.2 to 66.6%) [9]. In phase 3, 106 centers from 66 countries were participated to the study. In this study, a slight increase in prevalence of rhino conjunctivitis was observed worldwide. And, it was seen that the variations were larger among the centers than countries [9].

The first study using ISAAC methodology (phase 1) was carried out on the 13–14 age group in 2002 in Denizli, Turkey. Prevalence

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of lifetime rhinitis, prevalence of rhinitis in the last 12 months, prevalence of associated itchy eye in the last 12 months, prevalence of severe interference with daily activity in the last 12 months and prevalence of lifetime doctor diagnosed AR were 34.2%, 23.2%, 9.6%, 7.4% and 4.3% respectively. The aims of current study were to determine whether the prevalence of AR is changing in 13–14-yr-old school children attending the same school in Denizli, Turkey and to assess possible risk factors of AR. We compared the results of current study with the results of study conducted in the year 2002 using same questionnaire in the same age group.

## 2. Method

### 2.1. The place of the research

Denizli is a growing industrial city in the southwestern part of Turkey with an area of 11,868 km<sup>2</sup> and population of nearly 943,000 people. Textile and marble industry is important for the development of Denizli [10]. In summers, the weather is hot and it rarely gets cold in winter. Springs and autumns are rainy and warm in Denizli [10].

### 2.2. Questionnaire

The standardized core symptom questionnaire for rhinitis is as follows for 13–14-yr-old children [11]:

All questions are about problems which occur when you DO NOT have a cold or the flu.

1. Have you ever had a problem with sneezing, or a runny, or blocked nose when you DID NOT have a cold or the flu? Yes No

IF YOU HAVE ANSWERED “NO” PLEASE SKIP TO QUESTION 6

2. In the past 12 months, have you had a problem with sneezing, or a runny, or blocked nose when you DID NOT have a cold or the flu? Yes No

IF YOU HAVE ANSWERED “NO” PLEASE SKIP TO QUESTION 6

3. In the past 12 months, has this nose problem been accompanied by itchy-watery eyes? Yes No

4. In which of the past 12 months did this nose problem occur? (Please tick any which apply)

January May September February June October March July November April August December

5. In the past 12 months, how much did this nose problem interfere with your daily activities?

Not at all A little A moderate amount A lot

6. Have you ever had hay fever? Yes No

The written questionnaire was translated into Turkish for self-completion by the 13–14-yr-old following the ISAAC protocol. So far, many studies have been conducted in Turkey using the ISAAC questionnaire [12–14]. Therefore, it is well known and confirmed by Turkish studies.

In addition to ISAAC questionnaire, there were questions about demographic and environmental characteristics of children that could be potential risk factors for AR. In 2002 study, sex, atopic family history, active smoking, smoking of child's father or mother, presence of domestic animals, stuffed toys, education level of child's mother or father, annual family income, number of people living at home, sharing bedroom, heating system, bathed in sunlight house were asked. In addition to questions asked in 2002 study other questions (member of the family with atopic disease, kind of domestic animal, kind of bird, place of the animal in the house, whether mother or father is working in textile and/or marble industry or not, accompaniment of children to their parents

after school hours in textile and/or marble industry) were also asked in 2008 study.

### 2.3. Statistical analysis

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 prevalence calculations, but excluded from subsequent bivariate analysis [15,16]. 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 doctor diagnosed AR 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. Significant factors from the univariate analysis for new risk factors were taken into multivariate logistic regression analysis to assess the independent effects of risk factors on doctor diagnosed AR 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.

