

# Prevalence of asthma symptoms in Omani schoolchildren

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## مدى انتشار أعراض مرض الربو بين أطفال المدارس في سلطنة عُمان

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**ملخص: الهدف:** تحديد نسبة انتشار الربو بين أطفال المدارس في السلطنة بواسطة استخدام معايير الدراسة الدولية للربو والحساسية سدرية عند الأطفال. **الطريقة:** تم تعبئة الإستبيان الخاص من قبل 7067 من طلاب المدارس في المناطق الصحية العشر بالسلطنة من مجموعتين عمريتين مختلفتين. المجموعة الأولى تكونت من 2893 طالبا وطالبة (منهم 56% ذكور) وتراوحت أعمارهم ما بين 6-7 سنوات. مجموعة الثانية من 3174 طالبا وطالبة (منهم 51% ذكور) وتراوحت أعمارهم ما بين 13-14 سنة. **النتائج:** في السنة المنصرمة تم تقدير وسط انتشار التنفس المصحوب بصفير في الصدر بنسبة 7,8% والصغير الصدري المسبب للاستيقاظ 2,5% والمؤدي الى قصور في القدرة على التحدث 2,2% والصغير الصدري أثناء التمرين 6,9% لمجموعة أعمار 6-7 سنوات، فيما بلغت نسبة هذه الأعراض في المجموعة العمرية 14-19 سنة 8,9% و 2,9% و 4,0% و 9,2% على التوالي. أما السعال الليلي فكانت نسبة حدوثه عالية في المجموعتين (19,6% في الأولى و 20,9% في الثانية) كما كانت نسبة الإخبار الذاتي للإصابة بمرض الربو أعلى في المجموعة الثانية 20,7% مقابل 10,5% في المجموعة الأولى. لوحظ ان نسبة انتشار مرض الربو كانت أكثر شيوعا عند ذكور المجموعة الأصغر سنا (12,5% في الذكور مقابل 8,0% عند الإناث) في حين يوجد هذا الفرق عند المجموعة ذات الأعمار الأكبر. وأوضحت الدراسة وجود تباين في نسبة انتشار مرض الربو بين مناطق السلطنة حيث يت في بعض المناطق مثل (جنوب الشرقية) ثلاثة أضعاف مناطق أخرى (مثل مسندم). **الخلاصة:** تمثل هذه النتائج أول دراسة إحصائية عن مدى انتشار مرض الربو وأعراضه بين الأطفال العمانيين وهي تشير الى أن مرض الربو منتشر بنسبة عالية بين أطفال المدارس في السلطنة، وجود تباين في نسبة الإصابة بين المناطق المختلفة مما يشير الى الحاجة الى دراسات مستقبلية أخرى.

**ABSTRACT. Objectives:** To determine the prevalence of asthma in Omani schoolchildren using the International Study of Asthma and Allergies in Children (ISAAC) protocols. **Method:** The ISAAC-written questionnaire was completed by a total of 7,067 Omani schoolchildren (3,893 children aged 6–7 years of which 56% were boys and 3,174 aged 13–14 years of which 51% were boys) from the 10 health regions in the country. **Results:** The estimated mean national 12-month prevalence of any wheeze, night waking with wheeze, speech limiting wheeze and exercise wheeze were respectively 7.8%, 3.5%, 3.2% and 6.9% for the 6–7 year age group and 8.9%, 2.9%, 4.0% and 19.2% for the 13–14 year age group. Both age groups reported high prevalence of night cough (19.6% and 20.9% in the younger and the older children respectively). The prevalence of self-reported asthma diagnosis was higher in the older age group (20.7% vs. 10.5%,  $p < 0.001$ ). In the younger age group, the diagnosis of asthma was more common in boys (12.5% vs. 8.0%,  $p > 0.001$ ), but there was no significant difference between the two sexes in the older age group (22.0% of boys vs. 20.5% of girls). There was nearly three-fold difference in the prevalence of self-reported diagnosis of asthma between the regions with the highest and the lowest prevalence of asthma for both young and older children (from 5.3% and 9.5% in Musandam to 14.2% and 30.6% in South Sharqiya, respectively). **Conclusion:** The results of this first epidemiological survey of asthma in Oman indicate that asthma is common in Omani children and adolescents. Night cough is the most frequent symptom. There is also significant regional variation in prevalence of asthma symptoms and diagnosis within the country and this requires further investigation.

