



## Prevalence of asthma among Middle Eastern children: A systematic review

Masoud Mirzaei<sup>1</sup>, Mehran Karimi<sup>2</sup>, Shima Beheshti<sup>3</sup>, Masoud Mohammadi\*<sup>4</sup>

Received: 25 Oct 2015

Published: 02 Oct 2016

### Abstract

**Background:** The prevalence of asthma and allergy has increased during the last decades, especially in children. However, little is known about it in the Middle East region. This systematic review is aimed to estimate the prevalence of asthma among the Middle Eastern children.

**Methods:** Local and international scientific databases including SID, Iranmedex, Medline and Science Direct were systematically searched for relevant keywords including; asthma, prevalence, children, International Study of Asthma and Allergies in Childhood (ISACC) and the names of Middle Eastern countries for the period of 1996-2011. Papers in Persian and English which met the defined criteria were included into the study. Bibliographies of the extracted articles were also searched. After extraction of data, heterogeneity between studies and publication bias were measured using Egger's-test. Effect size was pooled by the random-effect model. Since significant heterogeneity was found between studies, univariate meta-regression analyses were done to assess the association of variables with the overall results.

**Results:** Fifty studies in the Middle East examined the prevalence of asthma and allergy in children under the age of 18 years according to the ISAAC criteria and were included. A total number of 289,717 children were examined in the included studies and the prevalence varied from 0.7 % in Isfahan to 22.3 % in Bagdad. The total prevalence of diagnosed asthma was calculated 7.53 % (95% CI: 6.38-8.75). Prevalence of asthma in the 13-14 years age group was 7.57% (95% CI: 5.78-9.29) and in 6-7 years age group was 7.43% (95% CI: 5.75-9.10). The prevalence of asthma among girls, based on random effect model, was 6.30% (95% CI: 4.97-7.61) and among boys, it was 8.91% (95% CI: 6.80-11.04).

**Conclusion:** The prevalence of asthma in the Middle East is lower than most developed countries. However, there is not enough longitudinal data to estimate the trend over time. In order to have more accurate estimates and to provide evidence for proper planning, standard epidemiologic studies should be conducted in countries of the region.

**Keywords:** Asthma, Prevalence, Middle East, Children, Systematic review

Copyright © Iran University of Medical Sciences

**Cite this article as:** Mirzaei M, Karimi M, Beheshti Sh, Mohammadi M. Prevalence of asthma among Middle Eastern children: A systematic review. *Med J Islam Repub Iran.* 2017(12 Feb);31:9. <https://doi.org/10.18869/mjiri.31.9>

### Introduction

Worldwide, the prevalence of asthma has increased during the last three decades (1,2). According to the World Health Organization estimate in 2005, around 300 million people were affected by asthma. According to the existing evidence, the prevalence of asthma and allergy in children is increasing around the world (3). It is estimated that this number will reach 400 millions by 2025.

In some industrialized countries the prevalence of asthma and allergy has reached to a warning level, and has affected more than one-third of the children (4). It is not clear that this increase is due to a real increase in the prevalence of asthma and allergy (5), or it is due to a higher level of awareness and diagnosis. According to some studies, in developed countries the prevalence of asthma has stopped to in-

Corresponding author: Masoud Mohammadi, [masoud.mohammadi1989@yahoo.com](mailto:masoud.mohammadi1989@yahoo.com)

<sup>1</sup> Yazd Cardiovascular Research Centre, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

<sup>2</sup> Department of Pediatrics, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

<sup>3</sup> Hormozgan University of Medical Sciences, Bandar Abbas, Iran.

<sup>4</sup> Department of Social Medicine, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran.

#### ↑What is "already known" in this topic:

Prevalence of asthma and allergy has reached to more than one-third of the children in some developed countries. It seems that factors like age, sex, economic status, genetics and exposure to indoor and outdoor pollutions are related to the prevalence of asthma.

#### →What this article adds:

The prevalence of asthma in the Middle Eastern countries is lower than most developed countries. The prevalence studies of asthma in the Middle East have to be repeated every 5 years using criteria such as that of ISACC to reflect the trends of the changes over time.

crease or even started to decrease in the recent years (6- 8). It seems that factors like age, sex, economic status, genetics and exposure to indoor and outdoor pollutions are related to the prevalence of asthma (9,10).

In a study by Smith Kline et al. in 2002, around one-third of those who were affected by asthma had some limitations in doing their daily activities such as physical exercise, social activities and sleeping (11).

Overall, respiratory diseases cause 6.3 % of the total death around the world, and the share of asthma is 0.4% (12). Based on the National Statistical Office of Korea, the mortality rate, due to chronic respiratory diseases (including asthma) increased during 1992 to 2002 from 12.9 to 22.6 per 100,000 population. In 1992 chronic diseases of the lower respiratory system was the eighth cause of death in Korea, and it reached to the fifth cause in 2002 (13).

Children's asthma is a main clinical concern around the world that imposes a great burden on families and the society. The disease can impede the academic development and social activities of the children. Children's asthma is a burden on the health care system due to successive referral to practitioner and hospital which costs a lot (14,15). Due to the lack of a standard method for asthma diagnosis, examining the prevalence of asthma over time (16) was difficult. The International Study of Asthma and Allergies in Children (ISAAC) was established in 1991 in order to provide reliable data on the prevalence of the disease, its symptoms and changes during the time and in different countries. In the first phase children in the age group of 13-14 years in 56 countries, and in the age group of 6 to 7 years in 38 countries were evaluated during 1994 to 1995. The second phase of ISAAC aimed to investigate risk factors of the disease in 1998; only 22 countries participated, and no Middle Eastern countries were involved. Several Middle Eastern countries took part in various phases of ISAAC. However no systematic review was published from these studies. This study aims to systematically review the prevalence of asthma, according to ISAAC standard method, in the Middle Eastern children.

## Methods

### Data

Iranian scientific databases including Iranmedex and SID, as well as major international databases including Medline and Science Direct were searched to find the relevant papers. The searched keywords were "Asthma", "prevalence", "children", "ISAAC" and "Middle East" in English and the Persian equivalents.

"Citation pearl growing" technique (17) was used to search the reference lists of the extracted papers. This cross checking method continued up until no other relevant article was found. In this study, all papers published from 1996-2011, in English or Persian languages, were searched, reviewed and included if they met certain quality criteria. The results of this research were limited to cross-sectional descriptive studies. The research was conducted during September to November 2012.

