

Prevalence of bronchial asthma and its impact on secondary school students in Al Majardah governorate, Aseer region, Saudi Arabia

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Abstract

Bronchial asthma is a major public health problem. The Saudi Initiative for Asthma (2012) reported that the prevalence of asthma in Saudi adults is not well known, but the overall prevalence in Saudi children ranged between 8 to 25%. The current study aimed to assess prevalence, identify triggers and risks and evaluate degree of control among Saudi children. A cross sectional study was conducted among secondary school students in the Al Majaridah governorate, Aseer region, Saudi Arabia using a structured questionnaire.. Responses were received from 792 students of both genders. Asthma prevalence was found to be 9.7%. Many asthmatic students report smoking and contact with animals as major triggers of asthma symptoms and more than two thirds of students had poor asthma control. In conclusion, most asthmatic students are not controlled and further studies of current health education available for students and families are required to explore why this is the case.

Objectives: The current study aimed to estimate the prevalence, to identify triggers and risk factors of asthma and to assess the degree of control among Saudi children in the Al Majaridah governorate. Aseer region, Saudi Arabia.

Methodology: This cross sectional study was conducted using a structured questionnaire which was distributed to all secondary school students in the Al Majaridah governorate during 2021. The questionnaire consisted of many parts; socio-demographics, risk factors, triggers of asthma and asthma control test questions. Data entry and analysis were made using SPSS.

Results: Out of a total 1490 secondary school students, 792 students participated in this study giving a response rate of 53%. The mean age of the participants was 17 years and the majority of them were male (62.9%). The prevalence of bronchial asthma was 9.7%. Risk factors of asthma at home were animals or birds (7%), cockroaches (14%), heavy exercise (32%) and smoking (8%). More than two thirds of participants had poorly controlled asthma .

Conclusion: The prevalence of bronchial asthma among students in the Al Majaridah governorate was similar to that in previous national studies. Most asthmatic students have poor control of their condition and intensive health education of students and their families is needed. Further studies are suggested to explore the reasons behind poor control of asthma among asthmatic students.

Key words: Bronchial asthma, Aseer, Risk factors, Control

Introduction

Bronchial asthma is a chronic airway inflammatory illness marked by bronchial hyper-reactivity and varying degrees of airway blockage. Clinical history, physical examination, and pulmonary function tests, including reversibility testing and bronchial reactivity measurement, are used to diagnose it [1].

The most prevalent symptoms of asthma were nasal congestion, sleep disturbance, and chest tightness, followed by wheezing and dyspnea, with a combination of symptoms (ie, wheezing, breathlessness, chest tightness, and cough) affecting the highest proportion of people.[2]. Infections and endotoxin exposure, for example, may be protective or pose risk, depending on the timing of exposure in infancy and childhood. Some prenatal risk factors, such as maternal smoking, are well known, but other factors including diet and nutrition, stress, antibiotic usage, and delivery mode may also influence the early development of allergy and asthma. Exposure to allergens later in childhood, during nursing (which may initially protect but ultimately increase the chance of sensitization), family size and structure, and gender are all potential risk factors [3-4]. Recurrence of childhood asthma in adulthood may be just as likely as new-onset asthma with an occupational cause. [5]

Bronchial Asthma is a major public health problem that affects people all over the world, with varying levels of prevalence and severity. Over the last few decades, there have been significant increases in the occurrence and severity of asthma in various geographical regions around the world. Asthma is a common chronic respiratory condition that affects more than 300 million individuals worldwide.[6-8] According to estimates from developed countries, it affects 11 and 20 % of all school-aged children. Asthma is one of the most frequent chronic diseases in children, with a higher prevalence in children than in adults [9].

In the past three decades, there has been an increase in the incidence of allergic disorders, including bronchial asthma. Asthma prevalence among children has also increased in the last two decades, including in Saudi Arabia [10].

Several cross-sectional studies conducted over the last 20-30 years showed an increased prevalence of allergic respiratory diseases worldwide, particularly among children in high-income countries, such as the United Kingdom (29%) Australia (30%), New Zealand (30%), and the United States of America (21%) [7-8]. In terms of asthma prevalence, clinical presentation, and natural history, there are significant differences between countries.

