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The Prevalence of Asthma and its Related Risk Factors among the Children in Riyadh, Saudi Arabia

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ABSTRACT

Background: The prevalence of asthma has increased considerably in the last few years. This study aimed at assessing the prevalence of asthma and its related risk factors among children in Riyadh, Saudi Arabia.

Methods: A cross sectional prospective study was carried out. Pretested well-designed questionnaires were distributed during the period from May to October 2016.

Results: Parents of 1700 children out of 4000 have completed the questionnaire with a response rate of 42.5%, 1082 (63.6%) of them were male. Asthma prevalence among girls (14.4%) was higher than boys (12.4%), but this difference was insignificant. Asthma prevalence was significantly higher among Saudi participants (14.4%)compared to non- Saudi (5.9%). Nature of residency, the presence of a plant or presence of pets at home had no significant effect on asthma prevalence. A smoking of family member and a history of asthma in the family had an important association on asthma prevalence rate. The highest prevalence of asthma (29.7%) was among the younger children (<3 years). Symptoms of asthma enhanced during exercise. The positive association between asthma and both cough and breathlessness was noted. Asthma had no effect on schools absenteeism, visiting or admission to hospitals. Body mass index had no effect on the prevalence of asthma.

Conclusion: The asthma prevalence rate among children was 13.1%, whereas, smoking and a history of asthma in the family increased this rate. Further studies are recommended to investigate asthma prevalence based on clinical and laboratory diagnosis to explore the link between asthma and obesity.

Keywords: asthma, prevalence, risk factors, Riyadh.

INTRODUCTION

Asthma is considered the major common chronic disease in children; it is characterized by repeated attacks of breathlessness and wheezing. The prevalence of asthma has increased considerably in the last few years in many countries. World Health Organization estimated that 235 million people currently suffer from asthma, thus, placing a huge burden on health resources in many countries [1]. Asthma is one of the most common chronic disorders in Saudi Arabia as more than 2 million Saudis suffer from asthma. . Under diagnosis and under treatment of asthma resulted in a considerable burden on individuals and families and often limits individuals' actions for a lifetime. The prevalence of asthma is on rise in the past few years in many countries including the Kingdom of Saudi Arabia (KSA). The impact of asthma is not confined to the patients themselves, but their families and the community are also affected. The socioeconomic consequences of asthma are manifested in terms of losing work and school absenteeism, low quality of life, repeated visits to emergency rooms, hospitalizations, and finally deaths [2-5]. Although asthma is a non-curable chronic disease; it has a relatively low mortality rate compared to similar chronic diseases. Local reports in the Kingdom suggested that the prevalence of asthma is increasing in spite of the abundance of high quality health services and the availability of worldwide guidelines. For example,

Al Frayh et al. [6] conducted a 9-year cross-sectional study to compare the prevalence rate of asthma among school children living in different regions of the Kingdom (Riyadh vs. Hail, Jeddah vs. Gizan). This study had shown that the prevalence of bronchial asthma among school children in the similar individuals increased considerably from 8% in 1986 to 23% in 1995. Furthermore, it indicated high exposure to environmental causes of asthma (smoking and indoor pets), probably through fast changes in the lifestyle of Saudi society (effects of modern life). A cross sectional questionnaire study was carried using 1,020 urban and 424 rural 12-year-old children. The prevalence of allergic symptoms was significantly higher in urban children than in rural

