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Effects of dietary habits and risk factors on allergic rhinitis prevalence among Turkish adolescents

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ABSTRACT

Background: Allergic rhinitis (AR) is a global health problem affecting many people from childhood to adulthood. The aim of this study was to evaluate the prevalence of AR and related symptoms, and to assess the risk factors, dietary habits and the Mediterranean diet affecting AR.

Methods: In a cross-sectional study design, 9991 children, aged 13–14 years in 61 primary schools in 32 districts of Istanbul were evaluated. The prevalence of AR symptoms among the children was evaluated using the ISAAC protocol.

Results: In our study, total of 10,984 questionnaires were distributed to 13–14 yr-old schoolchildren to 61 schools in 32 district of Istanbul and 9991 questionnaires were suitable for analysis with an overall response of 91.7%. The rates of lifetime rhinitis, rhinitis in last 12 months and lifetime doctor diagnosed AR prevalence were 53.5%, 38.3% and 4.5%, respectively. The variation among districts in the prevalence of doctor diagnosed AR was very high. The highest prevalence was about 10 times higher than in the district with the lowest prevalence (range: 1.4–14.5) of Istanbul.

A family history of atopy, mother with a university degree, presence of cat at home during last 12 months and adenoidectomy were significant for increased doctor diagnosed AR risk. Additionally, although fish and other sea foods, fermented drinks made from millets and various seeds, animal fats and butter were independent risk factors for doctor diagnosed AR, fish oil and hamburger were protective foods for doctor diagnosed AR. The MD was not associated with the prevalence of doctor diagnosed AR. **Conclusions:** This study shows that there are wide variations for the prevalence of AR related symptoms in 13–14 yr-old schoolchildren among districts of Istanbul in Turkey. Socio-economical, environmental factors, some dietary habits, but not Mediterranean diet may affect the prevalence of AR.

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1. Introduction

Allergic rhinitis (AR) is a global health problem affecting many people from childhood to adulthood [1]. It is a common disease and is characterized by nasal itch, sneezing, watery and mucous rhinorrhoea, and nasal obstruction [2].

The International Study of Asthma and Allergies in Childhood (ISAAC) program was designed (using standardized international methods) to allow comparisons of the prevalence of allergic diseases between populations in different countries and form the basis of further studies to investigate factors that potentially lead to these international patterns [3–6].

The prevalence of childhood AR shows wide variation throughout the world, ranging from 0.8% to 39.7% [7]. The prevalence rates for different regions of Turkey ranges from 2.9% to 31.0% [8–13]. However, based on Pub Med search, there are very few studies showing the prevalence rates of AR and related symptoms in Istanbul which is the largest city in Turkey [9,11].

In epidemiologic surveys, an increase in the prevalence of rhinitis has been reported [14–18]. The reasons for the global increase in prevalence of AR are still unknown, but various risk factors such as family history of atopy, month of birth, parental smoking, male sex and early exposure to allergens or pollutions have been described by epidemiological surveys [19–25]. However, major determinant contributing to the development of AR is still not clear.

The term “Mediterranean diet” (MD) refers to dietary patterns found in olive growing areas of the Mediterranean region. There are several variants of the Mediterranean diet, but some common components can be identified: a high ratio of monounsaturated to

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saturated fats; a high consumption rate of vegetables, fruits, pulses and grains; and moderate consumption of milk and dairy products [26]. These foods are important sources of dietary antioxidants. Antioxidants might have an important role in the pathogenesis of AR. Studies investigating the relationship between the Mediterranean diet and AR are very few [23–25].

In the present study, by using the ISAAC's self-response written questionnaire (WQ), we determined the prevalence of rhinitis and rhinitis-related symptoms among 13–14 yr-old schoolchildren living in all districts (32 districts) of Istanbul. Our secondary aim was to make comparisons between other cities in Turkey and other countries. Additionally, this study investigated the association between doctor diagnosed AR and dietary habits, especially Mediterranean diet.

2. Methods

2.1. Study area

The survey study was conducted in Istanbul which is the biggest metropolis, being home to 13.5 million people; and one of the greatest business and cultural centers of Turkey. The city constitutes 1/7 of Turkey's population with a surface area of 11,868 square kilometers [13]. It has 32 districts; they are shown on Istanbul, Turkey map in Fig. 1. The characteristic weather is a cooler version of the Mediterranean climate: a short spring, hot summer temperatures, a long autumn, and a rainy winter. Air pollution and heavy traffic can be considered to be the main problems of the city like all most metropolises.

