Eur Respir J 2002; 19: 1026–1034
DOI: 10.1183/09031936.02.01832001

European Respiratory Journal
ISSN 0903-1936

Asthma prevalence in children living in villages, cities and refugee camps in Palestine

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ABSTRACT: Previous studies have suggested that asthma prevalence is generally lower in the Middle East than in more developed countries. The aim of this study was to investigate the prevalence and severity of asthma and asthma symptoms in schoolchildren in the Ramallah District in Palestine.

In the autumn of 2000, 3,382 schoolchildren aged 6–12 yrs were surveyed in 12 schools, using the International Study for Asthma and Allergies in Childhood (ISAAC)-phase III, parents-administered translated questionnaire.

The crude prevalence rates for "wheezing-ever", "wheezing in the previous 12 months", and "physician-diagnosed asthma" were 17.1, 8.8 and 9.4% respectively, with urban areas having higher prevalence rates than rural areas. Within urban areas, refugee camps had higher prevalence rates than cities. Yet, within the rural areas, the 12-month prevalence was lower in the deprived villages than other residences. Place of residence remained significant for asthma and asthma symptoms, after adjusting for sex, age, and place of birth.

To conclude, children from refugee camps appear to be at higher risk of asthma than children from neighbouring villages or cities. The prevalence of asthma and asthma symptoms in Palestine appears to be close to that of Jordan, but it is much lower than Israel, and lower than some other countries in the region, such as Kuwait and Saudi Arabia, and more developed countries. This initial study is a baseline for a study on lifestyle and environmental determinants for asthma among Palestinian children.

Eur Respir J 2002; 19: 1026–1034.

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Keywords: Asthma, children, epidemiology, International Study for Asthma and Allergies in Childhood questionnaire, Palestine

Received: October 15 2001
Accepted after revision January 10 2002

This study was supported by Al-Quds University, International Study for Asthma and Allergies in Childhood, Directorate General for International Cooperation (DGIC-DGCI), and Belgian Technical Cooperation (BTC-CTB).

Numerous studies have assessed the epidemiology of asthma on the basis of morbidity and mortality data or from questionnaires [1]. Among children, higher prevalence rates have been found in industrialized Western countries than in developing countries in Asia and Africa [2]. These differences may be real [2–4] or they may reflect study methodology [3–5]. However, international comparisons of the prevalence and characteristics of asthma have been greatly facilitated by two international initiatives, the European Commission Respiratory Health Study and the International Study for Asthma and Allergies in Childhood (ISAAC), and these joint studies have suggested that differences in asthma prevalence are real.

Several studies have suggested that there is more asthma in urban than in rural areas [6–8]. This higher asthma prevalence does not appear to be related to urbanization *per se*, but could be associated with the increase of population susceptibility rather than changes in exposure to allergens. Overall, these studies point to a "Westernized lifestyle", a term that refers broadly, if somewhat vaguely, to a range of indoor and outdoor environmental factors, dietary habits and patterns of childhood infection that seem to be typical for modern Western societies, as the most probable determinant of population susceptibility [9–11]. However, the international comparison of disease prevalence needs to be taken with caution.

In the Middle East, asthma prevalence is reported to be lower than in "developed" countries (ranges 5–23%) [12–16]. The lowest 12-months wheezing prevalence rate was seen in rural Palestinian (5.5%) [16], and the highest in the desert population of Saudi Arabia (23%) [17]. In Palestine, physician-diagnosed asthma prevalence was 3.8%, and the prevalence of

recent wheezing was 8.9% [16]. Similar results were seen in neighbouring countries such as Jordan, where the prevalence rate for physician-diagnosed asthma was (4.1%) while reported-wheezing prevalence was 8.3% [13]. However, in Israel, which shares the same (outdoor) environment as Palestine, the 12-months prevalence of wheezing was 17.8%. SHOHAT *et al.* [15] indicated that the observed difference in the prevalence of asthma and asthma symptoms between Arabs and Jews might give a clue to the pathogenesis of asthma.