**Key Words:** asthma, prevalence, ISAAC, wheezing, night cough, Oman, children

ASTHMA IS ONE OF THE MOST COMMON CHRONIC conditions in children and adults worldwide and one with a very high socio-economic cost.<sup>1</sup> Numerous studies from the developed countries have reported increases in the prevalence of asthma and other allergic conditions (allergic rhinitis and eczema) over the last three decades, with marked variations between and within countries.<sup>2-11</sup> The greatest increases in the prevalence of asthma have been reported in children and young adults with up to 20–30% of the children affected in some countries.<sup>2-11</sup>

Studies from developing countries indicate that asthma is common in this part of the world also, with considerable variation in its prevalence between countries.<sup>12-18</sup> In 1991, the International Study of Asthma and Allergies in Children (ISAAC) was formed to maximise the value of epidemiological research into asthma and other atopic disorders by establishing and promoting standardised methodology and facilitating international collaboration by involving as many countries as possible provided they met the requirements of the study protocol.<sup>19</sup> has attracted large-scale participation

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from all parts of the world.<sup>10</sup> Oman was one of the collaborating centres in Phase I of the ISAAC project and our participation has yielded the only available data on the prevalence of asthma in this country.<sup>10-11</sup>

The summary of the results of our centre has been published as part of the ISAAC Steering Committee publications on the worldwide variations in asthma symptoms.<sup>10-11</sup> The aim of this paper is to report a detailed analysis of the prevalence of self-reported asthma symptoms and diagnosis in Oman and to compare the prevalence of asthma and its symptoms in different regions of the country.

## METHOD

### PROTOCOL AND SUBJECTS

A stratified multistage sampling method was used. The ten health regions of the Sultanate of Oman [Figure 1] were



**Figure 1.** Map of the Sultanate of Oman showing the ten health regions of the country

The regions shown above were used as the strata for recruitment of schoolchildren, in proportion to their population density. Because of their relatively sparse population, data from Musandum and Wusta were analysed together.

considered as strata. The first stage of sampling consisted of schools randomly selected as primary sample units. In the second stage, one class was chosen from each school as the secondary sample unit. The total national target sample was distributed among the ten regions of the country using the proportion allocation method. The sample frame of the survey was a list of public schools provided by the Ministry of Education indicating the district and town, number of schools with grades I and II primary (6–7 years age group) and I and II preparatory (13–14 years age group). The number of children in these grades was also indicated.

To achieve a final total sample size of 6,000 children (3,000 in each age group), a total of 7,625 copies of the questionnaire were distributed (4,079 to the 6–7 age group and 3,546 to the 13–14 age group). The sample size for the 6–7 year age group was kept higher by 15% to allow for the expected lower response rate, since questionnaire had to be filled by the parents. A total of 220 schools participated (118 primary and 102 preparatory). Of these, 117 (53%) were boys' schools (66 primary and 51 preparatory).

The ISAAC-written standardised questionnaire<sup>19</sup> was used to identify asthma, allergic rhinitis, atopic eczema and related symptoms. The questionnaire was translated to Arabic in the following manner: One of the two bilingual translators translated the questionnaire into Arabic and the other translated it back into English and the differences between the back translation and the original English version were resolved. The Arabic version of ISAAC