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children, and among Saudi compared to non Saudi Arab children. This study found that socioeconomic status had no effect on the prevalence of asthma. An interesting finding of this study was an increase in the prevalence of allergic disease among Saudi children while non-Saudi children have not been affected [7]. Children aged 7–12 years were investigated for asthma patterns using a cross sectional questionnaire based study in two regions (Dammam vs. Riyadh) of Saudi Arabia (1986–1989). Symptoms of wheezing, rhinitis, and eczema among children in Riyadh were more common than their counterparts in Dammam. Asthma prevalence (9.28%) is significantly ($P < 0.05$) higher among children in Riyadh compared to children in Dammam (3.59%). This study found a statistically significant link between asthma and breathlessness, father smoke, having pets, usually cough, and family history of allergy. A cross-sectional study compared the prevalence of physician-diagnosed asthma among Saudi school children in an industrial city of Yanbu, to 2 non-industrial communities (Al Furash and Al Gafur). The prevalence of asthma in Yanbu (13.9%) was much higher than the villages (8%)[8]. ***Al Kabbaa et al.*** [9] found that only 39% of primary care health workers meet the standards of the domestic guidelines in asthma management. Further, the general level of awareness among physicians was poor (52%). Their skills in overall knowledge, diagnosis, arrangement of severity, and management of asthma was also poor. The prevalence of asthma and related symptoms in 16 to18 year old youths (1504 boys and 1569 girls) going to high schools in Riyadh was investigated using the International Study of Asthma and Allergies in Children questionnaire. This questionnaire diagnosed asthma revealed that the prevalence of lifetime wheeze (25.3%), wheeze during the last 12 months (18.5%), and physician diagnosed asthma (19.6%). The prevalence rate of exercise triggered wheezing and coughing during the night in the last 12 months was 20.2% and 25.7%, respectively [10]. The general prevalence of asthma among Saudi children was reported to be from 8%to 25%, the highest prevalence (25%) of physician diagnosed asthma in KSA was reported by Sobki and Zakzouk in 2004[11]. In conclusion, epidemiological studies in Saudi Arabia showed the prevalence of asthma is on rise in the past 30 years, probably due to fast changes in lifestyle related to the modernization of Saudi society, changes in food habits, and increased exposure to environmental causes of asthma such as indoor allergens. Moreover, the increase in asthma prevalence could be explained in terms of an increase in awareness of asthma among the general public and healthcare workers. Thus more individuals were diagnosed with asthma. It is very clear that from previously mentioned studies, there is a hole in the scientific literature concerning the prevalence of asthma in the Riyadh area. This study focused on evaluating the link between asthma and its related risk factors among children in Riyadh city, and to compare these results and relate them to the sex of participants, a range of environmental causes of asthma (e.g., indoor allergen, outdoor allergen, tobacco smoke, and air pollution), and genetics. It explored the link between asthma, and the use and appropriateness of prophylactic drugs, visiting a family doctor, admission to a hospital, and prevalence of asthma. Finally, it compared asthma prevalence among the residence in different areas of the Riyadh city.

MATERIALS AND METHODS

Study design

A cross sectional study was conducted during the period from May to October 2016.

Study area and study population

The study included 40 children attending schools, or two major hospitals in Riyadh city during the time of the study. A consent form was explained by members of the research team, and signed by the parent's prior the completion of the questionnaire.

Sampling technique and sample size

A convenient sampling method was adopted. A total of 4000 questionnaires were distributed to representative schools in the four regions of Riyadh city as well as to the outpatient clinics of the collaborating hospitals.

Study instrument

A pre-tested and pre-coded questionnaire was explained by a member of the research team and completed by the parents. This questionnaire explored the association of asthma and the environmental factors, including indoor allergen (e.g., pets at home such as bird, cat), outdoor allergen (e.g., pollens and molds), presence of a smoking family member, and air pollution (i.e., living near industrial zones). It also explored the link between asthma and age (<3, 3–6, 6–12, and12–18 years). Visit the emergency room,

admission to a hospital, and the use and appropriateness of prophylactic drugs were other variables that were investigated by this questionnaire.

Data analysis and statistical tests

Data were analyzed using the Statistical Package for Social Sciences (IBM SPSS, version 22, Armonk, NY: IBM Corp.).Mean, frequencies as percentages were used to describe variables. Chi square analysis was used to test the association between the participants' demographic characteristics and the variables. One-way ANOVA, Tukey test was used to calculate the statistical significance among several variables, assuming equal variance. The significance of the differences was calculated at a 95% confidence interval (CI), and $P < 0.05$was considered as statistically significant. The study was revised and ethically approved by Almaarefa Colleges, College of Medicine and Surgery. Permission was obtained from the Ministry of Education, Riyadh and the administration of two participated hospitals.