Palestine, as a country in transition shifting from a "traditional" to a "modern" society, has several unique features, which may prove useful for the study of asthma. The population is young, with 46% being aged <15 yrs [18]. An increase in the fertility rate was the most important factor for the rapid growth of the population. The socioeconomic changes, the rural-urban migration and rapid industrialization are inevitably associated with changes in lifestyle and dietary habits, which in turn affect the health of the population. The aim of this study was to assess the prevalence of asthma, rhinitis, and atopic eczema in schoolchildren in Palestine and to test for a difference in asthma prevalence between cities, villages and refugee camps.

This prevalence survey using the ISAAC protocol and questionnaire in schoolchildren aged 6–12 yrs was conducted in the Ramallah district of the West Bank between September and December 2000 in spite of the difficult political circumstances.

Methods

Demography of the study area

Ramallah district is located in the middle part of the West Bank, occupying 14.5% of the West Bank. It extends over several hills with an altitude of 872 m above sea level, and is influenced by the Mediterranean climate [19]. Twenty-seven per cent of the Ramallah population is composed of children aged 5–14 yrs, of whom 98% attend schools [18]. According to the Palestinian Ministry of Education-Planning Dept, there are 167 schools in the Ramallah district: 118 Governmental schools, 30 supervised by United Nations Relief and Works Agency (UNRWA), and 19 private schools.

Study design

A sample size of 4,000 children was needed to detect a difference of 5% in the 12-months prevalence of wheezing between urban and rural areas [16], taking into consideration an estimated response rate of 85%. The study power to detect this difference was 90% at the 1% level of significance. This sample size was in agreement with the ISAAC Phase III suggested protocol for calculating sample size for asthma and allergy studies [20, 21].

A two-stage stratified systematic sampling strategy was used to get the required sample size. The sample frame (schools) was obtained from the Palestinian Ministry of Education. Primary schools were stratified according to school location (cities, villages, refugee camps) and school supervising body; then sorted by pupil sex (mixed sex, male pupils only, female pupils only), and school size (number of students in schools). The 4,000 children were distributed between the schools location using the "proportional allocation" method to have a good representation from each location. From each stratum, a systematic sample was used to select the required number of schools. The number of schools selected from each stratum varied according to the number of students in the school and the size of the stratum.

Ethical approval was obtained from the Palestinian Ministry of Education, the Palestinian Ministry of Health, the United Nations Relief and Works Agency (UNRWA) School Education dept, and private schools authorities.

Questionnaire

A specialized medical translator translated the ISAAC Phase III parent-administered questionnaire into Arabic. According to ISAAC protocol recommendations for questionnaire translation, a focus group consisting of a paediatrician, an immunologist, a dermatologist, an ear, nose and throat specialist, and an epidemiologist revised this translated questionnaire to fit with the Palestinian terminology used by physicians and health educators in the community. An independent translator translated the questionnaire back into English.

A pretest was carried out to test the capacity of parents to understand the questionnaire wording. Briefly, the parents of children from two classes, first and sixth grades (n=45), in one school, filled out the piloted questionnaire. A page was attached to the questionnaire for feedback from parents regarding wording, phrasing and layout of the questionnaire. The questionnaire layout was modified after the pilot.

Data collection

Thirteen schools were selected from a list of 133 primary schools in the Ramallah district. Twelve schools (three in cities, two in refugee camps, seven in villages) agreed to participate in the survey (fig. 1).

All children from the first to the seventh grades in the 12 selected schools were invited to participate. A total of 4,204 questionnaires were distributed, with a consent form to obtain parental agreement for the children to participate in the survey and to cooperate in future studies.

Analysis

EPI-INFO version 6 (Centres for Disease Control and Provention, Atlanta, GA, USA) and SPSS version 1.0 (Chicago, IL, USA) were used for data entry, cleaning and analysis.

