

Regional Variation in the Prevalence of Asthma Symptoms among Omani School Children

Comparisons from Two Nationwide Cross-sectional Surveys Six Years Apart

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التباين الإقليمي في انتشار أعراض الربو بين أطفال المدارس العمانيين مقارنة بين مسحين مقطعيين بينهما ست سنوات

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المخلص: الهدف: أكدت الدراسة الدولية للربو وأمراض الحساسية عند الأطفال (ISAAC - ايزاك) وجود اختلاف واسع في انتشار الربو بين مختلف الدول وحتى في نفس الدولة. ويهدف هذا البحث إلى تحديد الاختلاف في مدى انتشار الربو وأعراضه بين أطفال المدارس في المناطق المختلفة بالسلطنة. **الطريقة:** قمنا ضمن دراسة " ايزاك " بعمل مسحين مقطعيين: الأول عام 1995 (المرحلة الأولى من ايزاك) والثاني عام 2001 (المرحلة الثالثة من ايزاك) يشملان مرحلتين عمريتين - الصغار (6-7 سنوات) و الكبار (13-14 سنة) من طلاب المدارس بمختلف مناطق السلطنة. وقد شارك في المسح الأول 7067 طالبا (3893 من فئة الصغار و 3174 من فئة الكبار) وفي الثاني 7879 طالبا (4126 من فئة الصغار و 3753 من فئة الكبار). **النتائج:** بعد مرور ست سنوات من الدراسة الأولى استمرت منطقة الشرقية بإظهار أعلى معدل للإصابة بالربو وأعراضه في المرحلتين العمريتين مع ارتفاع واضح في معدل انتشار الصفير الصدري (من 8.7% إلى 13.8%) وكذلك في تشخيص الربو (من 13.8% إلى 17.8%) في الصغار. كما تم اكتشاف ارتفاع واضح في السعال الليلي في الكبار (من 21.6% إلى 27.8%). أما بالنسبة لبقية المناطق فقد ظلت نسب انتشار أعراض الربو ثابتة بين المسحين مع وجود هبوط طفيف في بعض المناطق. أما تشخيص الربو بين الأطفال المصابين بالصفير الصدري فقد ظل كما هو في كل المناطق بالسلطنة. كما ظلت نسبة الربو غير المشخص مرتفعة حيث أن (60%) فقط من الأطفال ذوي الصفير الصدري الشديد أقرروا بتشخيص الربو لديهم في كلا المسحين. **الخلاصة:** تؤكد هذه الدراسة وجود اختلاف في مدى انتشار الربو وأعراضه بين أطفال المدارس بالمناطق المختلفة بالسلطنة. مع وجود ارتفاع واضح في منطقة الشرقية. كما تبين الدراسة ضعف نسبة تشخيص الربو عند هؤلاء الأطفال.

مفتاح الكلمات: الربو . انتشار . أطفال . يافعين . عمان.

ABSTRACT Objectives: The International Study of Asthma and Allergies in Children (ISAAC) highlighted the presence of wide variations in asthma prevalence between and within countries. The aim of this study was to determine the changes in the prevalence of asthma and its symptoms across the different regions of Oman. **Methods:** Two cross-sectional surveys were conducted as part of ISAAC phases I (1995) and III (2001) in two age groups (6-7 and 13-14 years) from nation-wide samples of Omani school children, with 7,067 participants in 1995 (3,893 young and 3,174 older group) and 7,879 participants in 2001 (4,126 young and 3,753 older group). **Results:** Over the period of six years, the Sharqiya (Eastern) region continued to have the highest prevalence of self-reported asthma diagnosis and all asthma symptoms in both age groups, with a significant increase in the prevalence of wheeze in the past 12 months (from 8.7% to 13.8%; $p=0.002$) and asthma diagnosis (from 13.8% to 17.8%; $p=0.046$) in the young group, and a significant increase in night cough (from 21.6% to 27.8%; $p=0.039$) in the older group. All other regions had lower prevalence rates in 1995 in both age groups, and showed either no significant change or a decline in one or two of the self-reported asthma symptoms. The prevalence of asthma diagnosis among wheezy children remained unchanged across all regions. In addition, asthma under-diagnosis remains a problem with only 60% of children with severe wheeze reporting asthma diagnosis in both surveys. **Conclusion:** The geographic variation in the prevalence of self-reported of asthma symptoms among Omani school children persists with further increase in the Sharqiya region. The findings also suggest under-diagnosis and/or poor recognition of asthma which had not improved over time.