RESULTS

Four thousand questionnaires were distributed to the parents in the six selected locations. Parents of 1700 children gave their consent and have completed the questionnaires with response rate (42.5%), 1082 (63.6%) out of the participants were male. Asthma prevalence rate among girls (14.4%)was higher than boys (12.4%) but this was statistically insignificant ($P > 0.05\%$) [Table1]. Majority of participants 1460 (85.9%) were Saudi, while only 205 (12.1%) were non-Saudi [Table1]. Asthma rate was significantly ($P < 0.05$) higher among Saudi children (14.4%) than non-Saudi (5.9%) [Table1]. The majority of participants 1329 (96.1%) live in Riyadh city while only 54 (3.9%) live in rural areas around Riyadh [Table1]. However, the rate of asthma was higher in rural areas (16.7%) than urban areas (12.4%) but this difference was insignificant ($P > 0.05$). Nature of residency (i.e. villa, condo, and popular house) has no effect on asthma [Table 1]. Furthermore, the presence of a plant at home had no significant effect ($P = 0.907$) on the prevalence of asthma [Table 2]. Although 16.6% of asthmatic participant mentioned that they have pets at home compared to 12.8% of asthmatic children that they do not have them, this factor seemed to have unpronounced ($P = 0.132$) impact on asthma rate. Smoking of a family member has a significant ($P < 0.001$) positive impact on asthma prevalence rate among asthmatic children (39.0%) compared to non-asthmatic (8%) [Table2]. Age of participations was divided into four categories: <3, 3–6,6–12, and 12–18. The highest prevalence of asthma (29.7%)was reported among the younger children (<3 years), followed by the group aged 3–6 years (28.9%), the lowest prevalence (11.1%) was reported for children aged 12–18 years [Table 1]. Results revealed that prevalence of asthma is decreasing significantly ($P = 0.001$) as the children getting older There was a significant ($P = 0.003$) association between asthma prevalence rate and genetics, as 17.1% of asthmatic children have their parents suffer from bronchial asthma while only 11.6% of non-asthmatic children have normal (no signs of asthma) parents [Table2]. Table 2 shows asthma rate among the six different data collection sites. School children in Riyadh North showed the highest asthma rate (14.0%) among their counterparts living in other places of Riyadh city, whereas Riyadh South showed the lowest asthma rate (6.1%) [Table2]. Results of the current study indicated that there was a significant difference ($P < 0.001$) in asthma prevalence between these four regions [Table 2]. When comparing asthma rates among children visiting the Al Ymamamah Hospital and King Saud Medical City, it was very clear that asthma prevalence rate (34.1%) was considerably ($P < 0.001$) higher among asthmatic children at the Al Ymamamah Hospital than those visiting the King Saud Medical City [Table 2]. Results of this study indicated that body mass index (BMI) had no significant effect ($P > 0.05$) on asthma [Table 2]. Figure 1 showed the percent of asthma symptoms among asthmatic children in Riyadh city. Results revealed that cough was the most frequent occurred symptoms (33.7%) among asthmatic children. Difficulties in breathing were ranked the second common symptom (21%) while the wheezing prevalence was the least frequent occurred symptom (3.4%). Figure 2 showed that 58.8% of participants used inhalation bronchodilator for the treatment of asthma while 20.0% of asthmatic children used syrup. One interesting finding of this study was the time of diagnosis of asthma. About half (48.1%)of children suffer from asthma symptoms were diagnosed less than 1 year from the start of the present study [Figure 3]. When the parents have been asked about

frequency of their children suffer from asthma symptoms in the past 6 months. One third of the respondents (33%) indicated that their asthmatic children had asthma symptoms once per season. While 25% of children mentioned that, their children did not experience asthma in the last 6 months. Asthmatic children that experienced symptoms more frequently were (once per month) constitute 16% [Table 3]. The majority of asthmatic participants 109 (52.7%) (Data not shown) experienced symptoms during exercise, while 98 (47.3%) (Data not shown) of children did not have exercise induced asthma symptoms. Most of the asthmatic children participating in this study visited a family doctor once per season (51.4%) in the last 6 months, while 14.0% of children have seen their doctor once per month, and 11% have mentioned that they visited their doctors once per 3 months [Table 3]. Table 3 showed that the majority of asthmatic children (56.5%) did not experience difficulties in sleeping due to asthma during the last 6 months, where 23.6% of children with asthma had difficulties in sleeping. Regarding the effects of asthma on school absenteeism, 56% of participated asthmatic children did not absent from their schools in the past academic year, while the remaining (44%) were absent from school at varying levels. In the same context, 73.0% of asthmatic children never admitted to a hospital for the past 6 months, while 18% of the participants said that they have been admitted to a hospital once in the past 6 months.