## 3. Results

### 3.1. Prevalence results

In the 2002 study, 3004 questionnaires were completed while 4078 questionnaires were completed in the 2008 study, with an overall 93.8% and 75% response, respectively. The study groups included 1505 boys (50.1%) in 2002 and 2175 boys (53.3%) in 2008 (Table 1). Prevalence of lifetime rhinitis, of rhinitis in the last 12 months, of associated itchy eye in the last 12 months, of severe interference with daily activity in the last 12 months and of lifetime doctor diagnosed AR were 34.2%, 23.2%, 9.6%, 7.4% and 4.3% in 2002 and 49.4%, 32.9%, 14.9%, 7.1% and 7% in 2008 studies respectively (Table 2). The overall lifetime prevalence of rhinitis increased from 34.2% to 49.4% (POR = 1.87, 95% CI = 47.8–50.9 and  $p \leq 0.001$ ), the overall 12-month prevalence of rhinitis increased from 23.5.0% to 32.9% (POR = 1.59, 95% CI = 31.4–34.3 and  $p \leq 0.001$ ) and associated itchy eye in the previous 12 months increased from 9.6% to 14.9% (POR = 1.64, 95% CI = 13.8–16.0 and  $p \leq 0.001$ ). However, severe interference with daily activity in the previous 12 months decreased from 7.4% to 7.1% (POR = 0.95, 95% CI = 6.3–7.9 and  $p = 0.63$ ) whereas doctor diagnosed AR prevalence increased significantly from 4.3% to 7.0% (POR = 1.67, 95% CI = 6.2–7.8 and  $p \leq 0.001$ ).

### 3.2. Risk factors

In 2008 study, family history of atopy, stuffed toys, high annual family income, heating system, an allergic person in the family, accompaniment of children to their parents after school hours in textile industry, whether father or mother is working in marble

**Table 1**  
Demographic data in the 2002 and 2008 surveys.

| Sex               | 2002 survey (phase I) | 2008 survey (phase III) |
|-------------------|-----------------------|-------------------------|
| 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                      |

**Table 2**

Time trends of allergic rhinitis symptoms.

| Questions                                   | 2002 survey |           | 2008 survey |           | Prevalence odds ratio (95%) | p-Value |
|---------------------------------------------|-------------|-----------|-------------|-----------|-----------------------------|---------|
|                                             | n (%)       | 95% CI    | n (%)       | 95% CI    |                             |         |
| Lifetime rhinitis                           | 1028 (34.2) | 32.5–35.9 | 2016 (49.4) | 47.8–50.9 | 1.87 (1.7–2.07)             | <0.001  |
| 12-Month prevalence                         |             |           |             |           |                             |         |
| Rhinitis                                    | 705 (23.5)  | 22.0–25.0 | 1342 (32.9) | 31.4–34.3 | 1.59 (1.43–1.77)            | <0.001  |
| Associated itchy eye                        | 289 (9.6)   | 8.6–10.7  | 608 (14.9)  | 13.8–16.0 | 1.64 (1.42–1.91)            | <0.001  |
| Severe interference with daily activity     | 221 (7.4)   | 6.5–8.3   | 289 (7.1)   | 6.3–7.9   | 0.95 (0.79–1.14)            | 0.63    |
| Lifetime doctor diagnosed allergic rhinitis | 130 (4.3)   | 3.6–5.0   | 286 (7.0)   | 6.2–7.8   | 1.67 (1.35–2.07)            | <0.001  |

industry or not were found as risk factors for doctor diagnosed AR in univariate analysis. After the univariate analysis, multivariate analysis was performed for significant risk factors and family history of atopy, stuffed toys, high annual family income and accompaniment of children to their parents after school hours in textile industry were found as risk factors for doctor diagnosed AR. Because other significant risk factor (who has an allergy in the family) would decrease the number of children inserted into the analysis, it was not applied to multivariate analysis in order to prevent its possible effects on the evaluation of other risk factors.

Detailed results for the risk factors affecting prevalence of doctor diagnosed AR are given in Tables 3 and 4. In 2002 study, with univariate analysis, family history of atopy, high annual family income, heating system and in multivariate analysis only family history of atopy were found as risk factors for doctor diagnosed AR.

Sex, passive and active smoking, domestic animal at home, education levels of mother and father, number of people living in home, sharing bedroom, bathed in sunlight house were not significant risk factors for doctor diagnosed AR in the both 2002 and 2008 studies.