Key words: Asthma, prevalence; Children; Adolescents; Oman.

Advances in Knowledge:

The ISAAC project in Oman provided the first insight into the prevalence of asthma and its symptoms in Omani school children and this ISAAC Phase III survey reveals the following:

- Asthma symptoms in Omani children are not only common, but also associated with a relatively high frequency of severe symptoms such as frequent wheeze and speech limiting wheeze.
- There is also a significant difference in the prevalence of asthma and symptoms between the different regions of Oman, the cause of which is unclear and merits further evaluation.
- There was worrisome under-diagnosis of asthma in children all over Oman and this had not improved between the two surveys.

Application to Patients Care:

- Alerts healthcare providers to the burden of asthma and its symptoms
- Highlights the need to consider asthma in children with respiratory symptoms so that appropriate treatment can be initiated promptly.

ASTHMA IS ONE OF THE MOST COMMON chronic conditions in children and is a major global health problem.^{1,2} It is also perceived to be one of the most common chronic conditions in Oman. Studies from many different countries showed that the prevalence of asthma has been increasing over the last three decades and the results of the International Study of Asthma and Allergies in Childhood (ISAAC) confirmed the wide international variation in the prevalence of asthma diagnosis and symptoms.^{3,4}

Asthma management has many components; the first of which is surveillance, which determines how much asthma exists in the population, how severe it is and how well it is being detected and controlled. Such data enable healthcare providers to make evidence-based decisions in the development of asthma control programs.²

Our participation in ISAAC phase I (conducted in 1995), yielded the first epidemiological survey into symptoms of asthma in Oman, and revealed that asthma diagnosis and symptoms in Omani children are not only common, but also associated with a relatively high prevalence of symptoms indicative of severe or uncontrolled asthma (sleep-disturbing wheeze, speech-limiting wheeze and frequent attacks of wheeze).^{5,6} In addition, these results suggested under-diagnosis and/or undertreatment of asthma in these children. We also found a wide variation in the prevalence of asthma diagnosis and symptoms among the different geographical regions of the country with the Sharqiya (Eastern) region scoring the highest prevalence rates of self-reported asthma diagnosis and all asthma symptoms in

both age groups.⁵

The aim of this study was to evaluate the changes in the prevalence of asthma symptoms and severity among Omani schoolchildren across the different geographic regions of Oman by comparing the data from ISAAC phases I (1995) and III (2001).

METHODS

The details of study design and methods have been previously described.^{5,6} The study used the data collected in two ISAAC surveys 6 years apart (Phase I in 1995 and Phase III in 2001) using identical ISAAC protocols during the same month of the year (April).^{7,8} In both surveys, the total national target samples were randomly selected from the ten administrative (representing the eight geographical) regions of Oman using the proportion allocation method. The total number of distributed questionnaires (Arabic version) was 7,625 (4,079 aged 6–7 years and 3,546 aged 13–14 years) in 1995 and 8,080 questionnaires (4,235 aged 6–7 years and 3,853 aged 13–14 years) in 2001. The study design and data quality assurance followed the ISAAC protocol in all aspects, including the double entry of data and translation guidelines.

In Phase III, in addition to the written questionnaire, 13–14 year old children completed the ISAAC asthma video questionnaire.⁸ The international version of the ISAAC video shows young adults from a variety of ethnic backgrounds manifesting different symptoms of asthma during a set of five different short sequences as follows: wheezing at rest, wheezing after exercise, waking at night by wheezing, night cough,

Table 1: Regional distribution of the two age groups in two surveys ISAAC Phases I (1995) & III (2001)

Region	6-7 year age group		13-14 year age group	
	ISAAC Phase I number (% of total sample)	ISAAC Phase III n (%)	ISAAC Phase I n (%)	ISAAC Phase III n (%)
Muscat	518 (13.7)	639 (16.0)	507 (16.5)	636 (17.3)
Batinah	1167 (30.9)	1519 (38)	975 (31.7)	1291 (35.2)
Dakhiliya	550 (14.6)	434 (10.9)	485 (15.7)	551 (15)
Sharqiya	665 (17.6)	730 (18.3)	384 (12.5)	507 (13.8)
Dhahirah	384 (10.2)	355 (8.9)	353 (11.5)	340 (9.3)
Dhofar	493 (13.1)	319 (8)	376 (12.2)	345 (9.4)
Total national sample	3777 (100)	3996 (100)	3080 (100)	3670 (100)

and severe wheeze. After each scene, the children ticked the answer whether or not they experienced the same problems with breathing as the person in the video ever in life and if yes, whether in the past 12 months. The terms asthma and wheezing were not mentioned in the video questionnaire in order to avoid language problems.