The incidence rate in children aged 6 to 10 years was reported to be less than 10% in some countries, such as Austria, Belgium, Finland, France, Italy, and Switzerland, while it was higher in others, such as the Czech Republic (14.7 %), Norway (13.6 %), Bulgaria (14.5 %), and Ireland (17.4 %). In Kuwait, asthma was present in 17% of the population. Asthma prevalence was reported to be 4.8%

- 7.7% in Egyptian infants and children under the age of four years.

The aim of the study is to find out the prevalence of bronchial asthma, the risk factors and the degree of symptom control among secondary school students of Al Majardah governorate, Aseer region, Saudi Arabia.

Subjects and Methods

This cross-sectional study was conducted among secondary school students in Al Majaridah governorate, Aseer region, Saudi Arabia. Al Majaridah, is a governorate of low altitude area (around 580 m above sea level); its climate is generally hot during summer time, warm during winter. The total population is about 53,418 residents.

The study was conducted over a period of 6 months, between March and September 2021.

In the Al Majaridah governorate there are nine secondary schools and approximately 1490 secondary school students who were invited to participate in this study.

In order to achieve the objectives of the study the questionnaire was constructed by the panel of experts based on relevant literature review. The questionnaire composed of questions regarding demographic variables, variables related to bronchial asthma risk factors, control and impact on health. [26]

The questionnaire was sent to students through school supervisors using a Google form that included instructions and information advising that informed consent should be secured before completing the questionnaire.

Ethical approval from the Regional Committee for Research Ethics in Aseer was obtained (REC-NO : 11-3-2021) Data was coded and entered in the SPSS ver.20 software for analysis. Descriptive (mean, S.D , frequency and percentages) of the variable's was computed, and for inferential statistics t tests and chi-square tests were used to measure the degree of association between variables and to assess the significant differences. P-value is considered significant if less than 5%.

Results

Out of a total 1490 secondary school students in the Al Majaridah governorate, 792 students participated in this study giving response rate of 53%. The mean age of the participants was 17.16 Most of them were male (62.9%). The average weight of the respondents was 58.6 kilogrammes and their average height was 162.02 centimeters.

Table 1 depicts the socio-demographic characteristics of students and finds that out of total 792 respondents 37.1% of the respondents were female while 62.9% were male. Most parents were educated (85%), most of the fathers were working in government sectors (29.4% in the army while 31.9% were in civilian jobs). Most of the mothers were not working (75.6%) and more than 25% of the students family income exceed 10000 SAR monthly.

Table 1: Socio demographic characteristic of secondary school students (in Al Majaridah 2021)

Sex		
	Frequency	Percent
Male	498	62.9
Female	294	37.1
Father's education level		
Father is dead	46	5.8
Illiterate	64	8.1
Middle	115	14.5
Primary	138	17.4
Secondary	215	27.1
University	214	27.0
Father's job		
Army	233	29.4
Government	253	31.9
No working	241	30.4
Special Duty	65	8.2
Monthly household income (Saudi riyal)		
From 5000 to 10000	250	31.6
less than 5000	332	41.9
More than 10000	210	26.5
Mother's education level		
	Frequency	Percent
Mother is dead	15	1.9
Illiterate	186	23.5
Middle	94	11.9
Primary	131	16.5
Secondary	177	22.3
University	189	23.9
Mother's work		
No Working	599	75.6
Working	193	24.4
Nationality		
Non Saudi	11	1.4
Saudi	781	98.6
Total	792	100.0
Ranking among siblings		
Middle	470	59.3
Not bigger	184	23.2
only one	5	.6
Smaller	133	16.8
The number of bedrooms in the house		
1	4	.5
2	120	15.2
3	261	33.0
4	187	23.6
5	220	27.8

Table 2: Profile of risk factors of bronchial asthma among students (in Al Majardah 2021)

Are there animals or birds in the house?		
	Frequency	Percent
Animals	56	7
Birds	55	7
No pets	681	86
Are there cockroaches in the house?		
No	684	86
Yes	108	14
Do you do a lot of exercise?		
No	542	68
Yes	250	32
Do you smoke?		
No	730	92
Yes	62	8
Does anyone in the family smoke?		
No	506	64
Yes	286	36

Table 2 depicts domestic risk factors among students with bronchial asthma. 7% have animals in their house, 7% have birds, 14% have cockroaches, 32% do massive exercise and 8% were smokers.