**Table 3**

Time trends of factors affecting allergic rhinitis in 2002 and 2008 surveys.

| Factors                         | Children with AR<br>n (%) | 2002 survey (phase I) |                   | Children with AR<br>n (%) | 2008 survey (phase III) |                   |
|---------------------------------|---------------------------|-----------------------|-------------------|---------------------------|-------------------------|-------------------|
|                                 |                           | uOR                   | aOR               |                           | uOR                     | aOR               |
| Sex                             |                           |                       |                   |                           |                         |                   |
| Female                          | 66 (4.4)                  | 1.00 (0.99–1.02)      |                   | 147 (8.4)                 | 1.15 (0.92–1.44)        |                   |
| Male                            | 64 (4.3)                  |                       |                   | 139 (7.3)                 |                         |                   |
| History of family atopy         |                           |                       |                   |                           |                         |                   |
| Yes                             | 54 (6.8)                  | 2.04 (1.42–2.93)*     | 1.93 (1.30–2.87)* | 170 (12.6)                | 2.86 (2.25–3.68)*       | 3.22 (2.43–4.28)* |
| No                              | 72 (3.4)                  | 1.00                  | 1.00              | 107 (4.8)                 | 1.00                    | 1.00              |
| Passive smoking at home         |                           |                       |                   |                           |                         |                   |
| Yes                             | 66 (4.9)                  |                       |                   | 143 (7.7)                 |                         |                   |
| No                              | 64 (3.9)                  | 1.01 (0.99–1.03)      |                   | 132 (7.9)                 | 0.98 (0.76–1.25)        |                   |
| Active smoking                  |                           |                       |                   |                           |                         |                   |
| Yes                             | 6 (4.6)                   | 1.05 (0.46–2.44)      |                   | 8 (11.9)                  | 1.61 (0.76–3.40)        |                   |
| No                              | 124 (4.4)                 |                       |                   | 271 (7.8)                 |                         |                   |
| Domestic animals at home        |                           |                       |                   |                           |                         |                   |
| Yes                             | 48 (5.2)                  |                       |                   | 89 (8.9)                  | 1.22 (0.94–1.58)        |                   |
| No                              | 81 (4.0)                  | 1.32 (0.91–1.90)      |                   | 196 (7.4)                 | 1.00                    |                   |
| Stuffed toys                    |                           |                       |                   |                           |                         |                   |
| Yes                             | 69 (5.0)                  | 1.32 (0.93–1.89)      |                   | 183 (9.7)                 | 1.81 (1.40–2.35)*       |                   |
| No                              | 60 (3.8)                  |                       |                   | 92 (5.6)                  | 1.00                    |                   |
| Education level of mother       |                           |                       |                   |                           |                         |                   |
| High school or university       | 10 (4.6)                  |                       |                   | 38 (8.9)                  |                         |                   |
| Primary school                  | 118 (4.3)                 | 1.07 (0.55–2.06)      |                   | 238 (7.6)                 | 1.18 (0.82–1.69)        |                   |
| Education level of father       |                           |                       |                   |                           |                         |                   |
| High school or university       | 23 (5.0)                  |                       |                   | 56 (8.4)                  | 1.10 (0.81–1.50)        |                   |
| Primary school university       | 103 (4.1)                 | 1.23 (0.77–1.96)      |                   | 223 (7.6)                 |                         |                   |
| Annual family income            |                           |                       |                   |                           |                         |                   |
| > \$3000                        | 39 (6.0)                  | 1.02 (1.00–1.05)*     | NS                | 70 (10.9)                 | 1.69 (1.26–2.26)*       | 1.52 (1.12–2.08)* |
| < \$3000                        | 72 (3.7)                  |                       |                   | 178 (6.7)                 |                         | 1.00              |
| Number of people living in home |                           |                       |                   |                           |                         |                   |
| 4 or fewer                      | 111 (4.2)                 | 0.83 (0.50–1.42)      |                   | 196 (8.3)                 | 1.21 (0.95–1.54)        |                   |
| 5 or more                       | 17 (5.0)                  |                       |                   | 87 (6.9)                  | 1.00                    |                   |
| Sharing bedroom                 |                           |                       |                   |                           |                         |                   |
| 2 or fewer                      | 71 (4.6)                  | 1.17 (0.82–1.67)      |                   | 239 (7.9)                 | 1.30 (0.88–1.91)        |                   |
| 3 or more                       | 56 (4.0)                  |                       |                   | 27 (6.1)                  |                         |                   |
| Heating system                  |                           |                       |                   |                           |                         |                   |
| Stove                           | 83 (3.8)                  | 0.67 (0.46–0.97)*     |                   | 142 (7.1)                 | 1.24 (0.99–1.55)*       |                   |
| Central heating                 | 46 (5.6)                  |                       |                   | 141 (8.8)                 | NS                      |                   |
| Bathed in sunlight house        |                           |                       |                   |                           |                         |                   |
| No                              | 8 (5.2)                   | 1.00 (0.97–1.05)      |                   | 17 (9.6)                  | 1.25 (0.78–1.99)        |                   |
| Yes                             | 122 (4.3)                 |                       |                   | 265 (7.6)                 |                         |                   |