**Table 1.** Sex and regional distribution of the two age groups of Omani schoolchildren

	6–7 years age group			13–14 years age group		
	Boys N (%)	Girls N (%)	Total N	Boys N (%)	Girls N (%)	Total N
Muscat	301 (58)	217 (42)	518	270 (53)	237 (47)	507
Batinah (North)	441 (63)	258 (37)	699	256 (43)	343 (57)	599
Batinah (South)	213 (45)	256 (55)	469	204 (54)	172 (46)	376
Dakhiliya	256 (47)	294 (53)	550	303 (62)	182 (38)	485*
Sharqiya (South)	220 (68)	101 (32)	321*	90 (49)	93 (51)	183
Sharqiya (North)	266 (77)	79 (23)	345*	67 (33)	134 (67)	201*
Dhahirah	174 (45)	210 (55)	284	177 (50)	176 (50)	353
Dhofar	271 (55)	222 (45)	493	217 (58)	159 (42)	376
Musandum & Wusta	58 (51)	56 (49)	114	40 (43)	54 (57)	94
<b>Total national sample</b>	<b>2200 (56)</b>	<b>1693 (44)</b>	<b>3893</b>	<b>1624 (51)</b>	<b>1550 (49)</b>	<b>3174</b>

\*Significant difference in sex distribution within the group

questionnaire was distributed to the schoolchildren and was completed by the parents of the 6–7 year age group and by the children themselves in the 13–14 age group.

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

DATA PRESENTATION AND ANALYSIS

Data were collected and entered using the ISAAC International Data Centre protocol,<sup>10</sup> and were analysed using SPSS-9 software package for Windows. Groups were compared using the chi-square ( $\chi^2$ ) test. A p-value of <0.05 was considered statistically significant.

RESULTS

THE SUBJECTS

The ISAAC questionnaire was completed by a total of 7,067 pupils (92.7% response rate) from the ten Omani health regions and consisted of two age groups: 3,893 pupils aged 6–7 years (95.4% response rate) and 3,174 pupils aged 13–14 years (89.5% response rate). Table 1 shows the sex and regional distribution of the two age groups. Although Musandum and Wusta are separate geographical and health regions [Figure 1], their data were analysed together because of their smaller sample sizes. The sex distribution in the total national sample was nearly equal for both age groups (boys constituted 56% of 6–7 year-olds and 51% of the 13–14 year-olds). Similarly, the sex distribution in the regional samples was nearly even for most regions except for North and South Sharqiya and Dakhiliya regions; North and South Sharqiya regions contained significantly higher number of boys in the 6–7 year age group (77% and 68%, respectively). For the 13–14 years age group, boys predominated

(62%) the sample from Dakhiliya region while there were more girls (67%) in the sample from North Sharqiya. The number of participants belonging to the two age groups varied between regions, ranging from 114 and 94 children in Musandum and Wusta to 699 and 599 children in North Batinah for the young and older age groups respectively.

ESTIMATED NATIONAL PREVALENCE OF SELF-REPORTED ASTHMA SYMPTOMS AND DIAGNOSIS

Table 2 shows the prevalence of asthma symptoms and self-reported asthma diagnosis ('ever had asthma') in the two study groups. The estimated national cumulative prevalence of any wheeze ('wheeze ever'), and the 12-month period prevalence of any wheeze, and exercise wheeze were significantly higher in the 13–14 year age group (15.6, 8.9, and 19.2% respectively), compared to the 6–7 year age group (13.8, 7.8 and 6.9% respectively). There was no significant difference between the two groups in the 12-month period prevalence of four or more wheeze attacks, wheeze disturbing sleep, or severe wheeze ('wheeze limiting speech'). Night cough not related to upper respiratory tract infection was equally frequent in both age groups (19.6% and 20.9% in young and older children, respectively). The prevalence of self-reported asthma diagnosis was common in both age groups with the older children having nearly twice the prevalence in younger children (20.7% vs. 10.5%,  $p < 0.001$ ). Although, only 8.9% of children aged 13–14 reported any wheeze during the past 12 months, 19.2% of them reported to have had exercise induced wheeze during the same period.