2.2. Study population and design

The number of schools and children were calculated according to the number of children attending Grade 8 in each district. There were 181,271 children attending Grade 8 in Istanbul. Of those children, 5% from each district were planned to be included in the survey. According to this calculation, a total of 10,894 children aged 13–14 year in randomly selected 61 primary schools of 32 districts without selection by urban or suburban residence or variations in socioeconomic status were surveyed by the ISAAC questionnaire. The 13–14 yr age group was chosen to enable the use of self-completed questionnaire. Questionnaires were distributed by teachers for self-completion.

2.3. Questionnaire

The standardized core symptom questionnaire for 13–14 yr old was comprised six questions on symptoms relating to rhinitis or rhino conjunctivitis [27,28]. These questions were as follows:

1. Have you (has your child) ever had a problem with sneezing or a runny or blocked nose, when you DID NOT have a cold or the flu?
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?
3. In the past 12 months, has this nose problem been accompanied by itchy-watery eyes?
4. In which of the past 12 months did this nose problem occur? (Month names listed).

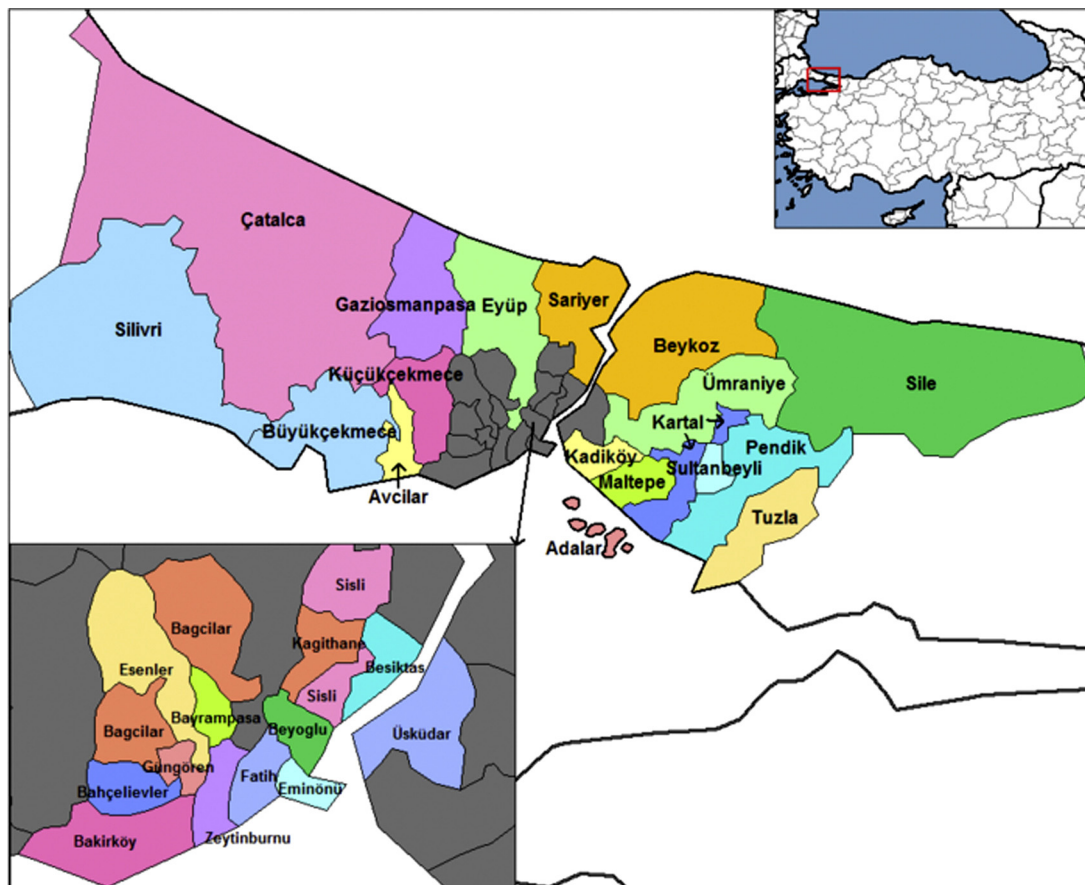


Fig. 1. Districts on Istanbul map and Istanbul on Turkey map.

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 with doctor's confirmation?

Question 1 was used to estimate the prevalence of lifetime 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 eye symptoms, question 5 were used to assess the prevalence of severe rhinitis symptoms and question 6 was used to estimate lifetime doctor diagnosed AR prevalence. There have been numerous studies carried out in Turkey using the ISAAC questionnaire [8–13]; therefore, the questionnaire was translated into Turkish and used.

An additional questionnaire was prepared to identify demographic features and potential risk factors, including: sex, atopic family history, number of siblings at home, being born in Istanbul, time lived in Istanbul, education level of child's mother and father, presence of domestic animals at home in lifetime, presence of fish, cats, dogs and birds at home during last 12 months, smoking of the child's mother (or guardian), smoking of the child's father, tonsillectomy or adenotonsillectomy.