Summaries of the extracted articles were reviewed first. Initial screening was done based on the subjects and summaries of the articles. If the article was a peer reviewed epidemiologic study and the prevalence of asthma and the asthma symptoms were reported in the article, then the article was considered for quality check and inclusion. If some articles were extracted from one study, the one with the most details was selected. If the full text was not available, authors of the paper were contacted.

Selection criteria for the included papers were; a) population-based studies which reported prevalence of asthma, b) age of the population groups less than 18 years, c) random or census sampling of the study, d) using ISACC methods to diagnose asthma, and e) the article published either in English or Persian.

Studies which had the criteria to be entered into the study were coded in an information summary form, using FileMaker Pro V. 8.0 (FileMaker Inc., Santa Clara, CA -USA). Some of the articles (10%) were summarized and evaluated by two coders.

Coding form of the studies consisted of four sections including information related to the aim of the study, characteristics of the target population, sampling method, information related to criteria for asthma diagnosis, epidemiologic information in order to extract the data reported in the article and information related to the quality of the study.

The quality of the studies was evaluated using a set of defined criteria. The relevant checklist was designed according to the critical evaluation guideline of research papers on prevalence published by Loney et al. (18). The criteria are about the design including proper sampling framework, adequate sample size, appropriate evaluation of the result and the response rate; interpretation included reporting the prevalence with confidence interval and adequate sub-group analysis and applicability of the results including explanation of the aims and detailed conditions. Quality grading of each study was made by two coders, and the results were compared to ensure inter-coder agreement. In cases of inconsistency between the coders, they discussed the issue until consensus was reached.

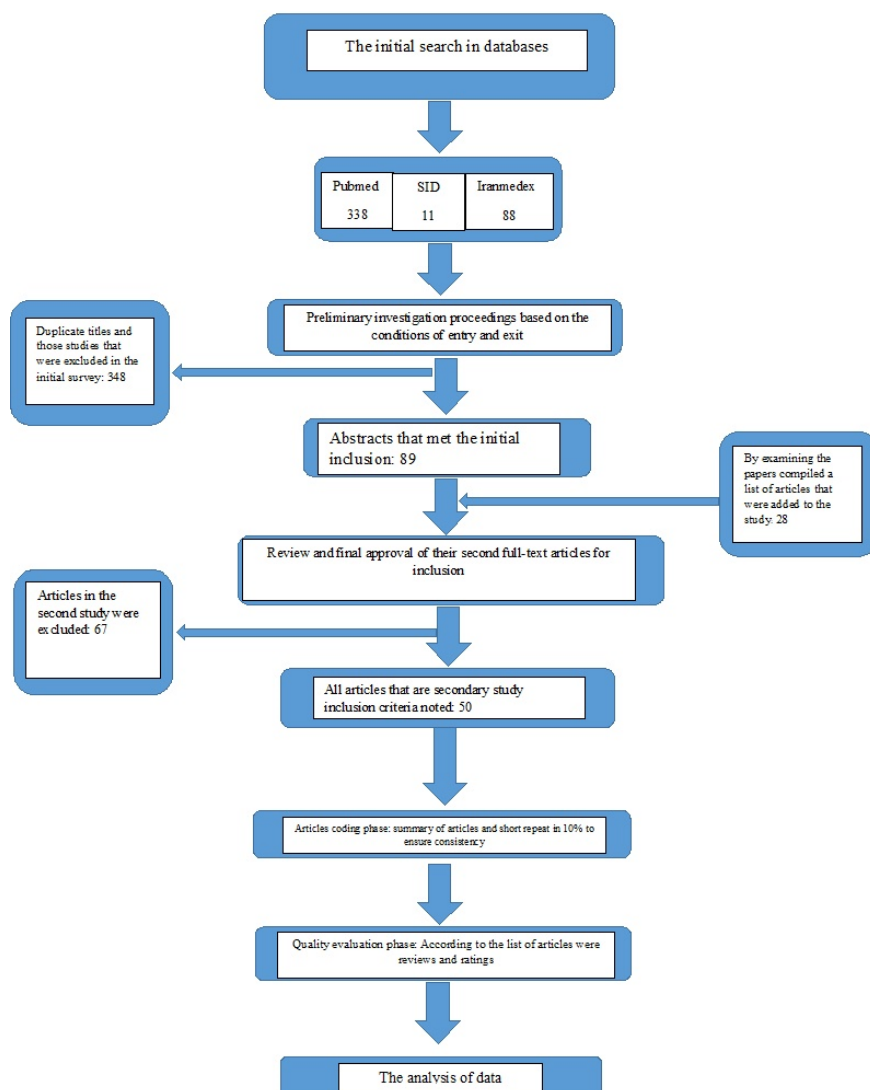


Fig. 1. Flowchart of the included studies

### Data analysis

The first step of data analysis was to estimate overall pooled prevalence of asthma among all studies. To assess heterogeneity,  $I^2$  Test was used in order to determine whether the difference between estimated prevalence in different studies is higher than the randomly expected value.

A significant heterogeneity between the included studies was found. Univariate meta-regression analysis was done in order to evaluate the relationship between methodological variables, age, and sex with the total estimate of the prevalence of asthma using meta-regression analysis. This analytical strategy tries to find which variable has affected the total result. Examined methodological variables were sample size, year of publication, quality score of the article, and also per capita income and air pollution of the countries.

In this analysis the relationship between methodological variables like sample size, published year of

the study, quality of the included studies, and also the language of the questionnaire, was analyzed to see any relation with the prevalence of asthma.

Due to the existing inconsistency in the studies, a sensitivity analysis was conducted to determine the influence of each included study on the total estimation. There was no significant change observed by excluding any particular paper.

Effect of each variable including methodology, geographic area of the study, urban and rural and population mean age on the prevalence estimate were investigated by meta-regression analysis. This strategy investigates which variable affects the final results. The regressed variables include sample size, publication year, and article's quality score. All statistical analysis was done using STATA SE (Ver.10).

### Results

Out of 814 identified papers in the initial search, after exclusion of repeated publications and critical

appraisal, 89 articles had the inclusion criteria. After searching bibliography of the papers, 28 more papers were identified, and the total number reached to 117 (Fig. 1).