OR, odds ratio.

\*  $p < 0.05$ 

NS: not significant.

**Table 4**

Other risk factors affecting prevalence of allergic rhinitis in 2008 study.

| Factors                                                                                                    | Children with allergic rhinitis | p value | Bivariant (OR)                | Multivariant (OR) |
|------------------------------------------------------------------------------------------------------------|---------------------------------|---------|-------------------------------|-------------------|
| Who has an allergy in the family? <sup>*</sup>                                                             |                                 | 0.004   |                               |                   |
| Mother or father                                                                                           | 86 (53.4)                       |         |                               |                   |
| Sister or brother                                                                                          | 36 (22.4)                       |         |                               |                   |
| Grandmother or grandfather                                                                                 | 14 (8.7)                        |         |                               |                   |
| Uncle or still                                                                                             | 12 (7.5)                        |         |                               |                   |
| Aunt or maternal uncle                                                                                     | 4 (2.5)                         |         |                               |                   |
| Cousin                                                                                                     | 9 (5.6)                         |         |                               |                   |
| Kind of domestic animal                                                                                    |                                 | 0.84    |                               |                   |
| Fish                                                                                                       | 45 (42.9)                       |         |                               |                   |
| Cat                                                                                                        | 9 (8.6)                         |         |                               |                   |
| Dog                                                                                                        | 20 (19.0)                       |         |                               |                   |
| Bird                                                                                                       | 20 (19.0)                       |         |                               |                   |
| Other (such as turtle, rabbit)                                                                             | 11 (10.5)                       |         |                               |                   |
| Kind of bird                                                                                               |                                 | 0.80    |                               |                   |
| Budgerigar                                                                                                 | 12 (70.6)                       |         |                               |                   |
| Pigeon                                                                                                     | 3 (17.6)                        |         |                               |                   |
| Canary                                                                                                     | 1 (5.9)                         |         |                               |                   |
| Parrot                                                                                                     | 1 (5.9)                         |         |                               |                   |
| Place of domestic animal                                                                                   |                                 | 0.45    |                               |                   |
| Outside (garden or balcony)                                                                                | 32 (32.3)                       |         | 1.06 (0.68–1.65)              |                   |
| Indoor                                                                                                     | 67 (67.7)                       |         |                               |                   |
| Does child's father or mother work in textile industry                                                     |                                 | 0.44    |                               |                   |
| Yes                                                                                                        | 69 (25.3)                       |         | 1.03 (0.77–1.37)              |                   |
| No                                                                                                         | 801 (24.7)                      |         |                               |                   |
| Do you have accompaniment of children to their parents after school hours in textile industry <sup>*</sup> |                                 | 0.01    |                               |                   |
| Yes                                                                                                        | 27 (26.5)                       |         | 1.89 (1.15–2.91) <sup>*</sup> | 1.78 (1.10–2.88)  |
| No                                                                                                         | 196 (16.4)                      |         | 1.00                          | 1.00              |
| Does child's father or mother work in marble industry <sup>*</sup>                                         |                                 | 0.04    |                               |                   |
| Yes                                                                                                        | 15 (7.9)                        |         | 1.79 (1.02–3.13) <sup>*</sup> | NS                |
| No                                                                                                         | 112 (4.6)                       |         | 1.00                          |                   |
| Do you have accompaniment of children to their parents after school hours in marble industry               |                                 | 0.08    |                               |                   |
| Yes                                                                                                        | 5 (4.9)                         |         | 2.42 (0.91–6.47)              |                   |
| No                                                                                                         | 25 (2.1)                        |         |                               |                   |

OR, odds ratio.