Residence was classified according to the Palestinian

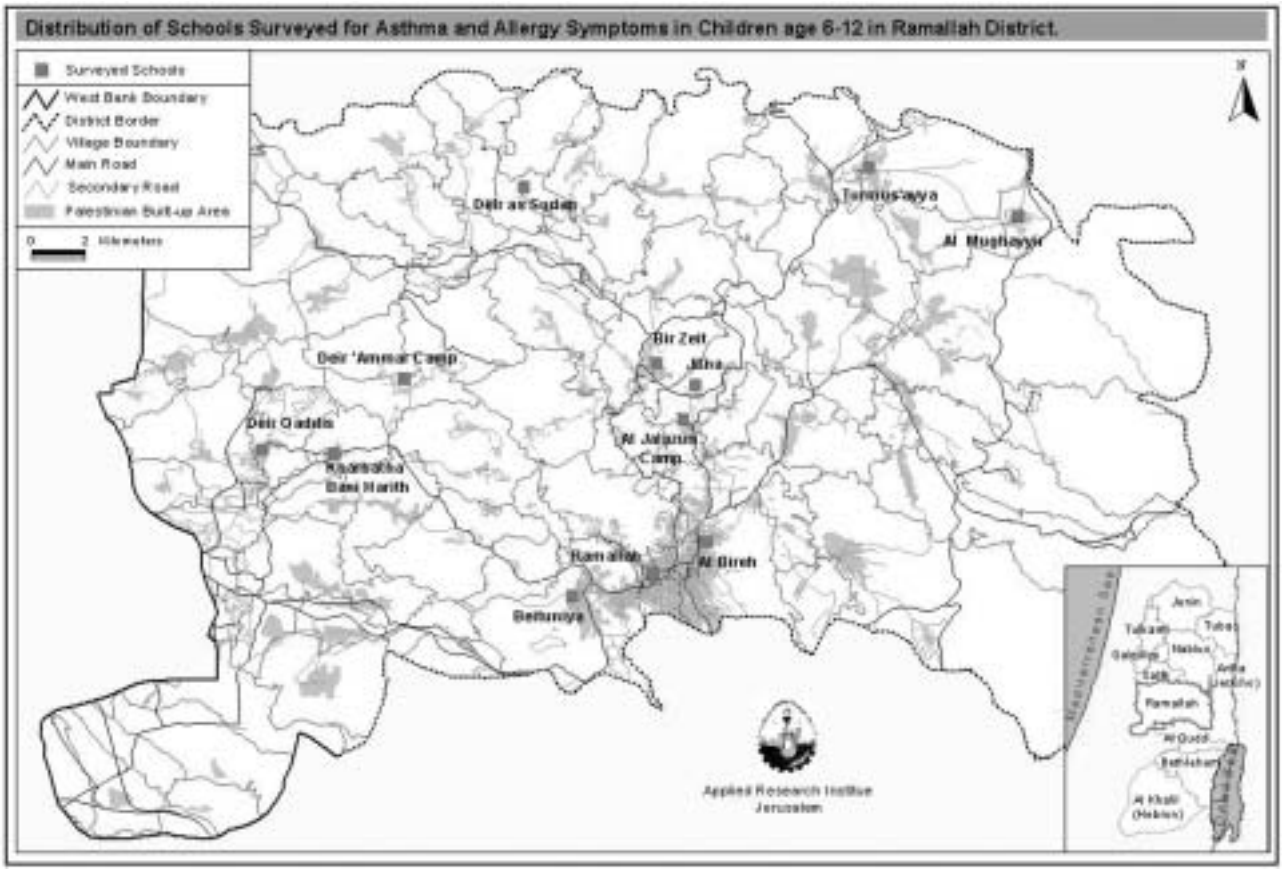

Fig. 1.—Distribution of the 12 selected schools (three in cities, two in refugee camps, seven in villages) that participated in the survey in Ramallah district.

Central Bureau of Statistics (PCBS) definition for cities, villages, and refugee camps. Within the rural areas in Palestine, there are considerable variations in infrastructure, *e.g.* electricity and telephone availability, distance from the main city, and proportion of migrants from outside Palestine. Consequently, rural areas were further stratified into semiurbanized communities (adjacent to cities and with apparently similar lifestyle), typical Palestinian rural villages, and primitive villages (recent electricity and telephone connections, animals kept within houses).

For asthma symptoms, children were classified as having asthma symptoms if they had wheezing or whistling in the chest in the previous 12 months, at least one attack of wheezing, sleeping disturbance due to wheezing or speech-limiting wheezing [22]. A frequency of >12 wheezing attacks per year was considered to reflect more severe asthma.