Dietary intake was estimated by using an additional semi-quantitative food frequency questionnaire. Consumption of foods including starch such as potatoes, rice, cereals, pasta, vegetables, fish, other sea foods, fruits, tomatoes, nuts, olive oil, fish oil, boiled grape juice, fermented drinks made from various seeds and mix pickles, hamburger, potato chips, crackers, chocolates, lollipops, candies, cookies, muffins and margarine, eggs, animal fats, milk and dairy products, meat, polyunsaturated fatty acids (butter), sun-flower oil, corn oil, tea, broad beans and olives were asked [29]. Analysis of diet variables were determined by the frequency of consumption of foods in three categories: "never or occasionally", "once or twice per week" and "three or more times a week".

Additionally, we calculated a Mediterranean diet score based on the work of García-Marcos et al. [30]. Fruit, seafood, vegetables, pulses, cereals, pasta, rice, and potatoes were considered Mediterranean foods and scored 0, 1, or 2 points, ranging from the least frequent to the most frequent intake: never or occasionally (0), 1–2 times/wk (1), and 3 or more times/wk (2). Meat, milk, and fast food were considered non-Mediterranean foods and scored 0, 1, or 2 points, ranging from the most frequent to the least frequent consumption: 3 or more times/wk (0), 1 to 2 times/wk (1) and never or occasionally (2). In all the analyses, the Mediterranean diet score was the sum of the points of each food, ranging from 0 to 22; the higher the score, the greater the adherence to the Mediterranean diet.

2.4. Statistical analysis

Statistical significance of differences was assessed by the chi-square test. A *P*-value less than 0.05 were considered as significant. Prevalence estimates were calculated by dividing positive responses to the given question by the total number of completed questionnaires while missing or inconsistent responses were excluded from subsequent univariate analyses according to ISAAC recommendations [27,31]. The children with no response for a question were excluded from analysis of the relevant variable. Prevalence of allergic diseases' symptoms and risk factors were calculated with a 95% confidence interval (CI).

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. Significant factors from the univariate analysis 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.

Multivariate logistic regression analysis for relation between the frequency of intake of foods and doctor diagnosed AR was applied separately from risk factors. Odds ratios for suffering from doctor diagnosed AR according to the consumption of each food (≥ 3 times/week compared with never or occasionally and 1–2 times/week) were adjusted by logistic regression.

The Mediterranean diet score among children with doctor diagnosed AR and children without doctor diagnosed AR was compared using the Independent Samples T Test.

The SPSS software package version 12.0 was used for all statistical analyses.

2.5. Ethical consideration

The study has been approved by the Ethics Committee of Istanbul University, Istanbul School of Medicine.

3. Results

Of 10,984 questionnaires, 10,298 were completed and 9991 questionnaires were suitable for analysis with an overall response of 91.7%. Response rates were between 76.5% and 98.3% in 32 districts. Of 9991 children, 4746 was boys (47.9%) and 5166 was girls (52.1%) with a M/F ratio of 0.92. The prevalence for lifetime rhinitis, rhinitis in last 12 months, rhino conjunctivitis in last 12 months and doctor diagnosed rhinitis were 53.5%, 38.3%, 7.8% and 4.5%, respectively (Table 1).

The highest prevalence was about 10 times higher than in the district with the lowest prevalence (range: 1.4–14.5%) for doctor diagnosed AR. The rates of variation for lifetime rhinitis and rhinitis in last 12 months were 1.71 (range: 39.6–67.7%) and 2.48 (range: 19.6–48.6%), respectively. Districts with highest prevalence ($>10\%$) for doctor diagnosed AR were Maltepe (14.5%) and Bakirkoy (12.2%) while districts with lowest prevalence ($<3\%$) were Bagcilar (1.4%), Beykoz (2.2%), Esenler (2.7%) and Tuzla (2.2%). Districts with highest prevalence ($>60\%$) for rhinitis ever were Bagcilar (61.4%), Buyukcekmece (61.7%), Catalca (63.2%), Eminonu (67.7%), Gaziosmanpasa (63.2%), Kagithane (64.1%) and Silivri (62.7%) while districts with lowest prevalence ($<50\%$) were Adalar (39.6%) and Maltepe (48.8). Total rates of prevalence for lifetime rhinitis, rhinitis in last 12 months, rhino conjunctivitis in last 12 months and doctor diagnosed AR for districts of Asian region were 49.4%, 32.9%, 14.6% and 5.1% with 56.0%, 41.3%, 17.1% and 4.2%, respectively for districts of European region. Prevalence rates of rhinitis, rhinitis in last 12 month and rhinitis interference daily activity in Asian districts were higher than those prevalence rates in European districts and it was statistically significant [$(P < 0.01)$, $(P < 0.01)$ and $(P = 0.02)$, respectively]. Prevalence rate of doctor diagnosed rhinitis in European districts was lower than Asian districts ($P = 0.017$). The summary of the prevalence of AR and related symptoms in 32 districts of Istanbul is shown in Table 2.