<sup>\*</sup>  $p < 0.05$ .

NS: not significant.

#### 4. Discussion

AR is common in children with an increasing trend as children get older and adversely affects their quality of life [17,18]. It is often associated with asthma, and makes treatment and prevention of asthma more difficult [19]. So treatment and prevention of AR is important and for this reason, the prevalence of the disease should be known.

This study was summarized the prevalence of doctor diagnosed AR and related symptoms in 13–14-yr-old school children living in Denizli. In two cross-sectional studies, children completed the same ISAAC-based questionnaires in the same schools at the same time of year in 2002 and 2008. The main purposes of this questionnaire are (1) to distinguish people with and without AR, (2) to predict predisposition to atopy in patients with rhinitis and (3) to predict the severity of disease in patients with rhinitis [11]. Question 1 was used to estimate the prevalence of life time rhinitis, question 2 was used to estimate the prevalence of current nose symptoms, question 3 was used to estimate the prevalence of current nose and eyes symptoms, question 5 was used to assess the prevalence of severe rhinitis symptoms and question 6 was used to estimate life time doctor diagnosed AR prevalence.

In 2008 study, prevalence of lifetime doctor diagnosed AR has increased significantly from 4.3% to 7%. And also all prevalence other than severe interference with daily activity in the last 12 months have increased significantly in 2008 compared with those in 2002 study. Severe interference with daily activity in the last 12 months has decreased, but it is not significant statistically. The

increasing trend of AR prevalence in our study is similar to many centers and countries in different parts of the world [9,20–22].

Increasing prevalence of allergic is observed mainly in populations undergoing rapid socio-economic development. The economy of Denizli has shown a great improvement in the last decades based notably on textile production and exports. Similar to other countries; this may explain the increase in the prevalence of AR in Denizli. In addition, genetic factors, like family history of atopy are important for development of allergic diseases [23,24]. The reasons for this rising trend cannot be explained by genetic factors only, but increased community awareness of AR among the general population and medical personnel, environmental changes caused by rapid westernization, rapid economic development, or increased air pollution may also play a role [23,25–27]. The division of Pediatric Allergy was established in 2006 in University Hospital in Denizli. Thereafter, pediatric allergist started working and organizing educational programs about AR for physicians, pharmacist and parents. These activities may have been effective in increasing public awareness about AR.

There were quite different results in the prevalence of allergic diseases in different parts of Turkey using ISAAC questionnaire. In developed western parts of Turkey, the prevalence of AR and other atopic diseases were higher than other parts of Turkey and the prevalence in urban areas are higher than that of rural areas [14,25,26]. Zeyrek et al. [23] reported that in the southeastern part of Turkey (in Sanliurfa) the total prevalence of AR was 2.9% in 13–14 age group. This result was quite low in contrast to our results. Studies [23,27] were reported that there were associations

between various factors suggested by the hygiene hypothesis, environmental factors and atopic diseases like asthma and AR.

#### 4.1. Risk factors

Numerous risk factors have been described for AR in different stages of life. Genetically predisposed individuals are under the increased risk for the development of AR when they are exposed to certain environmental and lifestyle factors. In the current literatures, positive associations were found between AR symptoms and use of paracetamol in infancy, in the last year [28], paracetamol use once per month [29], food allergy (milk, egg, peanut, and sesame) [30], frequent fast-food consumption, cat exposure at home, and smoking [29]. In addition high maternal consumption of fruit and berry juices was positively associated with the risk of AR in children [31]. Weaker associations were noted for antibiotic usage, exercise, and some dietary habits such as regular pasta ingestion [28]. It has been also been hypothesized that factors influencing the *in utero* environment, including maternal diet during pregnancy, may affect immune system development and later allergic diseases [32]. Recent studies supported these associations. During pregnancy, maternal intake of fish and dairy products which are important sources of micro-nutrients, fatty acids and probiotics may influence the risk of child asthma and allergic rhinitis, yet evidences are conflicting [33,34].