Table 3: Profile of asthma related symptoms among students (in Al Majardah 2021)

1. Have you had wheezing in the chest in the past?		
	Frequency	Percent
No	683	86
Yes	109	14
2. Have you had wheezing in the chest in the past 12 months?		
	Frequency	Percent
No	47	5.9
Yes	57	7.2
3. How many bouts of wheezing in the past 12 months?		
	Frequency	Percent
1 to 3	48	6.1
4 to 12	14	1.8
More than 12	9	1.1
No	35	4.4
4. In the past 12 months, how disturbed have you been during sleep due to asthma?		
	Frequency	Percent
I didn't wake up with wheezing	58	7.3
One night in a week	21	2.7
One or more nights in a week	23	2.9
5. During the past 12 months, has your breathing been difficult enough to limit your ability to speak one or two words between inhalation and exhalation?		
	Frequency	Percent
No	55	6.9
Yes	49	6.2
6. Have you ever suffered from asthma (allergic chest) before?		
	Frequency	Percent
No	30	3.7
Yes	77	9.7
7. During the past 12 months, have you experienced wheezing in your chest during or after exercising?		
	Frequency	Percent
No	26	3.2
Yes	51	6.4
8. During the past 12 months, have you had a dry cough at night due to asthma?		
	Frequency	Percent
No	36	4.5
Yes	41	5.1

Table 3 depicts that approximately 14% of students had wheezing in the chest while 7.2% had experienced wheezing in the past 12 months. Most of them had 1-3 attacks. Sleep disturbance due to asthma in the past 12 months was 6% while severe difficulty in breath was reported by 6%. Wheezing due to exercise was 6.4% while a dry cough at night was around 5%.

Table 4 : Association between risk factors and wheezing among asthmatic students

		Wheezing		Total	Chi-square	P value
		Yes	No			
Animals or Birds	Yes	7 70%	3 30%	10 100.0%	5.11	p=0.02
	No	22 33%	45 67%	67 100.0%		
Exercise	Yes	19 56%	15 44%	34 100.0%	0.667	p=0.41
	No	20 47%	23 53%	43 100.0%		
Smoking	Yes	33 67%	16 33%	49 100.0%	4.40	p=0.03
	No	12 43%	16 57%	28 100.0%		

Table 4 shows the association between wheezing and some risk factors for asthma. It was found that there were associations between wheezing and history of contact with birds or animals and a history of smoking. No association was found between performing exercise and wheezing.

Table 5: Pattern of drugs used among asthmatic students

Are you using or previously used any bronchial asthma medication?		
	Frequency (out of 54)	Percent
Steroid tablets		
Once daily	6	11%
Twice daily	3	5%
When necessary	14	26%
Steroid inhaler		
3 times daily	7	13%
Once daily	2	3%
Twice daily	6	11%
When necessary	15	27%
Intramuscular steroid		
3 times daily	2	3%
Once daily	5	9%
Twice daily	3	5%
When necessary	16	29%
Salbutamol with inhaled steroid		
3 times daily	3	5%
Once daily	10	18%
Twice daily	7	13%
When necessary	15	27%
Salbutamol nebulization		
3 times daily	2	3%
Once daily	5	9%
Twice daily	6	11%
When necessary	25	46%
Salbutamol inhaler		
3 times daily	6	11%
Once daily	11	20%
Twice daily	7	13%
When necessary	23	42%
Salbutamol syrup		
3 times daily	3	5%
Once daily	4	7%
Twice daily	5	9%
When necessary	16	29%
Salbutamol tablet		
3 times daily	3	5%
Once daily	3	5%
Twice daily	3	5%
When necessary	15	27%

Table 5 illustrates that 54 (70%) of the children previously used some form of bronchial asthma medication. Out of this 54 students 26% took steroid tablets when necessary, 27% reported using a steroid inhaler when necessary, 29% had an intramuscular steroid when necessary, 27% used Salbutamol inhalers with steroids when necessary. **Salbutamol nebulization** was also used when necessary among 46% of the children, compared to 42% for a Salbutamol inhaler, 29% for Salbutamol syrup, and 27% for salbutamol tablets.