**Table 2.** The overall national prevalence (%) of self-reported asthma symptoms and diagnosis in the studied age groups

	6–7 yrs old (n = 3893)	13–14 yrs old (n = 3174)	p-value
Ever Wheezed	13.8	15.6	0.04
12-month prevalence of:			
– Any wheeze	7.8	8.9	0.005
– Four or more wheeze	2.5	2.6	0.57
– Wheeze disturbs sleep	3.5	2.9	0.18
– Wheeze limiting speech	3.2	4	0.09
– Exercise wheeze	6.9	19.2	<0.001
– Night cough	19.6	20.9	0.2
Ever had asthma	10.5	20.7	<0.001

**Table 3.** Gender difference in the prevalence (%) of self-reported asthma symptoms and diagnosis in two study age groups

	6–7 years age group (n = 3893)			13–14 years age group (n = 3174)		
	Boys n=2200	Girls n=1693	p-value	Boys n=1622	Girls n=1552	p-value
Ever Wheezed	15.8	11.3	<0.001	16.3	14.9	0.28
12-month prevalence of:						
– Any wheeze	8.5	5.3	<0.001	9.2	8.6	0.59
– 4 or more wheeze	3	2	0.06	3	2.3	0.18
– Wheeze disturbs sleep	4	2.8	0.06	3.2	2.6	0.29
– Wheeze limiting speech	3.4	3	0.54	4.2	3.7	0.51
– Exercise wheeze	7.7	6	0.04	21.5	16.7	<0.001
– Night cough	20.3	18.7	0.21	21.3	20.4	0.56
Ever had asthma	12.4	8	<0.001	21.4	20	0.35

## GENDER DIFFERENCE

Table 3 shows the prevalence of self-reported asthma symptoms and diagnosis according to gender in the two age groups. In the 6–7 year age group, the cumulative prevalence of wheeze, the 12-month prevalence of ‘any wheeze’, ‘exercise wheeze’, and ‘ever had asthma’ were significantly higher in males. In contrast, there was no significant difference between the two sexes in asthma diagnosis or any of its symptoms in the 13–14 year age group except exercise induced wheeze which was more common in males (21.5% vs. 16.7%,  $p < 0.001$ ). There was no significant difference between the two sexes in the prevalence of night cough or symptoms of severe asthma (4 or more attacks per week, wheeze that disturbs sleep and speech limiting wheeze) in both age groups.

## REGIONAL VARIATION

The prevalence of self-reported asthma symptoms and diagnosis in the 10 Omani health regions is shown in Table 3 (children aged 6–7 years) and Table 4 (children aged 13–14 years). There was a significant variation in the prevalence of asthma diagnosis and its symptoms in both age groups, with nearly 3-fold difference in the prevalence of self-reported asthma diagnosis between the highest and

lowest prevalence regions. The prevalence of self-reported diagnosis of asthma in South Sharqiya was 14.2% and 30.6% for young and older children respectively, compared to 5.3% and 9.6% respectively in Musandum and Wusta. South and North Sharqiya regions (Eastern region of Oman) had consistently higher prevalence of all asthma symptoms, contrasting with Musandum which had the lowest prevalence of all asthma symptoms.

## DISCUSSION

Although data from many different countries provide compelling evidence that asthma and other allergic diseases are increasing, these were primarily from the developed countries which might not be representative of the remainder of the world.<sup>2–11</sup> The prevalence figures may be influenced by the difference in disease definition and classification, diagnostic methods, and the level of awareness of the disease as well as by the prevalence and distribution of its risk factors.<sup>2,6,15</sup> In addition, the causes of the rising trends in asthma and other atopic diseases remain to be identified.<sup>10–11</sup> This is the first epidemiological survey on self-reported asthma symptoms and diagnosis in the Sultanate of Oman. Using the ISAAC protocol, we found the symptoms suggestive of asthma to be quite common in Oman. We also

**Table 4.** Regional variation in the prevalence (%) of asthma symptoms in Omani schoolchildren aged 6–7 years using the ISAAC questionnaire