#### 4.2. Smoking

In many studies it is emphasized that, active and passive smoking resulted in increase of the risk of AR. Smoking leads to local irritation on the sino-nasal epithelial cells and elevation of matrix metalloproteinase 9 plays an important role for the pathophysiology of allergy [35–37]. But we did not find this association in our study.

#### 4.3. Atopic family history

In many studies the most important risk factor for allergic disease development is reported as genetic susceptibility [24–27,35]. In addition, if there is family history of atopy in first and second degree, this risk increases more [37]. As expected, we also found similar results that the prevalence of AR increased in children if their mother or father had atopic diseases in both these 2002 and 2008 studies.

#### 4.4. Stuffed toys

Stuffed toys are reservoir for house dust mites, which is an important environmental risk factor for allergic sensitization. Children often play with their stuffed toys and this contributes to the development of allergic diseases [37,38]. In our study in 2008 but not in 2002, also stuffed toys increased the prevalence of AR.

#### 4.5. Annual family income; education level of parents

We found that, high annual family income, significantly increased the prevalence of AR while education level of parents did not affect this prevalence. Studies [39,40] were reported that mortality and morbidity increase among lower socioeconomic status. Socioeconomic status was defined by education level of parents, annual family income or occupation. Some studies from Western European countries [41–44], and one study from Eastern Europe [45] reported that children from parents with high education level had an increased prevalence of AR and other allergic diseases in the former East Germany. There was a positive correlation between socioeconomic status and AR and/or other atopic diseases. In another study, it was seen that high and middle

socioeconomic level were associated with the risk of atopic dermatitis, but did not increase prevalence of AR [24].

#### 4.6. Heating system

There are different results in the studies that show the relationship between heating system of the house and AR. The installation of insulated windows and central heating systems associated with an increase of mite-allergen and mold spore concentrations in carpet, inducing sensitization and allergic disease [46]. Von Mutius et al. [47] and Hirsch et al. [46] reported that risk of developing AR and other atopic diseases was significantly lower in children whose homes were heated by coal or wood than in children living with a central heating system. Families often use wood-burning stove adopt the traditional way of life and this may explain the less occurrence of allergic diseases [47]. But, in another study, central heating did not increase the risk of allergic disease in children [48]. Although Kilpelainen et al. [49] found significant negative association between childhood wood stove heating and AR in the univariate analysis, they did not found significant association in the multivariate analysis.

In 2008 and in 2002 study, we found that central heating increased the risk of doctor diagnosed AR in univariate analysis, but this finding was not significant in multivariate analysis.

#### 4.7. Textile industry

Development of allergic diseases is likely to occur in people with certain occupation. Timely detection of an allergic disease due to occupational exposure in adolescents is important for prevention and/or treatment of the disease. Working in textile and clothing industry were found as risk factors for rhinitis in adolescent group [50,51].

A considerable part of the people in Denizli is working in textile industry [10]. For this reason, we evaluated whether there is a relationship between risk of doctor diagnosed AR and textile industry. We found that working mother or father in the textile industry was not associated with risk of AR, but accompaniment of children to their parents in textile industry increased risk of AR.

#### 4.8. Marble industry

Marble industry also plays an important role for development of Denizli [10]. There are many people working in the marble industry in Denizli, so we investigated whether there is a relationship between risk of doctor diagnosed AR and marble industry. In univariate analysis, we found that working mother or father in the marble industry was associated with risk of AR, but in multivariate analysis, we did not find significant association. Also accompaniment of children to their parents in marble industry did not increase risk of AR.

### 5. Conclusions

In this study, we evaluated time trends and possible risk factors associated with doctor diagnosed AR in 13- and 14-yr-old schoolchildren using ISAAC written questionnaire with an overall response rate of 75% and 93.8% in 2008 and 2002 respectively. We see that the prevalence of doctor diagnosed AR has increased significantly in 2008 when compared with the previous study in 2002. In addition to family history of atopy, stuffed toys, high annual family income and accompaniment of children to their parents after school hours in textile industry were found as risk factors for doctor diagnosed AR. However, further studies are

required to determine other risk factors related to the increase in AR prevalence.

## Conflict of interest

None of the authors declare any conflict of interest related with this manuscript.

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