Table 1
Summary of parental-completed allergic rhinitis questionnaire data (*n*: 9991).

Questionnaire	Female <i>n</i> (%)	Male <i>n</i> (%)	Total <i>n</i> (%)
Lifetime rhinitis	2629 (55.4)	2714 (52.5)	5343 (53.5)
12-month prevalence			
Rhinitis	1909 (40.2)	1916 (37.1)	3825 (38.3)
Associated itchy eye	884 (18.6)	732 (14.2)	1616 (16.2)
Severe interference with daily activity	557 (11.7)	447 (8.6)	1004 (10.0)
Lifetime doctor-diagnosed allergic rhinitis	227 (4.8)	222 (4.3)	449 (4.5)

Table 2

Summary of the prevalence of allergic rhinitis and related symptoms in districts of Istanbul.

Districts	Ever rhinitis	12-month prevalence			Ever had allergic rhinitis	n
		Rhinitis	Associated itchy eye	Severe interference with daily activity		
Asian districts	49.4	32.9	14.6	7.7	5.1	3255
Adalar	39.6	21.2	7.7	3.8	6.2	104
Beykoz	58.3	41.9	18.2	12.1	2.2	198
Kadikoy	50.6	33.9	11.2	5.2	6.7	484
Kartal	43.7	23.3	14.2	3.1	7.4	387
Maltepe	48.8	19.6	10.6	6.0	14.5	265
Pendik	62.1	42.6	18.6	11.3	6.4	408
Sultanbeyli	57.7	34.1	19.0	8.6	4.2	232
Sile	56.3	33.3	9.5	4.8	5.1	126
Tuzla	47.9	29.1	14.9	8.1	2.2	148
Umraniye	56.4	35.3	17.1	9.5	3.0	549
Uskudar	49.1	36.4	12.7	9.9	4.7	354
European districts	56.0	41.3	17.1	11.3	4.2	6736
Avcilar	55.4	34.3	13.7	8.3	5.4	315
Bagcilar	61.4	46.7	22.1	14.7	1.4	612
Bahcelievler	55.4	40.7	17.1	9.2	6.0	381
Bakirkoy	53.4	39.2	15.5	12.9	12.2	232
Bayrampasa	56.9	38.2	9.8	8.3	4.3	204
Besiktas	59.1	38.7	9.5	4.5	6.1	222
Beyoglu	53.2	31.4	9.8	17.6	3.2	153
Buyukcekmece	61.7	41.3	20.4	13.5	3.7	416
Catalca	63.2	40.1	18.2	5.2	7.6	192
Eminonu	67.7	48.5	21.6	9.3	5.4	97
Esenler	58.9	45.5	20.3	15.9	2.7	409
Eyup	52.8	38.1	11.9	5.9	6.8	236
Fatih	59.8	44.9	14.4	14.4	4.6	374
Gaziosmanpasa	63.2	39.3	18.8	11.4	5.0	511
Gungoren	60.0	48.6	26.7	14.4	3.2	360
Kagithane	64.1	46.6	14.8	12.5	4.8	311
Kucukcekmece	54.0	39.8	18.7	14.2	3.5	664
Sariyer	54.8	41.4	12.8	6.3	5.2	399
Silivri	62.7	42.3	14.4	5.4	7.0	111
Zeytinburnu	55.6	36.5	10.4	7.4	4.1	230
Sisli	54.3	34.9	18.9	8.1	4.1	307
Total	56.5	38.6	16.3	10.1	4.9	9991

3.1. Risk factors

A family history of atopy (aOR = 7.19, 95% CI = 4.01–12.89), mother with a university degree (aOR = 1.73, 95% CI = 1.12–2.67), presence of cat at home during last 12 months (aOR = 2.18, 95% CI = 1.52–3.12) and adenoidectomy (aOR = 3.13, 95% CI = 1.56–6.25) were significant risk factors for doctor diagnosed AR.

Although number of siblings, education level of child's father, presence of domestic animals at home, dog at home during last 12 month, bird at home during last 12 month and tonsillectomy were significant risk factors for doctor diagnosed AR by univariate analysis, their significances were lost when it was evaluated by multivariate analysis.