"Missing values" for any one question did not exceed 4%, and the distribution of the "missing values" did not differ significantly between variables. Therefore, denominators for prevalence varied to a small degree between tables.

The two-tailed Pearson Chi-squared test was used to compare the prevalence rates of asthma and asthma symptoms, and odds ratios (ORs) were calculated to evaluate the strength of association with the various independent demographic variables. The prevalence ratios did not differ from the prevalence OR (POR), and since the prevalence ratio for asthma and asthma symptoms did not exceed 10–20%, the OR was a good approximation of the prevalence ratios [23]. The use of PORs enabled the authors to compare the crude PORs with the adjusted ORs (AORs) in the logistic regression model.

A multivariate logistic regression model (MLR) was used to evaluate variables associated with asthma, while controlling for possible confounding variables (child′s age and sex, place of residence, and place of birth).

Results

Response rate

The total response rate in this study was 86% (3,623 questionnaires returned). However, only children within the predefined age group of 6–12 yrs (n=3,382) were included in the analysis. The response rate was 93% before the Intifada and dropped to 75% after the start of the unrest and the closure between cities and villages. Only 3% of the lost data was due to the refusal of parents to write their child′s name on the questionnaires.

The sample had approximately equal proportions of males and females (53% males, 47% females) (table 1). The mean age±SD was 8.8±1.9 yrs.

Table 1. – Crude prevalence rates and prevalence odds ratios (POR) of parents reporting asthma and asthma symptoms by sex, age group and place of birth in Ramallah district in 2000

		Sex			Age groups			Birth place[+]		
	Total	Male	Female	POR (95% CI)	Age 6–7	Age 8–12	POR (95% CI)	Not Palest.	Palest.	POR[#] (95% CI)
Total numbers[¶]	3382	1782	1600		1048	2334		345	2979	
Wheezing-ever	17.1	18.3	16.4	1.15 (0.96–1.37)	18.3	17.0	1.11 (0.91–1.33)	11.9	17.9	0.63 (0.45–0.87)
Wheezing in the previous 12 months	8.8	9.7	8.2	1.20 (0.95–1.53)	10.2	8.4	1.23 (0.96–1.58)	4.1	9.4	0.41 (0.24–0.69)
Wheezing attacks:										
⩾1 attacks/12 months	7.8	8.6	6.9	1.26 (0.98–1.63)	9.5	7.0	1.39[#] (1.08–1.81)	3.8	8.3	0.44 (0.25–0.75)
⩾4 attacks/12 months	1.7	2.3	1.1	2.07[#] (1.18–3.62)	2.5	1.4	1.77[#] (1.06–2.98)	1.1	1.8	0.58 (0.21–1.61)
Any sleep disturbance in the previous 12 months	5.9	7.0	4.8	1.48[#] (1.10–1.98)	7.0	5.5	1.29 (0.96–1.74)	3.0	6.3	0.46 (0.25–0.85)
Speech disturbance due to wheezing in the previous 12 months	2.0	2.3	1.7	1.37 (0.84–2.24)	2.3	1.9	1.22 (0.74–2.02)	1.1	2.1	0.50 (0.18–1.38)
Physician-diagnosed asthma	9.4	11.4	7.8	1.52[#] (1.20–1.93)	10.1	9.5	1.10 (0.83–1.36)	8.7	9.6	0.90 (0.61–1.32)
Exercise-related wheezing in the previous 12 months	6.0	7.0	5.4	1.31 (0.98–1.75)	6.2	6.3	0.98 (0.72–1.34)	4.9	6.2	0.78 (0.47–1.28)
Night cough without cold or chest infection in the previous 12 months	15.9	17.1	15.9	1.1 (0.91–1.31)	15.6	17.0	0.91 (0.74–1.10)	13.6	16.4	0.80 (0.59–1.10)

CI: confidence interval. [#]: Significant POR; [¶]: In the results, the actual denominator may be somewhat lower, since subjects with missing answers were excluded (<4% of total); [+]: Parents of 58 children did not report child's place of birth.

Univariate analysis

Overall, 8.8% (n=298) of children were reported to have had wheezing in the previous 12 months, and the lifetime prevalence of wheezing was 17.1%. In general, males had higher symptom prevalence than females, and this was significant for severe asthma (the prevalence in males was double that in females) and physician-diagnosed asthma (50% more prevalent) (table 1).