Out of the 117 articles, 67 articles excluded in the detailed review phase, either because they used non-ISAAC protocol and questionnaire, or conducted in a specific age group (19-22), or had ISAAC questionnaire, but their reports were different from ISAAC protocol and thus excluded (23-27). The total number of subjects in the included studies (N=50) was 289,717. Five articles (10% of all articles), had a population more than 10,000 (45.6% of the total subjects). The majority of the studies (88%) had the population between 1000 and 10000 (54% of all subjects). Only one study had a population less than 1000 (Table 1).

More than half of the studies were done in urban populations, and the rest were done in the urban and rural population at the same time. Only one study was conducted among men, and the rest included both men and women.

Eighteen countries of the Middle East including Iran, Saudi Arabia, Oman, Lebanon, Palestine, Qatar, Kuwait, Bahrain, Iraq, Morocco, Egypt, United Arab Emirates, Syria, Israel and Yemen were included in this systematic review. Twenty-six studies were from Iran (52%), eight studies were from other Persian Gulf countries (26%), six studies (16%) were from other Arabic countries of the Middle East and the rest were from North Africa (Table 2).

The majority of studies (52 %) used Persian translation of the ISAAC questionnaire followed by Arabic translation (46%) and French translation (2%).

Table 1. Summary of the included studies on prevalence of asthma in children of the Middle East from 1996-2011

Author	year	The study area	Country	Type of area	Sample size	The age range	Sex	Quality Score
El-Sharif N.A. et al (61)	2003	Ramallah & Qaza	Palestine	Urban / rural	14355	12 years	Girl/Boy	13
El-Sharif N.A. et al (53)	2002	Ramallah	Palestine	Urban / rural	3382	6 to 14 years	Girl/Boy	11
Bener A. et al (28)	2007	Qatar	Qatar	Urban / rural	31400	13 to 19 years	Girl/Boy	6
Janahi I.A. et al (62)	2006	Doha	Qatar	Urban / rural	3282	11 to 15 years	Girl/Boy	9
Nahas M. et al (54)	2012	Medina	Saudi Arabia	Urban	5188	6 to 14 years	Girl/Boy	10
Al Ghobain M.O. et al (63)	2012	Riyadh	Saudi Arabia	Urban	3073	6 to 7 years	Girl/Boy	10
Alshehri M.A. et al (64)	2000	Abha	Saudi Arabia	Urban	3274	13 to 14 years	Boy	10
Hijazi N. et al (65)	1999	Jeddah	Saudi Arabia	Urban / rural	1444	7 to 11 years	Girl/Boy	8
Mohammad Y. et al (66)	2010	Aleppo, Lattika, Tartous	Syrian Arab Republic	Urban	10214	6 to 7 years	Girl/Boy	12
Alsowaidi S. et al (20)	2010	Al-Ain	United Arab Emirates	Urban	2802	6 to 7 years	Girl/Boy	9
Georgy V. et al (67)	2006	EI Nozha area of Cairo	Egypt	Urban	2645	12 to 15 years	Girl/Boy	8
Zobeiri M. et al (68)	2011	Kermanshah	Iran	Urban / rural	6236	6 to 11 years	Girl/Boy	11
Rahimi Rad M.H. et al (69)	2008	Urmia	Iran	Urban	2999	6 to 12 years	Girl/Boy	11
Rahimi Rad M.H. et al (48)	2007	Urmia	Iran	Urban	3000	6 to 14 years	Girl/Boy	12
Kajbaf T.Z. et al (70)	2011	Ahvaz	Iran	Urban	903	13 to 14 years	Girl/Boy	6
Shakurnia A.H. et al (71)	2010	Ahvaz	Iran	Urban	2860	5 to 7 years	Girl/Boy	11
Masjedi M.R. et al (72)	2004	Tehran	Iran	Urban	6140	13 to 14 years	Girl/Boy	10
Golshan M. et al (73)	2002	Isfahan	Iran	Urban	3924	5 to 12 years	Girl/Boy	10
Golshan M. et al (29)	2001	Isfahan	Iran	Urban	3858	13 to 14 years	Girl/Boy	10
AL-Thamiri D. et al (30)	2005	Baghdad	Iraq	Urban	2889	13 to 14 years	Girl/Boy	9
Abu-Ekteish F. et al (74)	2009	Amman, Al-Mafraq	Jordan	Urban / rural	9108	13 to 14 years	Girl/Boy	12
Owayed A et al (75)	2008	Kuwait City	Kuwait	Urban	2882	13 to 14 years	Girl/Boy	12
Abal A.T. et al (76)	2010	Kuwait City	Kuwait	Urban	2117	6 to 14 years	Girl/Boy	8
Musharrafieh U. et al (77)	2009	Beirut	Lebanon	Urban / rural	3115	13 to 14 years	Girl/Boy	10
Waked M. et al (20)	2008	Beka, Beirut, Mount, Nabatieh, North, South	Lebanon	Urban / rural	3907	13 to 14 years	Girl/Boy	9
Waked M. et al (78)	2006	Beka, Beirut, Mount, Nabatieh, North, South	Lebanon	Urban / rural	1613	13 to 14 years	Girl/Boy	12
Ait-Khaled N. et al (60)	2007	Wialya of Algeria, Khartoum of Sudan, Grand Tunis & Sousse of Tunisia,...	Africa	Urban / rural	66335	6 to 14 years	Girl/Boy	10