Table 6: Bronchial asthma control among affected students (total number of affected students is 77)

During the past 4 weeks, how often have you had shortness of breath?			
		Frequency	Percent
	More than once a day	12	15%
	Once a day	11	14%
	3 to 6 times a week	8	10%
	Once or twice a week	13	16%
	Not at all	33	42%
During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication?			
	3 or more times a day	10	12%
	1 to 2 times per day	7	9%
	2 to 3 times per week	16	20%
	Once a week or less	8	10%
	Not at all	36	46%
During the past 4 weeks, how often did your asthma symptoms wake you up at night or earlier than usual in the morning?			
	4 or more nights a week	7	9%
	2 to 3 nights a week	15	19%
	Once a week	10	12%
	Once or twice	12	15%
	Not at all	33	42%
How would you rate your asthma control during the past 4 weeks?			
	Not controlled at all	17	22%
	Poorly controlled	6	7%
	Somewhat controlled	6	7%
	Well controlled	24	31%
	Completely controlled	24	31%
In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?			
	All of the time	7	9%
	Most of the time	7	9%
	Some of the time	26	33%
	A little of the time	14	18%
	None of the time	23	29%

Table 6 shows that 58% of the students experienced shortness of breath at differing levels. 54% had used their rescue inhaler or nebulizer medication, and 58% were woken up at night or earlier than usual in the morning due to asthma symptoms. Regarding perceived asthma control, 22% thought that their asthma was not controlled at all, while 62% thought that their asthma was well / totally controlled. Regarding the affect of asthma on their daily life, school and work, 33% reported some affect, 9% were affected all time while 29% reported no affect.