Asthma and asthma symptoms did not show any significant association with age taken as a continuous variable ($p>0.05$), but since ISAAC considers 6–7 yrs as early childhood [21], children were also categorized into 6–7 yrs and 8–12 yrs. Although there were slightly more symptomatic children in the younger age group, this was not significant (table 1). In general, children born outside Palestine (11% of total sample, n=345) were significantly less likely to report symptoms than those born in Palestine. Comparing those born in developed countries (USA, Australia and Europe, n=118) with those born in developing countries (Arab countries, South America, and South Africa, n=227), eight children (7.0%) born in developed countries were diagnosed as asthmatics, and only four (3.4%) had wheezing in the previous 12 months, whereas corresponding figures were 23 (10.4%) and 10 children (4.5%) for those born in developing countries ($p>0.05$).

Table 2 shows that urban areas (cities and camps) generally had higher symptom prevalences and more physician-diagnosed asthma than rural areas. Severity of wheezing attacks was significantly higher in urban areas (⩾one attack of wheezing in previous 12 months POR 1.39 (95% confidence interval (CI) 1.08–1.78), ⩾four attacks was 1.71 (1.01–2.88), and ⩾12 attacks was 2.67 (1.10–6.51)). However, the higher urban figures were entirely attributed to refugee camps figures (fig. 2). Thus, the 12-months wheezing prevalence amounted to 8.2, 7.2 and 12.6% for children residing in villages, cities and refugee camps, respectively ($p<0.001$). Wheezing-ever was reported for 22.1% of children in refugee camps *versus* 16.5 % in cities and 15.5% in villages ($p<0.05$). Physician-diagnosed asthma was almost double in refugee camps than other places (15.6% *versus* 8.1% in villages and 7.3% in cities, $p<0.001$). The semiurbanized villages had very close asthma and asthma symptoms prevalence rates to those seen in cities. Thus, 12-months wheezing was 6.3% in semiurbanized villages *versus* 7.2% in cities. However, the 12-months prevalence was lower in the deprived villages (5.9%) than in other areas ($p<0.01$), but this was not so for other asthma and asthma symptoms.

Table 2. – Crude prevalence rates of parents reporting asthma and asthma symptoms within urban and rural areas in Ramallah district in 2000

	Urban[#]		Rural areas[#]			POR (95% CI)
	Refugee camps	cities	Semi urban	Typical rural	Primitive	
Total numbers[#]	804	761	767	875	175	
Wheezing-ever	22.1	16.5	12.9	18.1	15.8***	1.29[¶] (1.08–1.54)
Wheezing in the previous 12 months	12.6	7.2	6.3	10.2	5.9***	1.24 (0.98–1.58)
Any sleep disturbance in the previous 12 months	9.2	3.4	3.9	7.2	4.6***	1.16 (0.87–1.54)
Speech disturbance due to wheezing in the previous 12 months	3.3	1.3	1.7	2.2	0.6	1.02 (0.59–1.76)
Physician-diagnosed asthma	15.6	7.3	5.6	10.0	9.9***	1.48[¶] (1.17–1.87)
Exercise-related wheezing in the previous 12 months	9.2	4.8	4.0	6.7	6.6***	1.30 (0.98–1.71)
Night cough without cold or chest infection in the previous 12 months	22.9	10.9	11.4	19.8	18.6***	1.08 (0.90–1.30)

POR: prevalence odds ratios for urban *versus* rural areas. [#]: In the results, the actual denominator may be somewhat lower, since subjects with missing answers were excluded (< 4% of total); [¶]: significant POR; ***: p<0.001, used to compare the 5 categories (refugee camps, cities, semiurban, typical rural, primitive rural).