Table 1. Cntd

Bouyad Z. et al (79)	2006	Casabelanca, Marrakech, BenSlimane, Boulmane	Morocco	Urban	5665	6 to 14 years	Girl/Boy	11
Al-Rawas O.A. et al (58)	2008	Eight geographical regions of Oman	Oman	Urban / rural	7879	13 to 14 years	Girl/Boy	11
Al-Riyami B.M. et al (59)	2003	Sultanate	Oman	Urban	3893	13 to 14 years	Girl/Boy	12
Shohat T. et al (56)	2000	Nicosia, Limass	Israel	Urban / rural	10057	13 to 14 years	Girl/Boy	13
Golshan M. et al (73)	2002	Zarinshahr	Iran	Urban	1309	6 to 13 years	Girl/Boy	9
Habibi Khorasani A. et al (80)	1998	Kermanshah	Iran	Urban	2217	6 to 12 years	Girl/Boy	9
Bazzazi H. et al (81)	2006	Gorgan	Iran	Urban	2800	12 to 13 years	Girl/Boy	8
Mohammadzadeh I. et al (82)	2008	Babol	Iran	Urban	5933	6 to 14 years	Girl/Boy	12
Hasanzadeh J. et al (83)	1390	Shiraz	Iran	Urban	3000	13 to 14 years	Girl/Boy	11
Abbasi Ranjbar Z. (84)	2004	Rasht	Iran	Urban	6060	6 to 14 years	Girl/Boy	12
Karimi M. et al (42)	2006	Yazd	Iran	Urban	2740	6 to 7 years	Girl/Boy	9
Sahebi L. et al (85)	2011	Tabriz	Iran	Urban	1508	13 to 16 years	Girl/Boy	6
Gharagozlou M. et al (86)	2006	Kashan	Iran	Urban	2533	13 to 14 years	Girl/Boy	11
Zohal M.A. et al (87)	2004	Qazvin	Iran	Urban	5068	6 to 14 years	Girl/Boy	12
Najafzadeh K. et al (88)	2008	Rasht	Iran	Urban	6074	6 to 14 years	Girl/Boy	12
Gharagozlou M. et al (89)	2002	Kashan	Iran	Urban	3003	6 to 7 years	Girl/Boy	10
Amra B. et al (90)	2005	Isfahan	Iran	Urban	2413	6 to 14 years	Girl/Boy	8
Karimi M. et al (45)	2006	Yazd	Iran	Urban	3151	13 to 14 years	Girl/Boy	10
Hatami G. et al (91)	2001	Bushehr	Iran	Urban	2699	13 to 14 years	Girl/Boy	11
Golshan M. et al (92)	1998	Isfahan	Iran	Urban	3924	10 to 17 years	Girl/Boy	9
Al-Rawas O.A. et al (58)	2009	Muscat, Sharqiah	Oman	Urban	2441	10 years	Girl/Boy	8
Golshan M. et al (29)	2001	Isfahan	Iran	Urban	3668	15 to 18 years	Girl/Boy	10
Hajavi et al (93)	2011	Gonabad	Iran	Urban / rural	1626	12 to 18 years	Girl/Boy	7

Table 2. Comparison of changes in the prevalence of asthma in the Middle East over the period of 1996-2011

Trend of change	The prevalence of asthma in the second study%	The prevalence of asthma in the First study%	Interval of 2 reviews	Age group	Country / City
Increase	11.2	4.5	2 Years	6 to 12 years	Palestine / Ramallah
Constant	2.5	2.6	6 Years	13 to 14 years	Iran / Tehran
Constant	10.6	10.5	6 Years	6 to 7 years	Oman / Sultanat
Decrease	19.8	20.7	6 Years	13 to 14 years	Oman/Sultanat
Increase	13.2	10.9	6 Years	13 to 14 years	Iran
Increase	2	1.4	8 Years	13 to 14 years	Iran / Tabriz
Increase	7.1	4.1	6 Years	6 to 7 years	Iran / Rasht
Increase	4.5	2.7	6 Years	13 to 14 years	Iran / Rasht
Decrease	Girls:1.2 Boys:1.0	Girls:1.5 Boys:1.9	6 Years	6 to 7 years	Iran / Tehran

The quality score of each paper was assessed, and the most common limitations of the studies were: 1) not reporting the confidence interval of the prevalence, 2) including age groups not comply with ISAAC protocol and 3) the reported prevalence was not according to the defined age groups of ISAAC (Fig. 2).

During the period of 1996-2011, the prevalence of asthma in children of the Middle East was 7.57% (95% CI=6.38-8.75). There was significant heterogeneity in the studies. ( $I^2=99\%$ ;  $p<0.001$ ,  $df=45$  and  $Q=9006.7$ ) (Fig. 3).

The prevalence of asthma among girls, based on the random effect model, was 6.30% (95% CI= 4.97-7.61) and among boys, it was 8.91% (95% CI= 6.80-11.04). Prevalence of asthma in the 13-14 years age

group (23 studies) was 7.53% (95% CI= 5.78-9.29) based on the random effect model. The prevalence of asthma in the 6 to 7 years old group, was 7.43% (95% CI= 5.75-9.1) based on the random effect model. In 12 studies, the prevalence of asthma in the age group of 6 to 7 was 7.68% (95% CI= 5.02-10.34) was higher than the age group of 13 to 14; 6.1% (95% CI= 4.41-6.91).

## Discussion

Prevalence of asthma in the Middle Eastern children aged 13-14 years was 7.57% (95% CI: 6.38-8.75). The minimum prevalence rate of asthma (0.7%) was observed in Isfahan in Iran (29), and the highest 22.3% was reported from Bagdad in Iraq

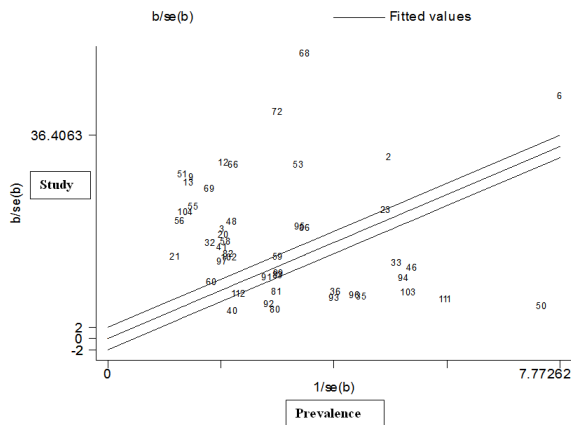


Fig. 2. Sensitivity analysis of the effect of excluded papers on the final estimate of asthma prevalence in children of the Middle East 1996-2011

(30).

Prevalence of asthma in the Middle East is lower than many developed countries such as the UK (25.9%) (31), Spain (12.8%) (32), Australia (31%) (33), and also Turkey (17.8%) (34). However, it is higher than some developing countries like Tibet area in China (1.1%), (35) India (4.9%) (36) and Taiwan (6%) (37).

Studies in the Middle East also show that the prevalence of asthma is higher among younger boys. However, the difference decreases between the two sexes in early adolescence. In Japan prevalence of asthma was higher in boys (6%) than girls (4%) (38).

In Turkey, the prevalence of asthma in boys (19.4%) is slightly higher than girls (16.2%) (34) similar to Nigeria, South Korea, and India (36,39,40).

The prevalence of asthma in countries around the world in the age group 6 to 7 years varies from 1.8% in Lithuania to 27.4% in Costa Rica. In the age group 13 to 14 years the lowest prevalence rate reported from Albania (2.6%) and the highest from Peru (30.5%).