Sex, being born in Istanbul or time lived in Istanbul, presence of fish at home during last 12 months, smoking of the child's mother (or guardian) or father did not affect the doctor diagnosed AR prevalence. Risk factors affecting the prevalence of doctor diagnosed AR was shown in Table 3.

3.2. Relationship between dietary habits and allergic rhinitis

According univariate analysis, foods included fish and other sea foods, nuts, olive oil, fish oil and fermented drinks made from various seeds, hamburger, chocolates, lollipops, candies, animal fats, meat and butter were associated with doctor diagnosed AR (Table 4). These foods associated with doctor diagnosed AR were tested in logistic regression analysis with adjusted odds. Fish and other sea foods (aOR = 1.60, 95% CI = 1.06–2.41), fermented drinks made from various seeds

(aOR = 2.19, 95% CI = 1.21–3.96), animal fats (aOR = 1.93, 95% CI = 1.13–3.29), and butter (aOR = 1.48, 95% CI = 1.09–2.01) were independently and significantly affected doctor diagnosed AR prevalence when these foods were consumed 3 or more times a week compared to never or occasionally. Fermented drinks made from various seeds (aOR = 2.15, 95% CI = 1.07–4.33) and butter (aOR = 1.58, 95% CI = 1.14–2.19) were associated with doctor diagnosed AR prevalence when these foods were consumed 3 or more times a week compared to once or twice per week. When fish oil was consumed 3 or more times a week, it was protective factor compared to once or twice per week (aOR = 0.50, 95% CI = 0.28–0.89). Interestingly, hamburger was protective factor when this food was consumed 3 or more times a week compared to once or twice per week (aOR = 0.69, 95% CI = 0.48–0.99). Relationship between doctor diagnosed AR and the frequency of intake of each food, compared with three or more times per week is shown in Table 5.

The mean total Mediterranean diet score for 11 foods was 12.35 for children with doctor diagnosed AR and 12.54 for children without doctor diagnosed AR from a maximum of 22 points ($P = 0.30$). Doctor diagnosed AR prevalence was not affected by the Mediterranean diet.

4. Discussion

This study was summarized the prevalence of doctor diagnosed AR and related symptoms in 13–14 yr-old schoolchildren living in all districts in Istanbul. Our study is the first study about AR covering all the districts in Istanbul.

Table 3

Risk factors affecting the prevalence of doctor diagnosed allergic rhinitis.

Factors	Children with allergic rhinitis	P-value	Univariate (uOR)	Multivariate (aOR)
Sex				
M	222 (4.8)		0.94 (0.77–1.13)	
F	227 (5.1)			
History of family atopy				
Yes	76 (13.4)		3.49 (2.68–4.55)*	7.19 (4.01–12.89)*
No	342 (4.2)		1.00	1.00
Number of siblings at home				
1–2	361 (5.2)		1.35 (1.07–1.72)*	NS
≥3	88 (3.9)		1.00	
Region of district				
Asia	165 (5.7)		1.25 (1.02–1.52)*	NS
Europe	284 (4.6)		1.00	
Being born in Istanbul				
Yes	320 (5.1)		1.14 (0.92–1.41)	
No	119 (4.5)		1.00	
Time lived in Istanbul				
More than 5 year	384 (4.7)		0.88 (0.59–1.33)	
5 or less than 5 year	26 (5.3)		1.00	
Education level of child's mother				
University	40 (10.4)		2.29 (1.63–3.23)*	1.73 (1.12–2.67)*
Primary school	386 (4.8)		1.00	1.00
Education level of child's father				
University	62 (7.0)		1.53 (1.16–2.01)*	NS
Primary school	374 (4.7)		1.00	
Presence of domestic animals at home				
Yes	120 (6.1)		1.35 (1.09–1.68)*	NS
No	320 (4.6)		1.00	
Fish at home during last 12 month				
Yes	36 (6.5)		1.37 (0.96–1.95)	
No	413 (4.8)		1.00	
Cat at home during last 12 month				
Yes	46 (9.1)		2.12 (1.54–2.93)*	2.18 (1.52–3.12)*
No	372 (4.5)		1.00	1.00
Dog at home during last 12 month				
Yes	41 (8.7)		1.97 (1.41–2.76)*	NS
No	380 (4.6)		1.00	
Bird at home during last 12 month				
Yes	65 (7.1)		1.56 (1.19–2.05)*	NS
No	384 (4.7)		1.00	–
Smoking of the child's mother (or guardian)				
Yes	117 (5.5)		1.18 (0.95–1.48)	
No	296 (4.7)		1.00	
Smoking of the child's father				
Yes	223 (4.9)		1.06 (0.87–1.30)	
No	184 (4.7)		1.00	
Tonsillectomy				
Yes	50 (8.7)		2.00 (1.47–2.73)*	NS
No	366 (4.5)		1.00	
Adenoidectomy				
Yes	56 (11.2)		2.72 (2.02–3.66)*	3.13 (1.56–6.25)*
No	361 (4.4)		1.00	1.00

* $P < 0.05$ is considered significant;

uOR, univariate odds ratio; aOR, adjusted odds ratio.