Multivariate logistic regression

The multivariate logistic regression model showed that place of residence (refugee camps, cities, and villages) remained significantly associated with asthma and asthma symptoms after adjusting for sex (more in males), age and place of birth (table 3). "Physician-diagnosed asthma" continued to be significantly associated with sex (AOR 1.31 (95% CI 1.01–1.70)), but this sex effect was no longer present for other asthma symptoms. When taking village residence as a reference, the estimated adjusted risk to have asthma or asthma symptoms (12-months wheezing, asthma-ever, exercise-related asthma and cough at night) was significantly higher for those residing in refugee camps (AOR 1.51, 1.87, 1.61, and 1.54, respectively). Differences between cities and villages did not show statistical significance for 12-months wheezing (AOR 0.83), asthma-ever (0.82) and exercise-related asthma (0.81), except for cough at night (0.63). However, risks were almost double for camps compared to cities for all asthma end points: AOR for 12-months wheezing was 0.56 (95% CI 0.39–0.79), and 0.44 (95% CI 0.31–0.62) for physician-diagnosed asthma, using camps as the reference.

Discussion

More asthma in children living in refugee camps

The novel finding of this prevalence study of childhood asthma in Palestine is that children from

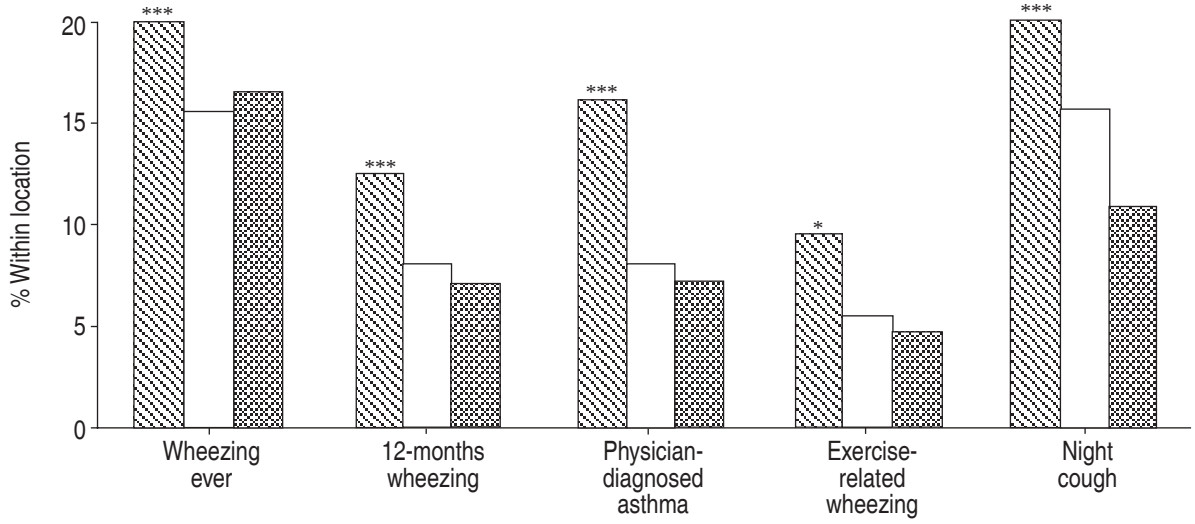

Fig. 2. – Crude prevalence rates of parents reporting asthma and asthma symptoms between the different residence areas (cities (n=761), villages (n=1817) and refugee camps (n=804)) in Ramallah district in 2000. ▨: refugee camps; □: villages; ■: cities. ***: p<0.001.

Table 3. – Multivariate logistic regression model results after controlling for the effect of demographic variables on the reported prevalence of asthma and asthma symptoms in Ramallah district in 2000

	Residence[#]	
	Cities	Refugee camps
Wheezing-ever	1.04 (0.82–1.32)	1.48[¶] (1.18–1.87)
12-months wheezing	0.83 (0.59–1.16)	1.51[¶] (1.12–2.04)
Physician-diagnosed asthma	0.82 (0.59–1.15)	1.87[¶] (1.41–2.49)
Exercise-related asthma	0.81 (0.54–1.22)	1.61[¶] (1.14–2.29)
Cough at night without cold or flu	0.63 (0.48–0.83)	1.54[¶] (1.22–1.94)

Data are presented as adjusted odds ratio (AOR) with 95% confidence intervals (CI) in parentheses. [#]: Villages are reference category; [¶]: significant AOR.

refugee camps appear to be at higher risk of asthma than children from neighbouring villages or cities. They had the highest prevalence of 12-months wheezing (12.6%), lifetime wheezing (22.1%), exercise-related wheezing (9.2%), nocturnal cough (22.9%), physician-diagnosed asthma (15.6%), and other severity indicators. Multivariate logistic regression confirmed that the estimated risk of having wheezing in the previous 12 months was higher for those residing in refugee camps than those living in villages and cities.