The prevalence of asthma is higher in older children, e.g. in Indonesia the prevalence of asthma among children 6-7 years is 5.3 % and among children 13 -14 years is 7 %. This increase was reported from Germany (4.3% vs. 7.5%) and Singapore (17% vs. 23.7) too. However, in some countries like Costa Rica the prevalence of asthma among children 6 to 7 years old (27.4%) is slightly higher than the 13-14 years age group (20.8%), the reported difference in other countries is limited to 1% (41).

In a systematic review, Pearce et al. reported that across 35 countries of the world, the prevalence of asthma in 21 countries (60%) is higher in the older age group and in nine countries (25.7%) is higher in the younger age group. It was reported in 10 countries (25.7%) that the difference was insignificant, and in only 5 countries the prevalence of asthma was higher in the 6 to 7 years age group including; Iran and Oman (41). Overall, in the Middle East, the prevalence of asthma is higher in the 13 -14 years

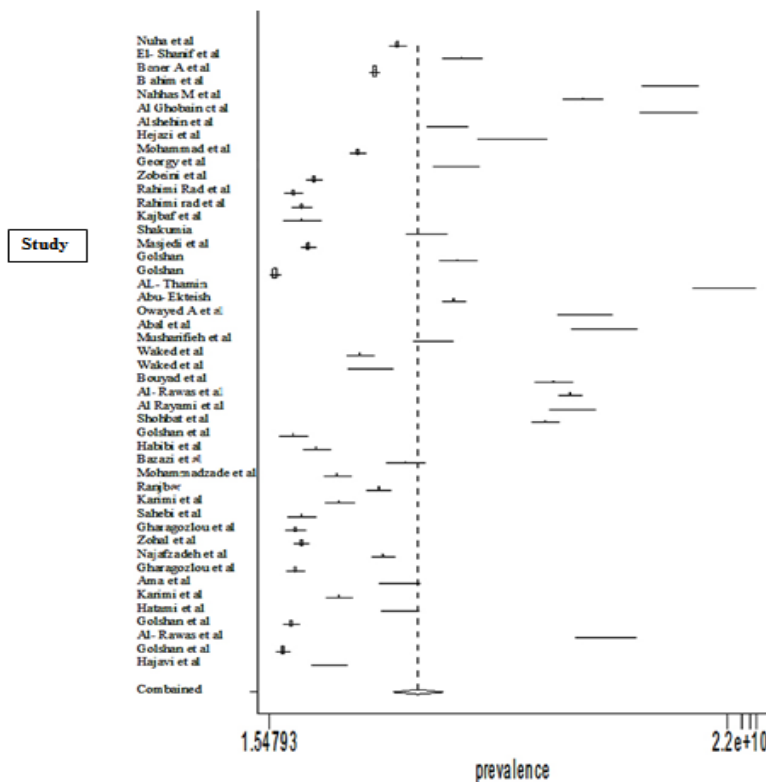


Fig. 3. Pool estimate of the prevalence of asthma in children of the Middle East 1996-2011

age group.

This is the first systematic review of the prevalence of asthma in children of the Middle East. There are some limitations to this study. The heterogeneity across the papers was significant. This may be due to different age groups considered across the studies although they used the same ISAAC criteria. According to the meta-regression analysis, there was no significant relationship between the prevalence of asthma and other methodological factors. There are not enough longitudinal data on changes in the prevalence over time. So the prevalence studies should be repeated.

### Conclusion

The prevalence of asthma in the Middle East is lower than most developed countries. However, there is not enough longitudinal data to estimate the trend over time. The prevalence studies of asthma in the Middle East have to be repeated every 5 years using standard criteria such as ISAAC to assess the secular trends of the changes over time.

### Acknowledgments

None.