In our study, the rate of doctor diagnosed AR ever was similar to that of Denizli (4.3%) [8], and this rate was lower than those reported for Istanbul (17.6% and 7.9%) [9,11] and Ankara (31.0%) [12], except for the rate of Bursa (2.9%) [13], which is lower than our result. Only Bursa and Denizli studies were performed among 13–14 yr-old school children. All other studies in Turkey were made among different age groups. In our study, prevalence of doctor diagnosed AR was low according to the studies previously conducted in Istanbul on different age groups.

There is wide range of prevalence both between districts and between Asian and European side. The reason for this may be due to environmental, socio-economic and genetic factors. Istanbul is the largest city in Turkey and also one of the largest urban agglomerations in Europe. Istanbul experienced rapid growth and its population increased tenfold from the mid-1950s to early the 2000s. It is largely fueled by migrants from eastern Turkey seeking employment and improved living conditions. The number of

residents of Istanbul originating from seven northern and eastern provinces is greater than the populations of their entire respective provinces. This may cause genetic heterogeneity among inhabitants. European side is the former part of the city, where most of the business areas are located along with abundant housing. Asian side has one-third of the city's population and only a quarter of its employment. It has a better infrastructure and tidier urban planning when compared with European areas. Higher prevalence rate of rhinitis symptoms in European side in comparison to Asian side may partly be explained by these environmental factors. Lower rate for doctor diagnosed AR in European side may be due to unwillingness of parents to request outpatient clinic appointment from busy official hospitals. Besides, primary care physicians and specialists are not distributed homogeneously in the city; and there may be some differences among physicians about awareness of AR.

It is difficult to explain the wide range of prevalence between districts with one or two factors since every district has its own

Table 4

Relationship between the prevalence of allergic rhinitis and dietary habits of Turkish children.

Foods	Never or occasionally <i>n</i> (%)	Once or twice per week <i>n</i> (%)	Three or more times per week <i>n</i> (%)	<i>P</i> -value
Potatoes	54 (6.0)	171 (4.7)	199 (4.9)	0.267
Rice	70 (5.2)	182 (4.7)	170 (5.2)	0.580
Cereal	50 (5.1)	90 (5.9)	277 (4.7)	0.177
Pasta	70 (4.8)	197 (4.7)	163 (5.6)	0.254
Vegetables	60 (5.4)	120 (4.9)	242 (4.8)	0.765
Fish and other sea foods [*]	158 (3.7)	195 (6.0)	51 (7.8)	<0.001
Fruits	33 (7.1)	79 (5.2)	311 (4.7)	0.060
Tomatoes	48 (4.5)	113 (5.0)	247 (4.7)	0.806
Nuts [*]	97 (4.1)	185 (4.9)	138 (6.1)	0.006
Olive oil [*]	132 (3.7)	153 (5.6)	108 (5.8)	<0.001
Fish oil [*]	287 (4.5)	69 (8.4)	23 (5.3)	<0.001
Boiled grape juice	220 (5.2)	122 (4.7)	67 (4.6)	0.559
Fermented drinks made from various seeds [*]	334 (4.6)	31 (6.4)	18 (11.2)	<0.001
Mix pickles	222 (4.7)	129 (4.6)	45 (5.4)	0.641
Hamburger [*]	211 (4.0)	138 (6.5)	60 (5.7)	<0.001
Potato chips, crackers	60 (4.4)	125 (4.4)	232 (5.3)	0.183
Chocolates [*]	44 (3.9)	107 (4.3)	263 (5.3)	0.045
Lollipops, candies [*]	141 (4.1)	121 (4.7)	145 (6.0)	0.005
Cookies, muffins	62 (3.8)	160 (4.8)	191 (5.3)	0.066
Margarine	186 (4.7)	123 (4.9)	92 (5.6)	0.325
Eggs	84 (5.3)	138 (4.7)	201 (5.1)	0.669
Animal fats [*]	318 (5.0)	33 (7.6)	22 (9.9)	0.001
Milk, dairy products	34 (5.3)	71 (4.1)	320 (5.2)	0.160
Meat [*]	109 (4.5)	199 (4.5)	111 (6.9)	0.000
Butter [*]	191 (4.3)	112 (4.9)	109 (7.1)	0.000
Sun-flower oil	204 (4.4)	99 (5.1)	70 (5.6)	0.141
Corn oil	198 (4.5)	115 (5.3)	65 (5.0)	0.413
Tea	53 (5.8)	73 (4.7)	283 (4.6)	0.302
Broad bean	74 (4.5)	204 (5.3)	137 (4.6)	0.239
Olive	84 (5.9)	119 (4.9)	209 (4.5)	0.080

^{*} *P* < 0.05 is considered significant.**Table 5**

Relationship between the prevalence of doctor diagnosed allergic rhinitis and the frequency of intake of each food, compared with three or more times per week.