The primary outcome measure was the changes in the prevalence of wheeze in the past 12 months, “cur-

rent wheeze” and self-reported asthma diagnosis. Secondary outcome measures included the prevalence of exercise induced wheeze, night cough and symptoms suggestive of severe asthma. For the purpose of this analysis severe asthma was defined as the presence (positive response to the written questionnaire) of one or more of any of the following during the past 12 months: frequent wheeze (four or more wheezing attacks), frequent sleep disturbance (one night or more

Table 2: Regional difference in the prevalence (%) of asthma symptoms and diagnosis in 6-7 year age group: Comparison between ISAAC Phases I (1995) and III (2001)

Region	12 Month Prevalence of									
	Any wheeze		Exercise wheeze		Night cough		Severe asthma symptoms		Ever had Asthma	
	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III
Muscat	5.4	7.2	5.6	4.4	17.8	16.6	4.2	3.3	9.5	9.7
Batinah	7.4	7.5	6.4	5.7	18.1	15.0*	6.3	4.8	9.4	8.8
Dakhiliya	7.5	5.8	7.5	5.3	20.7	13.4 *	7.6	3.5*	12.2	7.8*
Sharqiya	8.7	13.8	9.0	10.3	25.6	27.3	7.4	8.6	13.8	17.3 *
Dhahirah	6.3	7.0	6.8	7.0	20.6	16.6	5.2	4.8	6.8	9.9
Dhofar	6.3	6.6	7.1	5.6	16.2	22.6*	4.9	3.4	11.8	11.6
Total sample	7.2	8.3 *	7.0	6.4	19.8	18.1 *	6.1	5.0*	10.6	10.7

*Significant change in prevalence ($p < 0.05$) between the two surveys adjusted for sex

Table 3: Regional difference in the prevalence (%) of asthma symptoms and diagnosis in 13-14 year age group: comparison between ISAAC Phases I (1995) and III (2001)

Region	12 Month prevalence of									
	Any wheeze		Exercise Wheeze		Night Cough		Severe Asthma Symptoms		Ever had Asthma	
	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III	Phase I	Phase III
Batinah	11.9	10.6	23.1	20.8	21.7	19.1	8.8	6.4 *	24.5	19.3*
Dakhiliya	5.8	5.6	16.9	20.9	19.2	17.8	3.3	4.2	20.2	24.7
Sharqiya	11.2	12.6	25.0	21.9	21.6	27.8*	7.8	7.5	28.6	28.8
Dhahirah	7.9	11.5	17.8	17.4	19.0	20.0	5.4	7.4	15.0	15.0
Dhofar	7.7	4.3	17.6	13.9	21.8	16.5	5.6	3.5	13.8	12.5
Total sample	9.0	8.5	19.4	18.7	20.9	20.1	6.4	5.4 *	21.1	20.0

*Significant change ($p < 0.05$) in prevalence adjusted for sex

per week) and/or speech limiting wheeze.⁶

Ethical approval of the study protocol was obtained from both the Ministry of Health and the Ministry of Education.

Data were collected and entered according to the ISAAC protocol and were analysed using the Statistical Package for the Social Sciences (SPSS) package for Windows, Version 13 (SPSS Inc., Chicago, IL, USA). Prevalence estimates were calculated by dividing the number of positive responses to each question by the total number of completed questionnaires. As the changes in males and females were very similar (both in the direction and magnitude of change), the findings were presented for both sexes combined adjusted for sex. Comparisons between the two surveys were performed using the Pearson Chi-square test and results were adjusted for sex using logistic regression analysis. A p value of <0.05 was considered statistically significant.