**Conflict of Interest:** None declared.

### References

1. Upton MN, McConnachie A, McSharry C, Hart CL, Smith GD, Gillis CR, et al. Intergenerational 20 year trends in the prevalence of asthma and hay fever in adults: the Midspan family study surveys of parents and offspring. *Bmj* 2000; 321(7253):88-92.
2. Yunginger JW, Reed CE, O'Connell EJ, Melton LJ, O'Fallon WM, Silverstein MD. A community-based study of the epidemiology of asthma: incidence rates, 1964-1983. *American journal of respiratory and critical care medicine* 1992; 146(4):888-94.
3. Masoli M, Fabian D, Holt S, Beasley R. The global burden of asthma: executive summary of the GINA Dissemination Committee report. *Allergy* 2004; 59(5):469-78.
4. Committee IS. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology* 1998;12(2):315-35.
5. Beasley R, Crane J, Lai CKW, Pearce N. Prevalence and etiology of asthma. *Journal of allergy and clinical immunology* 2000; 105(2):S466-S72.
6. Toelle BG, Ng K, Belousova E, Salome CM, Peat JK, Marks GB. Prevalence of asthma and allergy in schoolchildren in Belmont, Australia: three cross sectional surveys over 20 years. *Bmj* 2004; 328(7436):386-7.
7. Robertson CF, Roberts MF, Kappers JH. Asthma prevalence in Melbourne schoolchildren: have we reached the peak? *Medical Journal of Australia* 2004;180(6):273-6.
8. Mommers M, Gielkens-Sijstermans C, Swaen G, Van Schayck C. Trends in the prevalence of respiratory symptoms and treatment in Dutch children over a 12 year period: results of the fourth consecutive survey. *Thorax* 2005;60(2):97-9.
9. Lee SI, Shin MH, Lee HB, Lee JS, Son BK, Koh YY, et al. Prevalences of symptoms of asthma and other allergic diseases in Korean children: a nationwide questionnaire survey. *Journal of Korean medical science* 2001;16(2):155-64.
10. Kim YK, Kim SH, Tak YJ, Jee YK, Lee BJ, Park HW, et al. High prevalence of current asthma and active smoking effect among the elderly. *Clinical & Experimental Allergy* 2002;32(12):1706-12.
11. Research/GlaxoSmithKline I. Asthma Insights and Reality in Asia Pacific (AIRIAP) Korea: Executive Summary 2002.
12. Mathers CD, Stein C, Ma Fat D, Rao Ch IM, Tomijima N. Global Burden of Disease 2000: Version 2 methods and results, Global Programme on Evidence for Health Policy Discussion Paper No. 50. World Health Organization [Sitio en Internet] 2002.
13. (KNSO) KNSO. News release: Summary report of the cause of death statistics in 2003. Available from: kosis.nso.go.kr/Magazine/YD/VD0002. xls [accessed: 3 Jan 2005].
14. Moin M, Aghamohammadi A, Gharavi MH, Ardestani A, Faghihimehr A, Kouhi A, et al. Risk factors leading to hospital admission in Iranian asthmatic children. *International archives of allergy and immunology* 2008;145(3):244-8.
15. Balkissoon R. Asthma overview. *Primary Care: Clinics in Office Practice* 2008;35(1):41-60.
16. Magnus P, Jaakkola JJK. Secular trend in the occurrence of asthma among children and young adults: critical appraisal of repeated cross sectional surveys. *Bmj* 1997;314(7097):1795.
17. Gassel A. Finding quality resources on the Internet: filtering and selecting for the Internet scout project. Amsterdam, the Netherlands: International Federation of Library Associations and Institutions 1998. [Cited 11 Oct 2004].
18. Loney PL, Chambers LW, Bennett KJ, Roberts JG, Stratford PW. Critical appraisal of the health research literature: prevalence or incidence of a health problem. *Chronic Dis Can* 1998; 19(4):170-6.
19. Al-Ghamdi B, Mahfouz A, Abdelmoneim I, Khan M, Daffallah A. Altitude and bronchial Asthma in south-western Saudi Arabia. *Eastern Mediterranean health journal* 2008;14:17-23.
20. Alsowaidi S, Abdulle A, Bernsen R, Zuberbier T. Allergic rhinitis and asthma: a large cross-sectional study in the United Arab Emirates. *International archives of allergy and immunology* 2010;153(3):274-9.
21. Tootoonchi P. Prevalence of asthma, related symptoms and risk factors in children younger than 5 years. *Acta medica Iranica* 2004;42(6).
22. Naeimi A, Hadinia A, Karimi A. Asthma prevalence and associated factors in children under six years of the logistic regression models and probity. *Armaqane danesh* 2011;272:16-81.
23. Sobki SH, Zakzouk SM. Point prevalence of allergic rhinitis among Saudi children. *Rhinology* 2004;42(3):137-40.
24. Waked M, Salameh P. Risk factors for asthma and allergic diseases in school children across Lebanon. *Journal of asthma and allergy* 2008;2:1-7.
25. Mortazavimoghadam GH, Saadatjoo R. Prevalence of asthma symptoms among 13 to 14 year old students in Birjand. *Zahedan Medical University* 2004;6(3):9-15
26. Boskabady M, Karimian M. Prevalence of asthma symptoms among secondary school students in the city of Mashhad, north-east of Iran. Available at: <http://www.ams.ac.ir/AIM/0034/boskabady0034.html>.
27. Behbehani NA, Abal A, Syabbalo NC, Abd Azeem A, Shareef E, Al-Momen J. Prevalence of asthma, allergic rhini-