	Ever wheezed	12 – month prevalence of					Ever had asthma
		Any wheeze	Wheeze disturbs sleep	Wheeze limiting speech	Exercise wheeze	Night cough	
Muscat	10.4	5.2	2.7	1.7	5.6	17.8	9.5
Batinah (North)	16.2	7.7	5.9	2.6	6.2	17.0	10.2
Batinah (South)	14.7	6.8	4.3	3.8	6.8	19.6	8.3
Dakhiliya	13.8	7.5	2.5	4.7	7.5	20.7	12.2
Sharqiya (South)	16.8	8.1	4.7	3.7	10.6	23.4	13.4
Sharqiya (North)	15.9	9.3	6.4	3.7	7.5	27.5	14.2
Dhahirah	13.8	6.3	3.4	4.9	6.8	20.6	6.8
Dhofar	12.8	7.3	2.8	2.3	7.1	16.2	11.8
Musandum & Wusta	5.3	4.4	0.9	2.6	3.5	15.8	5.3
Total national sample	13.8	7.8	3.5	3.2	6.9	19.6	10.5

**Table 5.** Regional variation in the prevalence (%) of asthma symptoms in Omani schoolchildren aged 13–14 years using the ISAAC questionnaire

	ever wheezed	12-month prevalence of:					Ever had asthma
		Any wheeze	Wheeze disturbs sleep	Wheeze limiting speech	Exercise wheeze	Night cough	
Muscat	11.6	6.7	1.6	3.0	12.6	21.3	19.1
Batinah (North)	19.9	12.7	4.0	5.7	25.7	23.2	25.2
Batinah (South)	18.1	10.6	4.3	5.9	18.9	19.4	23.4
Dakhiliya	11.5	5.8	3.3	1.6	16.9	19.2	20.2
Sharqiya (South)	26.8	14.2	13.3	4.9	31.1	23.0	30.6
Sharqiya (North)	16.4	8.5	4.5	2.5	19.4	20.4	26.9
Dhahirah	14.2	7.9	1.7	4.2	17.8	19.0	15.0
Dhofar	13.8	7.7	2.9	4.0	17.6	21.8	13.8
Musandum & Wusta	9.6	5.3	2.1	3.2	12.8	18.1	9.6
Total national sample	15.6	8.9	2.9	4.0	19.2	20.9	20.7

found significant variation in the prevalence of asthma diagnosis and symptoms between the different regions.

#### NATIONAL PREVALENCE OF SELF-REPORTED ASTHMA SYMPTOMS AND DIAGNOSIS

##### *6–7 year age group*

The estimated national prevalence of parent-reported asthma diagnosis in this age group was 10.5%. This puts Oman in the intermediate prevalence compared to the rest of the world for this age group.<sup>10</sup> In keeping with the findings in most ISAAC centres, boys had significantly higher prevalence than girls for cumulative wheeze, 12-month history of ‘any wheeze’ and ‘exercise wheeze’, and parent-reported history of asthma (‘ever had asthma’).<sup>10</sup> However there was no significant difference between the two sexes in night cough or any of the symptoms suggestive of severe asthma (the 12-month prevalence of: four or more attacks of wheeze, sleep disturbing wheeze and speech limiting wheeze). Only three Eastern Mediterranean countries (Iran, Malta and Oman) were included this ISAAC Phase-I optional age group with a mean prevalence of ‘ever had wheeze’ of 6.56%. Among these, Oman had the highest prevalence of ‘ever had asthma’ and all asthma symptoms

except the 12-month prevalence of any wheeze which was slightly higher in Malta (7.1% vs. 8.8%).<sup>10</sup>

##### *13–14 year age group*

Like most participating countries, the prevalence of self-reported asthma symptoms and diagnosis was higher in this age group compared to the younger group.<sup>10</sup> This suggests that symptoms starting at young ages persist into adolescence (cumulative effect) or that more new cases develop with time compared to those which resolve spontaneously (net effect). The prevalence of ‘ever had asthma’ in this age group in Oman (20.7%) was the highest among the seven Eastern Mediterranean participating countries: Iran (2.7%), Kuwait (17.5%), Lebanon (11.6%), Malta (11.1%), Morocco (11.7%) and Pakistan (7.3%).<sup>10</sup> Only six of the 56 participating countries reported prevalence rates higher than 20% (range: 20–28%) in this age group (Peru, United Kingdom, Australia, New Zealand, Singapore and Oman).<sup>10</sup> With the exception of Oman, in all of these countries and many other countries the reporting of 12-month prevalence of wheeze was higher than ‘ever had asthma’. In contrast, Oman was one of the several countries where the reporting of ‘ever had asthma’ was more frequent than ‘ever wheeze’. The cause of this difference is not clear, but it may be due to over-reporting of asthma diagnosis in Oman. An

alternative and more plausible explanation is that the diagnosis of asthma may be based on symptoms other than wheeze.<sup>20</sup> This is supported by the high prevalence of night cough (20.9%) and exercise-induced wheeze (19.2%). A third possibility is that many of the children with previous history of asthma ('ever had asthma') in this age group did not have 'any wheeze' during the previous 12 months.