RESULTS

The sex distribution in the total national sample as well as regional samples was nearly equal for both groups and both surveys. Because of the small sample size of the Musandam and Wusta regions, the observed changes between the two surveys in these two regions may not be reliable and therefore were not included in the trend analysis. Table 1 shows the regional distribution of the two age groups for both surveys (Phase I in 1995 and Phase III in 2001). Table 2 shows the changes in the prevalence of asthma diagnosis and its symptoms in the 6 to 7 year old age group. There

was no significant change over the 6 year period in the nationwide prevalence of self-reported asthma or any of the listed asthma symptoms except for wheeze in the last 12 months which had slightly increased from 7.2% to 8.3% ($p = 0.041$). This was mainly driven by the high increase in the Sharqiya region from 8.7% to 13.8% ($p = 0.002$). The Sharqiya region had the highest prevalence of parent-reported asthma diagnosis and symptoms in both surveys with a significant increase in self-reported asthma from 13.8% in 1995 to 17.8% in 2001 ($p = 0.046$). On the other hand, the Dakhiliya (Interior) region had a significant drop in the prevalence of asthma diagnosis (from 12.2% to 7.8%; $p = 0.016$), night cough (from 20.7% to 13.4%; $p = 0.003$) and symptoms of severe asthma (from 7.6% to 3.5%; $p = 0.005$). There were no significant changes in asthma diagnosis and symptoms in any of the remaining regions (Muscat, Batinah, Dhahirah and Dhofar), except for night cough which increased in Dhofar (from 16.2% to 22.6%; $p = 0.025$); and decreased in Batinah (18.1% to 15%; $p = 0.039$).

Table 3 shows the changes in the prevalence of asthma diagnosis and symptoms between Phase I and Phase III surveys in the 13-14 year old age group. Again, the Sharqiya region had the highest prevalence of asthma diagnosis and all asthma symptoms in both phases with significant increase in the prevalence of night cough (from 21.6% to 27.8%; $p = 0.039$). In Batinah region, there was a significant drop in self-reported asthma diagnosis (from 24.5% to 19.3%; $p = 0.003$) and in symptoms of severe asthma (from 8.8% to 6.4%; $p = 0.02$) with no significant change in other

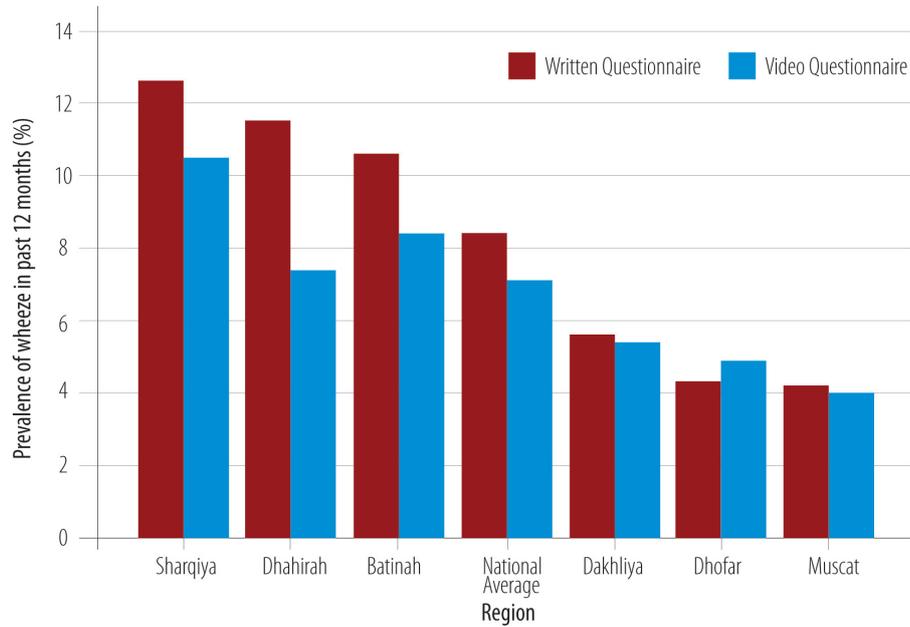


Figure 1: The prevalence rates of wheeze in the past 12 months calculated from the written and video questionnaire for each region in the 13-14 years old age group in ISAAC Phase III ($n = 3,679$)

symptoms. The only change in the Muscat region was in the prevalence of severe asthma symptoms which declined from 4.9% to 2.7% ($p = 0.048$). There was no significant change in asthma diagnosis or in any of the reported asthma symptoms in the remaining regions (Dakhiliya, Dhahirah and Dhofar) in this age group.