Table 1: Demographic characteristics of school children and out patient visitors' participants

Demographic Characteristics	Total (%) Frequency	Asthmatic (%)		value
		Yes	No	
Gender				
Male	1082 (63.6)	134 (12.4)	947 (87.6)	0.234
Female	617 (36.4)	89 (14.4)	528 (85.6)	
Nationality				
Saudi	1460 (85.9)	210 (14.4)	1249 (85.6)	0.001
Non Saudi	205 (12.1)	12 (5.9)	193 (94.1)	
Age (years)				
<3	64 (3.8)	19 (29.7)	45 (70.3)	0.001
3-6	45 (2.7)	13 (28.9)	32 (71.1)	
6-12	953 (56.1)	121 (12.7)	832 (87.3)	
12-18	630 (37.2)	70 (11.1)	560 (88.9)	
Residency				
Riyadh city	1329 (96.1)	165 (12.4)	1163 (87.6)	0.357
Riyadh suburbs (Villages)	54 (3.9)	9 (16.7)	45 (83.3)	
Nature of residency				
Villa	389 (25)	48 (12.4)	340 (87.6)	0.671
Condo	967 (56.9)	113 (11.7)	854 (88.3)	
Popular house	202 (11.9)	20 (9.9)	182 (90.1)	

Table 2: The relation between prevalence of asthma and different risk factors

Risk factor	Total (%) Frequency	Asthma (%)		*P* value
		Yes	No	
Presence of plant				
Yes		84 (13.4)	542 (86.6)	0.907
No		138 (13.2)	906 (86.8)	
Presence of pet				
Yes		34 (16.6)	171 (83.4)	0.132
No		189 (12.8)	1290 (78.2)	
Living near Industrial zone				
Yes		19 (11.7)	144 (88.3)	0.52
No		204 (13.5)	1312 (86.5)	
Smoking of family member				
Yes		108 (39.0)	169 (61.0)	<0.001
No		112 (8.0)	1294 (92.0)	
Asthmatic parent (s)				
Yes		81 (17.1)	392 (82.9)	0.003
No		140 (11.6)	1065 (88.4)	
Body mass index				
Underweight		55 (14.3)	329 (85.7)	>0.05
Normal		12 (5.5)	208 (94.5)	
Overweight		11 (14.3)	66 (85.7)	
Obese		11 (9.7)	102 (90.3)	
Location of data collection				
KSMC	55 (3.2)	13 (23.6)	42 (76.4)	<0.001
Alymamamah Hosp.	127 (7.5)	43 (34.1)	83 (65.9)	
Riyadh East	312 (18.4)	29 (9.3)	283 (90.7)	
Riyadh West	351 (20.6)	46 (13.1)	305 (86.9)	
Riyadh South	346 (20.4)	21 (6.1)	325(93.9)	
Riyadh North	509 (29.9)	71 (14.0)	437 (86.0)	

Table 3: Signs of asthma and its effects on children

Signs								
Suffering from asthma	Never	1/week	1/2 week	1/month	1/2 months	1/3 months	1/6 months	1/ season
symptoms e.g., wheezing.	25.3%	6.6%	3.5%	16.2%	4.0%	5.1%	6.1%	33.3%
Sleeping difficulties	Never	Daily	<2/week	>2/week	2/month	>2/month		
	56.5%	5.8%	4.2%	2.6%	23.6%	7.3		
Effects								
	1/week	1/2 weeks	1/month	1/2 months	1/3 months	1/6 months	1/season	
Visited family doctors	4.4%	5.5%	14.4%	6.6%	11.0%	6.6%	51.4%	
Absent from school	Never	1/month	1/2 week	or more/week				
	55.7%	19.0%	10.9%	14.4%				
Admission to hospital	Never	1/last 6 months	2 or more/ Last 6 months					
	73%	18%	9%					