- tis, and eczema in 13- to 14-year-old children in Kuwait: an ISAAC study. *International Study of Asthma and Allergies in Childhood. Ann Allergy Asthma Immunol* 2000; 85(1):58-63.
28. Bener A, Janahi I. Association between childhood atopic disease and parental atopic disease in a population with high consanguinity. *Collegium antropologicum* 2005;29(2):677-82.
  29. Golshan M, Mohamad-Zadeh Z, Zahedi-Nejad N, Rostam-Poor B. Prevalence of asthma and related symptoms in primary school children of Isfahan, Iran, in 1998. *Asian Pacific journal of allergy and immunology / launched by the Allergy and Immunology Society of Thailand* 2001; 19(3):163-70.
  30. Al-Thamiri D, Al-Kubaisy W, Ali SH. Asthma prevalence and severity among primary-school children in Baghdad. *Eastern Mediterranean health journal* 2005;11(1-2):79-86.
  31. Anderson HR, Ruggles R, Strachan DP, Austin JB, Burr M, Jeffs D, et al. Trends in prevalence of symptoms of asthma, hay fever, and eczema in 12-14 year olds in the British Isles, 1995-2002: questionnaire survey. *Bmj* 2004;328(7447):1052-3.
  32. García-Marcos L, Quirós AB, Hernández GG, Guillén-Grima F, Díaz CG, Urena IC, et al. Stabilization of asthma prevalence among adolescents and increase among schoolchildren (ISAAC phases I and III) in Spain. *Allergy* 2004; 59(12):1301-7.
  33. Toelle BG, Ng K, Belousova E, Salome CM, Peat JK, Marks GB. Prevalence of asthma and allergy in schoolchildren in Belmont, Australia: three cross sectional surveys over 20 years. *Bmj* 2004; 328(7436):386-7.
  34. 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(12):1448-53.
  35. Yangzong Y, Shi Z, Nafstad P, Håheim LL, Luobu O, Bjertness E. The prevalence of childhood asthma in China: a systematic review. *BMC public health* 2012;12(1):860.
  36. Dhabadi B, Athavale A, Meundi A, Rekha R, Suruliraman M, Shreeranga A, et al. Prevalence of asthma and associated factors among schoolchildren in rural South India. *The International Journal of Tuberculosis and Lung Disease* 2012;16(1):120-6.
  37. Lee YL, Hwang BF, Lin YC, Guo YL. Time trend of asthma prevalence among school children in Taiwan: ISAAC phase I and III surveys. *Pediatric allergy and immunology* 2007;18(3):188-95.
  38. Kusunoki T, Morimoto T, Nishikomori R, Yasumi T, Heike T, Fujii T, et al. Changing prevalence and severity of childhood allergic diseases in Kyoto, Japan, from 1996 to 2006. *Allergology international: official journal of the Japanese Society of Allergology* 2009;58(4):543-8.
  39. Falade A, Olawuyi J, Osinusi K, Onadeko B. Prevalence and severity of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema in 6-to 7-year-old Nigerian primary school children: the international study of asthma and allergies in childhood. *Medical Principles and Practice* 2004;13(1):20-5.
  40. Hong S, Son DK, Lim WR, Kim SH, Kim H, Yum HY, et al. The prevalence of atopic dermatitis, asthma, and allergic rhinitis and the comorbidity of allergic diseases in children. *Environmental Health and Toxicology* 2012;27.
  41. Pearce N, Ait-Khaled N, Beasley R, Mallol J, Keil U, Mitchell E, et al. Worldwide trends in the prevalence of asthma symptoms: phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2007;62(9):758-66.
  42. Karimi M, Mirzaei M, Ahmadi MH. Acetaminophen use and the symptoms of asthma, allergic rhinitis and eczema in children. *Iranian journal of allergy, asthma, and immunology* 2006; 5(2):63-7.
  43. Karimi M, Mirzaei M, Baghiani Moghadam B, Fotouhi E, Zare Mehrjardi A. Pet exposure and the symptoms of asthma, allergic rhinitis and eczema in 6-7 years old children. *Iranian journal of allergy, asthma, and immunology* 2011;10(2):123-7.
  44. Mirzaei M. Children exposed to secondhand smoke associated Yazdi and Prevalence of asthma and allergies. *Hormozgan University of Medical* 2007;1:2-11
  45. Karimi M, Mirzaei M. Antibiotic Use and Symptoms of Asthma, Allergic Rhinitis and Eczema in Children. *Iranian Journal of Pediatrics* 2009; 19(2):141-6.
  46. Karimi M, Ehrampoush M, Mirzaei M, Ahmadi MH. Type of fuel consumed and frequency of lorry passing associated with allergic rhinitis and asthma symptoms in children. *Iranian Journal of Environmental Health Science & Engineering* 2005;2(2).
  47. Karimi M, Mirzaei M, Akhondzarini R. And the prevalence of asthma and allergies in children's food. *Shahid Sadoughy University of medical* 2010;19(1):35-44
  48. Rahimi Rad MH, Hejazi ME. Agreement between written and video asthma symptoms questionnaires in school children in Urmia, Iran. *Iranian journal of allergy, asthma, and immunology* 2007; 6(1):21-5.
  49. Mirsaid Ghazi B, Imamzadehgan R, Aghamohammadi A, Darakhshan Davari R, Rezaei N. Frequency of Allergic Rhinitis in School-age Children (7-18 Years) in Tehran. *Iranian journal of allergy, asthma, and immunology* 2003;2(4):181-4.
  50. Al-Sahab B, Atoui M, Musharrafieh U, Zaitoun F, Ramadan F, Tamim H. Epidemiology of eczema among Lebanese adolescents. *International journal of public health* 2008;53(5):260-7.
  51. Al-Rawas OA, Al-Riyami BM, Al-Kindy H, Al-Maniri AA, Al-Riyami AA. Regional Variation in the Prevalence of Asthma Symptoms among Omani School Children: Comparisons from Two Nationwide Cross-sectional Surveys Six Years Apart. *Sultan Qaboos University medical journal* 2008;8(2):157-64.
  52. The ISAAC Story. Available from: [isaac.auckland.ac.nz/resources/tools.php](http://isaac.auckland.ac.nz/resources/tools.php).
  53. El-Sharif N, Abdeen Z, Qasrawi R, Moens G, Nemery B. Asthma prevalence in children living in villages, cities and refugee camps in Palestine. *The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology* 2002;19(6):1026-34.
  54. Nahhas M, Bhopal R, Anandan C, Elton R, Sheikh A. Prevalence of allergic disorders among primary school-aged children in Madinah, Saudi Arabia: two-stage cross-sectional survey. *PloS one* 2012;7(5):e36848.
  55. Shohat T, Graif Y, Garty BZ, Livne I, Green MS. The child with asthma at school: results from a national asthma survey among schoolchildren in Israel. *The Journal of adolescent health: official publication of the Society for Adolescent Medicine* 2005;37(4):275-80.
  56. Shohat T, Green MS, Davidson Y, Livne I, Tamir R, Garty BZ. Differences in the prevalence of asthma and current wheeze between Jews and Arabs: results from a national survey of schoolchildren in Israel. *Annals of Allergy, Asthma & Immunology* 2002;89(4):386-92.
  57. Mohammad Y, Tabbah K, Mohammad S, Yassine F, Clayton T, Hassan M. International study of asthma and allergies in childhood: phase 3 in the Syrian Arab Republic. *Eastern Mediterranean health journal* 2010;16(7):710-6.
  58. Al-Rawas OA, Al-Riyami BM, Al-Maniri AA, Al-Riyami AA. Trends in asthma prevalence and severity in Omani schoolchildren: comparison between ISAAC phases I and III. *Respirology (Carlton, Vic)* 2008;13(5):670-3.
  59. Al-Riyami BM, Al-Rawas OA, Al-Riyami AA, Jasim LG, Mohammed AJ. A relatively high prevalence and severity of asthma, allergic rhinitis and atopic eczema in schoolchildren in the Sultanate of Oman. *Respirology (Carlton, Vic)*