Figure 1. Asthma control level based on asthma severity score among students

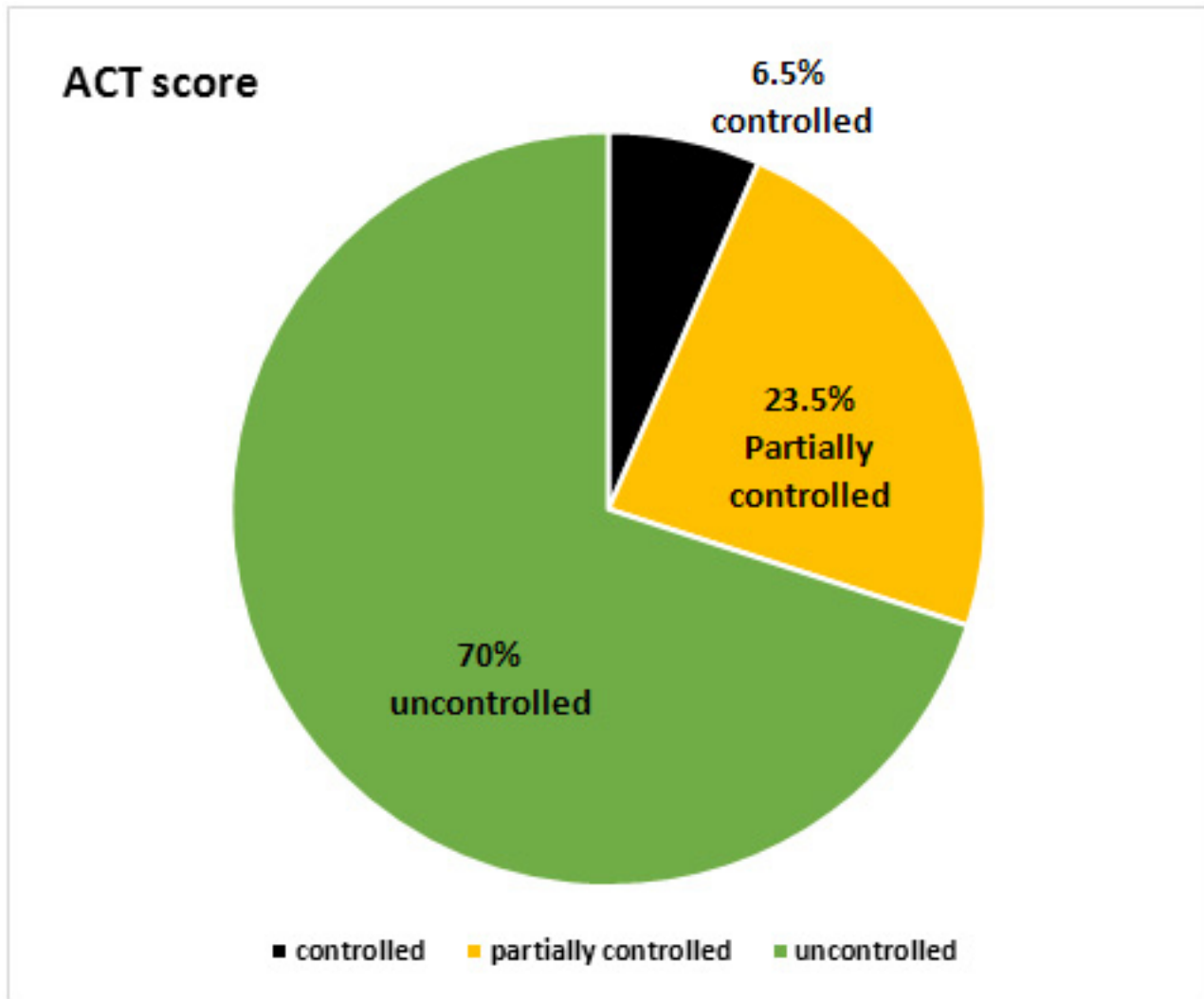


Figure 1 shows that the vast majority of the students (70%) had poor asthma control, (23.5%) reported partial control while (6.5%) reported good control.

Discussion

In Saudi Arabia, asthma is considered the 26th cause of mortality. [11] The prevalence of bronchial asthma is increasing in Saudi Arabia. [12]. The Saudi Initiative for Asthma (2012) reported that the prevalence of asthma in Saudi adults is not well known, but the overall prevalence in Saudi children ranged between 8 to 25 % [13].

The current study aimed to assess the prevalence, risk factors and impact of bronchial asthma on secondary school students in Al Majardah governorate, Aseer region, Saudi Arabia.

This study showed that 13.5% of the students had a history of wheezing while 9.7% of the students were diagnosed with bronchial asthma. This finding was consistent with other studies done in different regions of Saudi Arabia where the prevalence was 9.5% in al Khobar, [14] 9% in Abha, [15] 11.4% in Arar, [16] 13.1% in Al-Taif [17] and 14.1% in Jeddah. [18].

Many global studies reported different rates, for example in Oman 20%, [19] Qatar 19%, [20] and Iran 15.9%. [21] In English-speaking countries, the prevalence ranged from 17 to 30% in the United Kingdom, New Zealand and Australia [22]. In India, the prevalence of asthma varies greatly, ranging from 3.3 to 11.6% , It has been observed that urban areas have a higher prevalence than rural areas. [23] The reasons for such a wide variation in the estimated prevalence could be due to wide differences in samples, different methodologies, lack of consistency in age groups, rural-urban variation, study instruments, and criteria for a positive diagnosis.

In this study, we found that around 13% of all students were exposed to pets and insects, around 30% of students were involved in heavy exercise and around 8% were smokers. When studying the association between such triggers and the occurrence of wheezing, we found that smoking and contact with pets can have a positive association with wheezing attacks among students. In this regard, health education about such triggers is an important part of bronchial asthma management among students.

Regarding asthma control, the current study showed that more than two-thirds of the students had poor asthma control with less than one-third reporting good or partial control. This finding is accordance with other studies conducted in Saudi Arabia among 1009 patients which reported only 30% have controlled asthma. [24] More than half of the students had used their rescue inhaler or nebulizer medication, and also woken up at night or earlier than usual in the morning due to asthma symptoms. Regarding perceived asthma control, 22% thought that their asthma was not controlled at all, while 62% thought that their asthma was well/totally controlled .