Figure 1 shows the prevalence rates of wheeze in the past 12 months calculated from the written and video questionnaire responses for each region in the 13-14 years old age group of Phase III. In the total national sample, the frequency of positive responses to the video questionnaire was significantly lower than written questionnaire (7.0% versus 8.4%; $p < 0.001$) with good correlation between the two responses ($r = 0.60$, $p < 0.001$). The ranking of the regions by responses to both questionnaires was similar, with the Sharqiya region recording the highest prevalence rate of wheeze in both questionnaires, with good correlation between the two responses in all regions (r values ranged from 0.48 in Dhofar to 0.67 in Batinah). The responses to the video and written questionnaires were similar in regions with relatively low prevalence of wheeze (Dakhiliya, Dhofar and Muscat), whereas the responses to the video were lower than that of the written questionnaire in the regions with higher prevalence of wheeze (Batinah, Sharqiya, Dhahirah).

Figure 2 shows the changes in the prevalence of self-reported asthma diagnosis among children (both age groups combined) who reported symptoms of se-

vere asthma by region. In the nationwide sample, as well as in most regions, approximately 60% (ranging from 48.7% in Dhahirah to 76.3% in Muscat) of all children with severe asthma symptoms reported the diagnosis of asthma with no significant change in either the national average or any of the regions over the 6 year period.

DISCUSSION

This study was a follow up on ISAAC Phase I which took place in 1995 and was the first study ever done in Oman on the prevalence of asthma in Omani schoolchildren.^{5,6,9} The results of Phase I highlighted two striking features of asthma in Omani schoolchildren: the first was the relatively high prevalence of severe asthma symptoms compared to regional and international prevalence rates, and the second was the significant variation in asthma diagnosis and symptoms between the different regions of Oman.^{5,6} Participation in the ISAAC Phase III survey in 2001 has provided us with an opportunity to analyse the changes in the prevalence of asthma diagnosis and symptoms over a period of 6 years (between 1995 and 2001) in the different regions of Oman.

The results of this study revealed that over a period of six years the Sharqiya region continued to have the highest prevalence of self-reported asthma diagnosis and all symptoms of asthma in both age groups with a significant increase in the prevalence of current

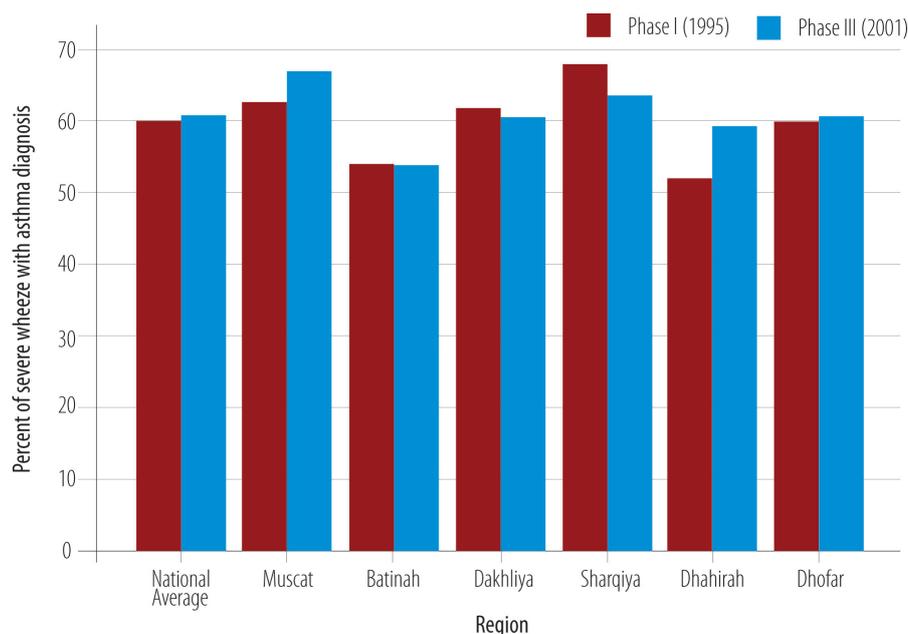


Figure 2: The changes in the prevalence of self-reported asthma diagnosis among children (both age groups combined) who reported symptoms of severe asthma by region.

wheeze and asthma diagnosis in the 6 to 7 year old age group and a significant increase in night cough in the older group. All other regions had lower prevalence rates in 1995 in both age groups, and showed either no change or a decline in one or two of the asthma symptoms. In general, the prevalence of asthma symptoms in the different regions of Oman in Phase III resembled Phase I results.