Foods	Never or occasionally (aOR)	<i>P</i> -value	Once or twice per week (aOR)	<i>P</i> -value
Fish and other sea foods [*]	1.60 (1.06–2.41) [*]	0.024	1.21 (0.83–1.77)	0.32
Nuts	0.86 (0.60–1.24)	0.42	0.94 (0.70–1.25)	0.66
Olive oil	1.36 (0.99–1.86)	0.054	0.93 (0.69–1.26)	0.658
Fish oil ^{**}	0.77 (0.45–1.33)	0.36	0.50 (0.28–0.89) [*]	0.018
Fermented drinks made from millets and various seeds [*]	2.19 (1.21–3.96) [*]	0.009	2.15 (1.07–4.33) [*]	0.031
Hamburger [*]	1.23 (0.85–1.79)	0.26	0.69 (0.48–0.99) ^{**}	0.043
Chocolates	1.40 (0.84–2.34)	0.193	0.90 (0.66–1.21)	0.47
Lollipops, candies	1.24 (0.97–1.85)	0.080	1.28 (0.95–1.73)	0.108
Animal fats [*]	1.93 (1.13–3.29) [*]	0.016	1.55 (0.80–2.98)	0.191
Meat	0.95 (0.65–1.38)	0.77	1.15 (0.85–1.55)	0.36
Butter [*]	1.48 (1.09–2.01) [*]	0.011	1.58 (1.14–2.19) [*]	0.006

^{*} *P* < 0.05 is considered significant.

aOR, adjusted odds ratio.

social, economic and geographical features. It is rather a complex interaction of multiple factors. However districts with highest symptoms are either crowded suburban ones, or rural areas with rich forests. Districts with lowest prevalence for doctor diagnosed asthma were the ones that are either far from the city or suburban areas with low socio-economic status and poor health facilities.

Prevalence of doctor diagnosed AR was also low according to the results of other countries including Brazil (19.9%) [32], Africa (10.8%) [33], China (9.8%) [34], Italy (24.4%) [35], Spain (17.9%) [36], except for Tibet result (1.2%) [37].

4.1. Risk factors

As expected, we found atopic heredity as the most important risk factor for doctor diagnosed AR. The relation between socioeconomic status and allergic diseases in childhood is controversial [38]. Almqvist et al. [39] reported that asthma, rhinitis and sensitization are more common in lower than in higher socioeconomic groups. However, Durkin et al. [40] reported that

the increased socio-economic status is associated with increased risk of symptoms of asthma. In our study, a significant positive relationship was observed between higher maternal education level and the risk of doctor-diagnosed AR. Our result supported socioeconomic status hypothesis reported by Durkin et al. [40]. Social and environmental factors of highly educated mothers who are mostly working women, may influence the immune system of the fetus during pregnancy.

Environmental allergen exposure is associated with increased risk of allergic diseases [41]. Roost et al. [42] reported that current cat ownership represented a significant risk factor for sensitization to cat if cats were allowed indoors. Hesslema et al. [41] found that exposure to cat or dog during the first year of life was associated with a lower prevalence of AR and asthma in school children. Prodanovic et al. was not found any difference between the four groups with regard to cat, dog, bird or other pet ownership irrespective of the pet was kept in-doors or outdoors [16]. Brunekreef et al. [17] reported that current exposure to cats and dogs combined, and to dogs only, is a risk factor for symptom

reporting by adolescents. In our study, presence of cat during last 12 months was associated with increased doctor diagnosed AR risk while the presence of fish, cat, dog or bird at home was not significant risk for doctor diagnosed AR.

Tonsils and adenoids are of Waldeyer's ring, involved in the defense against microorganisms. Surgical removal of these tissues may cause a reduction in stimulation of the Th1-type immune response and may lead to a rise in Th2-type-mediated atopic diseases according to "hygiene hypothesis" [43]. Allergy and sensitivity to different kinds of allergens are thought to be risk factors for adenoid hypertrophy in children [44]. Adenoid hypertrophy is also risk factor for adenoidectomy. Children with AR usually had nasal congestion causing them to breathe through the mouth. This might lead to frequent tonsillopharyngitis and enlarged tonsils resulting in tonsillectomy. Akcay et al. [45] reported that tonsillar hypertrophy might be a risk factor for asthma-related symptoms but they found no relationship between tonsillectomy and/or adenoidectomy and asthma symptoms. British National Child Development Study has shown a positive relationship between adenoidectomy or tonsillectomy in childhood and the incidence of atopic disease in later childhood was positive [46]. In our study, although adenoidectomy was associated with increased doctor diagnosed AR risk, tonsillectomy was not significant according to multivariate analysis.