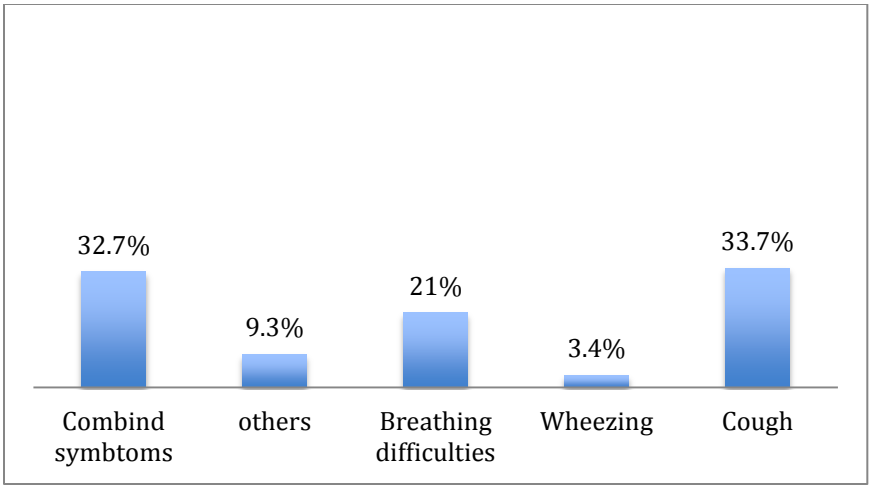

Figure 1: Symptoms of asthma among asthmatic children

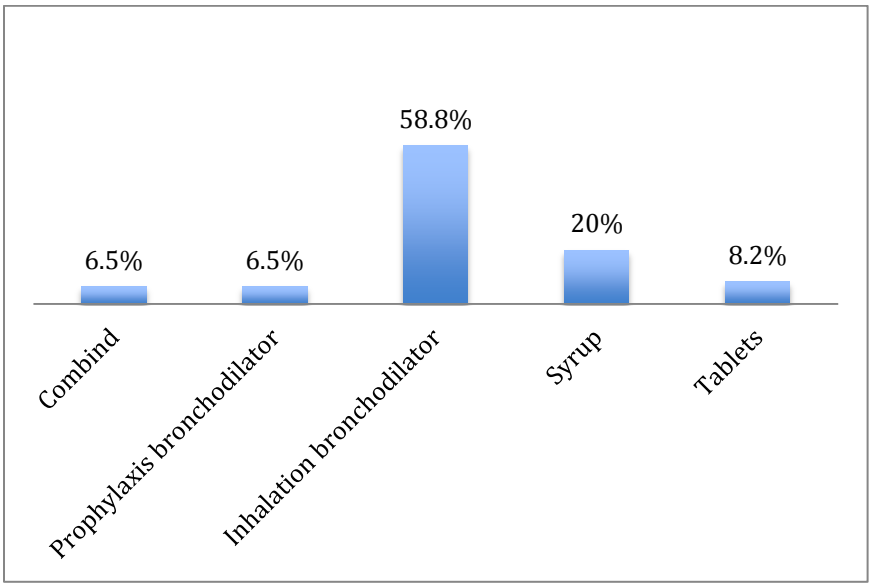

Figure 2: Type of treatment of asthmatic children

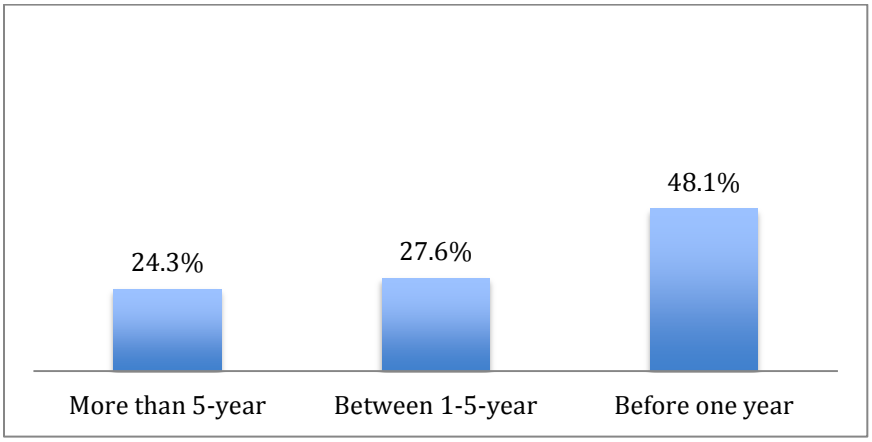

Figure 3: Diagnosis time of asthma among participated asthmatic children in Riyadh (n = 1700)