Control of asthma is affected by many factors such as exposure to triggers, adherence of patients to their management plans and the use of appropriate anti-asthmatic drugs. In this regard, it is suggested that students with poor asthma control should undergo regular assessment and follow up appointments to identify the reasons and manage accordingly .

Concerning the effect of asthma on childrens' daily life, school, and work, about on third of students reported effects for some time, 9% reported asthma effects all the time and 29% reported no effects at all.

Regarding anti-asthma medications among affected students, we found that around one third had either used intra- muscular steroid injections, Salbutamol syrup or Salbutamol tablets. These findings could be due to a variety of causes such as doctors malpractice or self-prescribing by patients themselves from private pharmacies. This behaviour could explain poor control of asthma in the vast majority of students. In this regard it is suggested there is a need to increase health education for asthmatic students to address self-care issues and for medical practioners and pharmacists as recommended by SINA. [25]

The limitation of our study is that it is a cross-sectional study conducted in schools of one particular area. As a result, genuine prevalence and a direct causal link between risk variables within the community cannot be assumed. Similar studies could be conducted in other areas to gather consolidated data which would be helpful to plan national awareness programmes regarding asthma.

Conclusion and Recommendations

In conclusion, the prevalence of bronchial asthma among secondary school students in this study was within the estimated worldwide ranges despite the high variability for many factors . The students were exposed to some common risk factors like pets, smoking, exercise-induced, and air pollution. The vast majority of the students showed poor asthma control due to multiple factors such as a lack of adherence to medications, use of old medications that are prescribed either by patients themselves or non-updated doctors. This study identified some aspects of bad asthma management that needs urgent action to educate students and their families about the appropriate

management of asthma and to educate health care providers about evidence based guidelines of asthma management. Further studies are urgently needed to explore the magnitude and control of bronchial asthma among students in other governerates in the region.

References

1. Moradi-Lakeh M, El Bcheraoui C, Daoud F, Tuffaha M, Kravitz H, Al Saeedi M, et al. Prevalence of asthma in Saudi adults: findings from a national household survey 2013. *BMC Pulm Med.* 2015;15:77. [PMC free article] [PubMed] [Google Scholar]
2. Burney PG, Luczynska C, Chinn S, Jarvis D. The European Community Respiratory Health Survey. *Eur Respir J.* 1994;7:954–960. [PubMed] [Google Scholar]
3. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *Eur Respir J.* 1995;8:483–491. [PubMed] [Google Scholar]
4. Janson C, Anto J, Burney P, Chinn S, de Marco R, Heinrich J, et al. European Community Respiratory Health Survey II The European community respiratory health survey: what are the main results so far? *European community respiratory health survey II.* *Eur Respir J.* 2001;18:598–611. [PubMed] [Google Scholar]
5. European Community Respiratory Health Survey. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS) *Eur Respir J.* 1996;9:687–695. [PubMed] [Google Scholar]
6. Mahboub BH, Al-Hammadi S, Rafique M, Sulaiman N, Pawankar R, Al Redha AI, et al. Population prevalence of asthma and its determinants based on European community respiratory health survey in the United Arab Emirates. *BMC Pulm Med.* 2012;12:4. [PMC free article] [PubMed] [Google Scholar]
7. Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS) *Eur Respir J.* 1996;9:687–695. [PubMed] [Google Scholar]
8. Modaihsh AS, Mahjoub MO. Falling dust characteristics in Riyadh city, Saudi Arabia during winter months. *APCBEES Procedia.* 2013;5:50–58. [Google Scholar]
9. MacNee W, Donaldson K. Particulate air pollution: injurious and protective mechanisms in the lungs. In: Holgate ST, Samet JM, Koren HS, Maynard RL, editors. *Air Pollution and Health.* London (UK): Academic Press; 1999. pp. 653–672. [Google Scholar]
10. Al-Jahdali HH, Al-Hajjaj MS, Alanezi MO, Zeitoni MO, Al-Tasan TH. Asthma control assessment using asthma control test among patients attending 5 tertiary care hospitals in Saudi Arabia. *Saudi Med J.* 2008;29:714–717. [PubMed] [Google Scholar]
11. Memish ZA, Jaber S, Mokdad AH, AlMazroa MA, Murray CJ, Al Rabeeah AA, Saudi Burden of Disease Collaborators. Peer reviewed: Burden of disease, injuries, and risk factors in the Kingdom of Saudi Arabia, 1990–2010. *Preventing chronic disease.* 2014;11.