- 2003;8(1):69-76.
60. Ait-Khaled N, Odhiambo J, Pearce N, Adjoh K, Maesano I, Benhabyles B, et al. Prevalence of symptoms of asthma, rhinitis and eczema in 13-to 14-year-old children in Africa: the International Study of Asthma and Allergies in Childhood Phase III. *Allergy* 2007;62(3):247-58.
  61. El-Sharif NA, Nemery B, Barghuthy F, Mortaja S, Qasrawi R, Abdeen Z. Geographical variations of asthma and asthma symptoms among schoolchildren aged 5 to 8 years and 12 to 15 years in Palestine: the International Study of Asthma and Allergies in Childhood (ISAAC). *Ann Allergy Asthma Immunol* 2003;90(1):63-71.
  62. Janahi IA, Bener A, Bush A. Prevalence of asthma among Qatari schoolchildren: International Study of Asthma and Allergies in Childhood, Qatar. *Pediatric pulmonology* 2006;41(1):80-6.
  63. Al Ghobain MO, Al-Hajjaj MS, Al Moamary MS. Asthma prevalence among 16- to 18-year-old adolescents in Saudi Arabia using the ISAAC questionnaire. *BMC Public Health* 2012;12:239.
  64. Alshehri MA, Abolfotouh MA, Sadeg A, Al Najjar YM, Asindi AA, Al Harthi AM, et al. Screening for asthma and associated risk factors among urban school boys in Abha city. *Saudi medical journal* 2000;21(11):1048-53.
  65. Hijazi N, Abalkhail B, Seaton A. Asthma and respiratory symptoms in urban and rural Saudi Arabia. *The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology* 1998;12(1):41-4.
  66. Mohammad Y, Tabbah K, Mohammad S, Yassine F, Clayton T, Hassan M. International study of asthma and allergies in childhood: phase 3 in the Syrian Arab Republic. *Eastern Mediterranean health journal* 2010;16(7):710-6.
  67. Georgy V, Fahim HI, El-Gaafary M, Walters S. Prevalence and socioeconomic associations of asthma and allergic rhinitis in northern [corrected] Africa. *The European respiratory journal: official journal of the European Society for Clinical Respiratory Physiology* 2006;28(4):756-62.
  68. Zobeiri M. Prevalence, risk factors and severity of asthma symptoms in children of Kermanshah, IRAN: ISAAC phase I, II. *Acta medica Iranica* 2011;49(3):184-8.
  69. Rahimi Rad MH, Hejazi ME, Behrouzian R. Asthma and other allergic diseases in 13-14-year-old schoolchildren in Urmia, Iran. *Eastern Mediterranean health journal* 2007;13(5):1005-16.
  70. Kajbaf TZ, Asar S, Alipoor MR. Relationship between obesity and asthma symptoms among children in Ahvaz, Iran: a cross sectional study. *Italian journal of pediatrics* 2011;37:1.
  71. Shakurnia AH, Assar S, Afra M, Latifi M. Prevalence of asthma among schoolchildren in Ahvaz, Islamic Republic of Iran. *Eastern Mediterranean health journal* 2010;16(6):651-6.
  72. Masjedi MR, Fadaizadeh L, Najafzadeh K, Dokouhaki P. Prevalence and Severity of Asthma Symptoms in Children of Tehran- International Study of Asthma and Allergies in Childhood (ISAAC). *Iranian journal of allergy, asthma, and immunology* 2004;3(1):25-30.
  73. Golshan M, Mohammad-Zadeh Z, Khanlar-Pour A, Iran-Pour R. Prevalence of asthma and related symptoms in junior high school children in Isfahan, Iran. *Monaldi archives for chest disease* 2002;57(1):19-24.
  74. Abu-Ekteish F, Ootom S, Shehabi I. Prevalence of asthma in Jordan: comparison between Bedouins and urban schoolchildren using the International Study of Asthma and Allergies in Childhood phase III protocol. *Allergy and asthma proceedings: the official journal of regional and state allergy societies* 2009;30(2):181-5.
  75. Owayed A, Behbehani N, Al-Momen J. Changing prevalence of asthma and allergic diseases among Kuwaiti children. An ISAAC Study (Phase III). *Medical principles and practice: international journal of the Kuwait University, Health Science Centre* 2008;17(4):284-9.
  76. Abal AT, Ayed A, Nair PC, Mosawi M, Behbehani N. Factors responsible for asthma and rhinitis among Kuwaiti schoolchildren. *Medical principles and practice: international journal of the Kuwait University, Health Science Centre* 2010;19(4):295-8.
  77. Musharrafieh U, Al-Sahab B, Zaitoun F, El-Hajj MA, Ramadan F, Tamim H. Prevalence of asthma, allergic rhinitis and eczema among Lebanese adolescents. *The Journal of asthma: official journal of the Association for the Care of Asthma.* 2009;46(4):382-7.
  78. Waked M, Salameh P. Asthma, allergic rhinitis and eczema in 13-14-year-old schoolchildren across Lebanon. *Le Journal medical libanais The Lebanese medical journal* 2006;54(4):181-90.
  79. Bouayad Z, Aichane A, Afif A, Benouhoud N, Trombati N, Chan-Yeung M, et al. Prevalence and trend of self-reported asthma and other allergic disease symptoms in Morocco: ISAAC phase I and III. *The international journal of tuberculosis and lung disease: the official journal of the International Union against Tuberculosis and Lung Disease* 2006;10(4):371-7.
  80. Khorasani S, Janqorbani M, et al. The prevalence of asthma among school children in Kerman 1997. *Kerman University of Medical Journal* 2002; 9(4):93-184.
  81. Bazzazi H, Gharagozlou M, Kassaiee M, Parsikia A, Zahmatkesh H. The prevalence of asthma and allergic disorders among school children in Gorgan. *Journal of research in medical sciences* 2007;12(1):28-33.
  82. Mohammadzadeh I, Ghafari J, Savadkoobi RB, Tamaddoni A, Dooki MRE, Navaei RA. The Prevalence of Asthma, Allergic Rhinitis and Eczema in North of Iran. *Iranian Journal of Pediatrics* 2008;18(2).
  83. Jafar zadeh, Basiri F, et al. Prevalence of asthma and allergic diseases in Shiraz adolescents with ISSAC. *Zahedan University of Medical Journal* 2010;13(8):5-39
  84. Abbasi Ranjbar Z. Prevalence of asthma symptoms in children. *Gilan University of Medical Journal* 2004;14(56)
  85. Shabestari MS, Sahebi L. Prevalence of Asthma, Rhinitis Allergic and Eczema among Middle School Students in Tabriz (Northwestern of Iran). *Pediatric Research* 2011;70:5
  86. Gharagozlou M, Khalili S, Hallajmofrad M, Mohammadzadeh R, Mousavi G, Golkari H. Gender similarity in low agreement between written and video ISAAC asthma questionnaires. *Monaldi archives for chest disease* 2006;65(4):184-8.
  87. Hashemi nasab R, Zohal M, et al. The prevalence of asthma among children in Qazvin. *Qazvin University of Medical Journal* 2006;1:2-9
  88. Najafzadeh K, Fadaizadeh L, Salek S. Prevalence and severity of asthmatic symptoms in rasht students: A report from ISAAC study. *Tanaffos* 2008;7(1):40-6.
  89. Garaguzlo M, KHalili S, et al. The frequency and severity of asthma, rhinitis and eczema in children aged 7-6 Kashan. *TUMJ* 2003;61(1)
  90. Amra B, Rahmani A, Salimi S, Mohammadzadeh Z, Golshan M. Association between asthma and body mass index in children. *Iranian Journal of Allergy, Asthma and Immunology.* 2005;4(1).
  91. Hatami G, Amirozedi A, et al. Prevalence and severity of asthma, allergic rhinitis and atopic eczema in 14-13 year old school students in Bushehr. *Outhern Medical Journal Bushehr University of Medical Sciences and Health Services*

2001;5(2):67-175.

92. Olshan M, Khanlarpour A, et al. The prevalence of asthma in adolescents in secondary schools. *Research in Medical Sciences* 1999; 5(2):67-175
93. Hajavi J, Tolideei H, et al. Does the prevalence of allergic disorders in children are different underlying urban and rural? *Journal of Ofoqe Danesh* 2012;18(2):6-21.