DISCUSSION

Parents of 1700 children gave their consent and have completed the questionnaires with more male participants. Asthma prevalence rate among girls was higher than boys. Average asthma prevalence rate (13.4%) among children was higher than that found in Riyadh (9.28%) and Dammam (3.59%)[5]. On contrast, asthma prevalence of the present study was within the national range (8–23%) in the Kingdom [6]. It was also agreed with those of ***Bener et al.*** [12], who found that the prevalence of asthma in Yanbu, Saudi Arabia was 13.9%. Asthma rate was higher among Saudi children than non-Saudi. Our results agreed with those of ***Bener et al.*** [8], who found higher rate of allergic disease among Saudi children than non-Saudi. The difference in asthma rate among Saudi and non-Saudi children live in the same urban was interesting. The exact nationality of each non-Saudi child was not included in the questionnaire. It would be difficult to explain the low rate of asthma among non-Saudi children. Therefore, further studies should be conducted to investigate differences in asthma rate between these two groups living in Riyadh area. The majority of participants live in Riyadh city while only few live in rural areas around Riyadh. However, the rate of asthma was higher in rural areas than urban areas. Theoretically, asthma rate should be higher in children in an urban environment than rural areas, possibly due to increased aeroallergen (indoor and outdoor). Results presented here disagreed with other studies. [8,7] For example, ***Bener et al*** [12] found that physician diagnosed asthma rate in the industrial city of Yanbu (13.9%) was higher than the corresponding rate (8%) in two non-industrial villages. Nature of residency (i.e. villa, condo, and popular house) has no effect on asthma. Furthermore, the presence of a plant at home had no effect on the prevalence of asthma. Although most of asthmatic participant mentioned that they have pets at home compared to other asthmatic children that they do not have them, this factor seemed to have unpronounced impact on asthma rate. Our results were inconsistent with those of ***Al Dawood***, [3] who found a positive link between asthma and presence of pets at homes of schoolboys in Al Khobar city, KSA. ***Al Frayh et al.*** reported a similar association [6]. Smoking of a family member has a positive impact on asthma prevalence rate among asthmatic children compared to non-asthmatic. This finding clearly indicated that increase exposure to tobacco enhances prevalence of asthma via irritating inflamed bronchial airways. The positive association between smoking tobacco and asthma of this study is consistent with several research works that have been conducted in KSA and in the globe [3, 5,6,12]. For example, ***Al Frayh et al.*** [6] found that 17% of asthmatic children had at least one or more family members were cigarettes smoker. Age of participations was divided into four categories, the highest prevalence of asthma was reported among the younger children (<3 years), followed by the group aged 3–6 years, the lowest prevalence was reported for children aged 12–18 years. Results revealed that prevalence of asthma is decreasing significantly as the children getting older, possibly airways could develop some kind of protection with advancing age. Our results agreed with those of ***Al Frayh et al.*** [6], who found that asthma rate decreases as age increases. There was a significant association between asthma prevalence rate and genetics, as most of asthmatic children have their parents suffer from bronchial asthma while only few of non-asthmatic children have normal (no signs of asthma) parents. Our results show asthma rate among the six different data collection sites. School children in Riyadh North showed the highest asthma rate among their counterparts living in other places of Riyadh city, whereas Riyadh South showed the lowest asthma rate. Results of the current study indicated that there was a significant difference in asthma prevalence between these four regions. It could be explained through increased aeroallergen in Riyadh North, possibly due to the presence of many farms, the industrial zone, Riyadh International Airport, and the airbase. Although children living near the industrial zone in Riyadh South did not exhibit the same rate of asthma. Thus, further studies should be conducted to investigate these results. When comparing asthma rates among children visiting the Al Ymamamah Hospital and King Saud Medical City, it was very clear that asthma prevalence rate was considerably higher among asthmatic children at the Al Ymamamah Hospital than those visiting the King Saud Medical City. Results of this study indicated that body mass index (BMI) had no significant effect on asthma. Furthermore, further statistical analysis confirmed such a result as 95% CIs were insignificant. This finding regarding the relationship between BMI and asthma was against