In the 13–14 age group, exercise-induced wheeze in the last 12 months was reported more frequently than 'any wheeze' within the same period. This pattern was reported in most of (50 of 56) the participating countries.<sup>10</sup> On theoretical grounds one would expect the opposite pattern (i.e. the reporting of 'any wheeze' to be more frequent than any of its components such as exercise induced wheeze). The reason for this is not clear and has not been previously explained.<sup>10</sup> One possibility is that children at this age group, who self-completed the ISAAC questionnaire, perceived exercise induced wheeze as a separate entity from the ordinary wheeze of asthma.

#### REGIONAL VARIATION

In the ISAAC Phase-I, several countries participated with more than one centre (18 countries for 6–7 year age group and 30 countries for 13–14 year age group) and these yielded significant variations in the self-reported asthma symptoms and diagnosis within countries.<sup>10</sup> Oman participated with only one centre for both age groups. However we sought to determine the difference in asthma and other allergies among the 10 health regions of the country by distributing the total sample among these regions in proportion to their population. A clear and consistent pattern of regional variation in the prevalence of asthma and symptoms emerged. The eastern region (North and South Sharqiya) had the highest asthma diagnosis and symptoms in the country for both age groups and both sexes. In contrast, Musandum and Wusta (northernmost middle regions respectively) had the lowest prevalence rates for both age groups and both sexes. Overall, the north-western regions had less asthma diagnosis and symptoms than the south-eastern regions with the interior region (Dakhiliya) having intermediate rates. The cause of this variation is not known, but might be due to the difference in the distribution of the risk factors of atopy and asthma in different regions.<sup>13,21</sup> There is no information on the prevalence and the regional distribution of the risk factors for asthma and atopy in Oman. Investigations of these factors in the different regions of the country will not only help elucidating the causes of the regional variation in the prevalence of asthma, but also help in the development of national health and environmental strategies to control asthma and other atopic conditions.

## CONCLUSION

The prevalence of self-reported asthma symptoms and diagnosis is relatively high in Oman with significant regional variation within the country. The cause of this high prevalence and its regional variation is not clear, as there are no data on the risk factors for the development of asthma and other allergic diseases. Participation in ISAAC Phase II may define some of risk factors for asthma in Oman which may be different in different regions of the country.

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## APPENDIX

### CORE QUESTIONNAIRE FOR WHEEZING AND ASTHMA (ISAAC PHASE I)

- |  |   |
|--|---|
| 1. Have you (has your child) ever had wheezing or whistling in the chest at any time in the past?  | Yes/No  |
| <i>If you have answered 'No' please skip to question 6</i>   |   |
| 2. Have you (has your child) had wheezing or whistling in the chest in the last 12 months?   | Yes/No  |
| <i>If you have answered 'No' please skip to question 6</i>   |   |
| 3. How many attacks of wheezing have you (has your child) had in the last 12 months?   | None / 1–3 / 4–12 / >12   |
| 4. In the last 12 months, how often on the average, has your (your child) sleep been disturbed due to wheezing?  | Never woken with wheezing / less than one night per week / one or more nights per week. |
| 5. In the last 12 months, has wheezing ever been severe enough to limit your (your child's) speech to only one or two words at a time between breaths? | Yes / No  |
| 6. Have you (has your child) ever had asthma?  | Yes/No  |
| 7. In the last 12 months, has your (your child's) chest sounded wheezy during or after exercise?   | Yes/No  |
| 8. In the last 12 months, have you (your child) had a dry cough at night apart from a cough associated with a cold or flu?                             | Yes/No  |