The regional variation in the prevalence of asthma symptoms within Oman is similar to reports from other countries and is consistent with ISAAC findings.⁹⁻¹¹ The cause of the higher and increasing prevalence of asthma symptoms in the eastern (Sharqiya) region compared to other regions of Oman is not clear, and in the absence of previous information, all the possible factors of high asthma prevalence need to be considered and evaluated.¹²⁻¹⁵ Thus the observed regional difference may be explained by differences in one or more of the following factors: interpretation of the written questionnaire, recognition of asthma diagnosis and symptoms, healthcare utilization and prevalence of genetic and environmental risk factors.¹³

Although the possibility of regional differences in the interpretation of the written questionnaire can not be completely excluded, our analysis suggests that it is unlikely to be a significant factor.¹⁶ The Arabic version of the written questionnaire had been previously validated,¹⁷ and the Arabic translation of the English

term “wheeze” used descriptive words/phrases common to all regions of Oman. In addition, the pattern of difference in the prevalence of cough, a symptom with more uniform interpretation, mirrored that of wheeze. Furthermore, the ranking of the regions for the prevalence of wheeze in the past 12 months was similar in both the written and the video questionnaires (Sharqiya region had the highest rates in both questionnaires). By showing, rather than describing, symptoms of asthma, the ISAAC video questionnaire was developed to minimise the effect of language, culture, and literacy.^{18,19} Like most centres, the frequency of positive responses of our children to question on wheezing in the last 12 months on the video questionnaire was lower than the written questionnaire.^{9,20} It has been suggested that the visible and audible scenes on a video are likely to represent more severe symptoms than the full spectrum from mild to severe asthma covered by the written questionnaire.²¹

Another possible factor to be considered is poor recognition and/or under-diagnosis of asthma. Children and parents who are more alert to asthma and its symptoms are more likely to report it, and physicians who are more alert to a particular condition, tend to diagnose more cases.²²⁻²⁵ In addition, under-diagnosis and/or under-treatment of asthma is associated with higher prevalence of severe asthma symptoms.^{26,27} In our study, only 60% of children with severe asthma

symptoms reported asthma diagnosis, with no significant difference between Sharqiya and other regions. Although this suggests poor recognition and/or under-diagnosis of asthma across the country, which has not improved over time and merits attention, it does not explain the observed differences between regions.

Since this study did not investigate the pattern of asthma management or the health seeking behaviour among asthmatics, it is not possible to determine if there were regional differences in the use of effective treatment, especially inhaled corticosteroids which could reduce the prevalence of severe asthma symptom.²⁸⁻³¹ It is possible that the observed decline in the prevalence of severe asthma symptoms in most regions was due to improved use of effective treatment. However, the use of effective treatment is unlikely to affect the prevalence of asthma diagnosis, and is therefore unlikely to explain the regional difference in prevalence of asthma.

Although there is no information available on the prevalence of 'established' asthma risk factors in Oman, the observed regional difference in asthma symptoms may be due to differences in the prevalence of genetic and/or environmental risk factors.² Potential factors include family history of atopy, sensitisation to aeroallergens such as house dust mite, respiratory infections, dietary habits, parental smoking, and residence in urban areas. These factors may influence the pathogenesis and severity of asthma and require investigation. The finding of the regional difference in the prevalence of asthma symptoms in both age groups, suggest that the causes of this difference exert their effect early in childhood.¹⁰

CONCLUSION

In conclusion, this study demonstrated a relatively high prevalence of asthma in Omani schoolchildren with significant variations between its regions. It alerts healthcare planners and providers to the particularly high and rising prevalence of asthma symptoms in the Sharqiya region and to the need to investigate the possible causes and prioritise resources for asthma control.

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