Other risk factors including sex, number of siblings at home, region of district, being born in Istanbul, time lived in Istanbul, education level of child's father, presence of domestic pet at home (fish, dog and bird) and smoking of the child's parents were not associated with doctor diagnosed AR prevalence in our study.

4.2. Relationship between dietary habits and allergic rhinitis

Although many studies have been conducted to establish the link between diet and atopy, findings are often conflicting, inconsistent, and inconclusive [47]. There has been a few studies about relationship between dietary habits and AR. According to diet hypothesis, that plant based diet is protective against asthma and allergies and a "Western" diet is positively associated with asthma and allergies [48]. One hypothesis for the increased prevalence of atopic diseases is the growing consumption of polyunsaturated fatty acids (PUFAs), specifically a high intake of ω -6 in relation to ω -3. The presence of PUFAs could intensify the production of IgE through the formation of arachidonic acid-derived eicosanoids, which could in turn favor the development of allergic diseases [49,50]. A diet rich in antioxidants, could have a protective effect against atopic diseases [51].

Many studies indicate that the consumption of foods containing antioxidants (e.g., fruits and vegetables) acts as a protective factor against atopy [51,52], whereas other studies found a positive association [53] or none at all [54]. In our study, we could not find any association between consumption of fruits and vegetables and risk of having AR.

The potential influence of altered consumption of PUFAs on the increasing prevalence of atopic diseases is under investigation [55,56]. Epidemiologic studies based on an ecological study design [57,58] supported that dietary fat consumption might play a role in atopy. Studies on relation between allergic eczema (AE) and oils have conflicted results. Many studies indicate that increased n -6 PUFAs (margarine, vegetable oil) intake was associated with AE [59] and atopic diseases [51,60–62]. Chatzi and Kogevinas found association between margarine and increased AR risk [23]. In ecological analysis study of the ISAAC, olive oil was negatively associated with AR, but soya oil was positively associated with AR [48]. Several authors suggest that butter, a source of saturated fatty acids, is associated with a lower risk of atopic diseases [60,63]. In our study, animal fats and butter were independent risk factors for

doctor diagnosed AR. However, olive oil, margarine, sun flower oil and corn oil were not associated with doctor diagnosed AR risk.

Fish oils are particularly rich in n -3 fatty acids, and it has been suggested that these may compete with n -6 fatty acids in a way that reduces the inflammatory components of AE [51]. Decreased n -3 PUFA (oily fish) intakes have contributed to increases in asthma and atopic disease [51]. In our study, fish oil was protective factor for doctor diagnosed AR, when fish oils consumed 3 or more times a week compared to once or twice per week.

Hamburger was associated with decreased doctor diagnosed AR prevalence when these foods consumed 3 or more times a week compared to once or twice per week. This may be due to limitation of frequent consumption of hamburgers by parents of children with doctor diagnosed AR.

The traditional Mediterranean diet is characterized by an increased intake of plant foods such as fruits and vegetables, bread and cereals, legumes and nuts. Although these foods are important sources of dietary antioxidants, a few authors reported that the Mediterranean diet was protective for AR [23,24]. However, in our study, the MD was not associated with the prevalence of doctor diagnosed AR, as has been reported by Suárez-Varela et al. [64].

There are several strengths of this study. First, the ISAAC questionnaire used in this study has been worldwide validated. Our data can easily be comparable with other studies done with ISAAC questionnaire, since they would share the same standardized methodology. Secondly, the total number of questionnaires filled from different districts is quite enough to reflect the whole target population of the city. A weakness of this study is that the data are based on children's reports, there is no objective data such as physical examination or allergy screening tests. Second, primary care physicians and specialists are not distributed homogeneously in the city, and there may be some differences among physicians about awareness of AR.

In conclusion, our study shows that there are wide variations for the prevalence of AR related symptoms in 13–14 yr-old schoolchildren among districts of Istanbul in Turkey. Family history of atopy, maternal education degree, presence of cat at home during last 12 months and adenoidectomy were found to be potential risk factors for doctor diagnosed AR. Although some dietary habits may have some effect on prevalence of AR, Mediterranean diet is not associated with prevalence of AR in Turkish adolescent children.

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