12. Al Frayh AS. A 17 year trend for the prevalence of asthma and allergic diseases among children in Saudi Arabia. *Journal of Allergy and Clinical Immunology*. 2005 Feb 1;115(2):S232.
13. Al-Moamary MS, Alhaider SA, Al-Hajjaj MS, Al-Ghobain MO, Idrees MM, Zeitouni MO, Al-Harbi AS, Al Dabbagh MM, Al-Matar H, Alorainy HS. The Saudi initiative for asthma–2012 update: guidelines for the diagnosis and management of asthma in adults and children. *Annals of thoracic medicine*. 2012 Oct;7(4):175.
14. Al-Dawood KM. School boys with bronchial asthma in Al-Khobar City, Saudi Arabia: are they at increased risk of school absenteeism? *J Family Community Med*. 2001; 8(2): 25–33.
15. 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 Med J*. 2000; 21(11): 1048–53.
16. Alruwaili MF, Elwan A. Prevalence of asthma among male 16 to 18-year-old adolescents in the Northern Borders Region of Saudi Arabia. *Electronic Physician* 2018; 10(6): 6920-6926.
17. Hamam F, Eldalo A, Albarraq A, Khaleel M, Kaabi Y, Al Ghamdi A, et al. The prevalence of asthma and its related risk factors among the children in Taif area, Kingdom of Saudi Arabia. *Saudi J Health Sci*. 2015; 4(3): 179-84.
18. Al-Frayh AR, Shakoor Z, Fakhri SAM, Koshak EA, Al Nameem S, Al Ageb A, et al. A 17-year trend for the prevalence of asthma and allergic diseases among children in Saudi Arabia. *Curr Pediatr Res*. 2004;8:1–5.
19. 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* 2003;8(1):6976.
20. Janahi IA, Bener A, Bush A. Prevalence of Asthma among Qatari School children: International Study of Asthma and Allergies in Childhood, Qatar. *Pediatr Pulmonol* 2005;41:80-86.
21. Boskabady MH, Simaei NR. Prevalence of Asthma Symptoms Among High School Students In The City Of Mashhad, North-East Of Iran. *Iran J Med Sci* 1999; 24:48-52.
22. Asher MI, García-Marcos L, Pearce NE, Strachan DP. Trends in worldwide asthma prevalence. *European Respiratory Journal*. 2020 Dec 1;56(6).
23. Al Ghobain, M. O., Algazlan, S. S., & Oreibi, T. M. (2018). Asthma prevalence among adults in Saudi Arabia. *Saudi medical journal*, 39(2), 17 <https://doi.org/10.15537/smj.2018.2.20974>.
24. Al-Jahdali H, Wali S, Salem G, Al-Hameed F, Almotair A, Zeitouni M, et al. Asthma control and predictive factors among adults in Saudi Arabia: Results from the Epidemiological Study on the Management of Asthma in Asthmatic Middle East Adult Population study. *Ann Thorac Med* 2019;14:148-54.
25. Al-Moamary MS, Alhaider SA, Alangari AA, Idrees MM, Zeitouni MO, Al Ghobain MO, Alanazi AF, Al-Harbi AS, Yousef AA, Alorainy HS, Al-Hajjaj MS. The Saudi Initiative for Asthma - 2021 Update: Guidelines for the diagnosis and management of asthma in adults and children. *Ann Thorac Med* 2021;16:4-56
26. A modified translated International Study of Asthma and Allergy in Childhood (ISAAC) questionnaire . https://www.researchgate.net/publication/6675434_ISAAC_International_Study_of_Asthma_and_Allergies_in_Childhood_Manual