expectation. Obese people tend to have under-expanded lungs, and the size of breath is smaller than normal non-obese persons. Furthermore, obese persons have low-grade systemic inflammation that stemmed from inflammation of fat tissues. Therefore, these factors may cause narrowing of lung airways. Another biochemical effect of obesity is variations in the level of serum leptin.

These unexpected results should be thoroughly investigated in future. Pulmonary function test (screening for lung capacity), allergy skin pick test, plasma total IgE levels, blood eosinophil counts, and serum leptin levels should be examined, and compared among asthmatic and non-asthmatic obese children.

Results revealed that cough was the most frequent occurred symptoms among asthmatic children. Difficulties in breathing were ranked the second common symptom while the wheezing prevalence was the least frequent occurred symptom. The results presented in this study showed a significant positive association between prevalence of asthma and both cough and breathlessness. ***Bener et al.*** [8] found that the frequency of cough, breathlessness, and wheezing among children in Riyadh was 7.9%, 12.13%, and 11.86%, respectively. Furthermore, these symptoms were occurring more frequently in Riyadh (dry inland) compared to Dammam (humid-coastal). Our results showed that most of participants used inhalation bronchodilator for the treatment of asthma while few of asthmatic children used syrup. One interesting finding of this study was the time of diagnosis of asthma.

About half of children suffer from asthma symptoms were diagnosed less than 1 year from the start of the present study. When the parents have been asked about frequency of their children suffer from asthma symptoms in the past 6 months. One third of the respondents indicated that their asthmatic children had asthma symptoms once per season. While some of children mentioned that, their children did not experience asthma in the last 6 months. Asthmatic children that experienced symptoms more frequently were (once per month) constituted. The majority of asthmatic participants experienced symptoms during exercise, while half of children did not have exercise induced asthma symptoms. ***Al Moamary et al.*** [2] found that exercise stimulated wheeze (57.4%) in school children in Riyadh. ***Matsumoto et al.*** [12] found that a 6-week swimming program has a protective role against exercise-triggered asthma. Exercise stimulated asthma could be due to a change in osmolarity of the lining fluid of the airways, possibly due to heat and water loss to the inspired air [12]. However, the exact mechanism is still not fully understood, and thus, further studies should be carried out to investigate such mechanism. Most of the asthmatic children participating in this study visited a family doctor once per season in the last 6 months, while few of children have seen their doctor once per month, and little have mentioned that they visited their doctors once per 3 months. ***Al Dawood.*** [3] found that 65.2% of children in Al Khobar city have visited a hospital emergency service in the present academic year compared to 34.8% of asthmatic school boys have used such services.

In this study showed that the majority of asthmatic children did not experience difficulties in sleeping due to asthma during the last 6 months, where some of children with asthma had difficulties in sleeping. Regarding the effects of asthma on school absenteeism, half of participated asthmatic children did not absent from their schools in the past academic year, while the remaining were absent from school at varying levels. ***AlDawood.*** [3] reported that the mean period of school absenteeism (13.6 ± 3.4) in an academic year among asthmatic schoolchildren in Al Khobar city (KSA). In the same context, most of asthmatic children never admitted to a hospital for the past 6 months, while few of the participants said that they have been admitted to a hospital once in the past 6 months. ***Al Dawood.*** [3] found similar results as 87.9%of schoolboys of Al Khobar city never admitted to a hospital because of asthma.

CONCLUSION

The asthma prevalence rate among children was 13.1% within the national range (8–23%) in the Kingdom, whereas smoking and a history of asthma in the family increased this rate.

Future studies are recommended to investigate asthma prevalence based on clinical and laboratory diagnosis to explore the link between asthma and obesity.

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