At this stage, the authors can only speculate about the possible cause(s) for this observation. One possibility may be that the obtained figures result from a response bias, whereby parents from refugee camps might be more likely to respond positively to health-related questions. The unique situation of refugees in Palestine has made them a recipient for many health education programmes. In addition, the UNRWA provides free healthcare for all registered Palestinian refugees, thus increasing their accessibility to healthcare. Hence, health education and good accessibility to healthcare might have led to higher awareness and, therefore, higher parental reporting of health symptoms, as well as more asthma diagnoses by physicians (15.6% *versus* 8.1% in villages and 7.3% in cities, $p<0.001$). However, the findings in this study may also indicate that the indoor/outdoor environment or other factors in refugee camps really do increase the risk of asthma symptoms. Refugee camps constitute a special type of urban environment. Although no solid data are currently available and it is difficult to make accurate transnational comparisons of the degree of poverty, camps may be compared to the deprived inner cities of European or North-American towns [24, 25], where a strong association between poverty rates and presence of asthma in children has been shown [26, 27]. The refugee camps are characterized by poor housing conditions, dampness (which encourages the growth of moulds and house-dust mites), use of polluting fuels for home heating, and cooking without proper ventilation. In the past year, these conditions were becoming even worse due to the Intifida, which led to particularly strenuous circumstances for the refugee populations. Thus, according to United Nations Office of the Special Coordinator in the Occupied Territories reports [28], there was a rise in unemployment (affecting 38% of the labour force) and poverty (43.8% by the end of 2001), and a dramatic drop in the Gross Domestic Product (GDP), (50.7% of the GDP produced in the period October–November 2000), thus worsening living conditions. Several studies have shown that wheezing is more prevalent in poor communities than in affluent communities [29]. In Latin America, several studies revealed that socioeconomic factors contributed to the prevalence of asthma and asthma symptoms [30]. In the USA, poverty has been associated with increased rates of asthma in black children living in inner cities [31]. In Germany, severe asthma was found to be significantly more prevalent in a low as compared with a high socioeconomic group [32]. Poverty *per se* is not the cause of asthma but conditions associated with deprivation, such as smoking [33], high indoor and outdoor pollution, large family size and crowding, as well as characteristics of diet [29]. However, the exact determinants are not known, and not all data are consistent, particularly in view of the fact that rural communities are often poorer than urban communities.

Urban versus *rural differences in the Middle East and developing countries*

A previous survey, in 1998, compared asthma and asthma symptoms in schoolchildren aged 6–7 and 13–14 yrs in Ramallah city, in the middle area of the West Bank, with those from Anin village in its northern area [16]. However, this survey did not include refugee camps schools nor private schools. Physician-diagnosed asthma in the 1998 study was much lower than the findings in this study (4.5% in Ramallah city in 1998 and 1.7% in Anin village, *versus* 11.2% in urban areas and 7.9% in rural area in Ramallah district in 2000). Similarly lower figures were found for asthma symptoms. This may reflect either a change in the diagnosis for asthma, better access to healthcare services, a more successful health education especially in the rural areas of Ramallah, or an underestimation in the 1998 study. In this study, multivariate logistic regression showed that neither age nor sex had any significant effect on reporting of asthma symptoms. However, physician-diagnosed asthma was higher among males than females, and symptom severity, number of wheezing attacks, speech and sleeping disturbance were more prevalent among the younger and male children. Similar findings were seen in several studies [15], and the findings of this study are consistent with Kuwaiti, British and the Israeli studies [12, 15, 34].

In the present study, the 12-months wheezing prevalence rate in Palestine was 7.2% in the urban areas (excluding refugee camps) and 8.2% in the rural areas, and there was very little difference between

urban and rural areas for most questions, although the lowest 12-months prevalence of wheezing was found in the "primitive" villages (5.9%). In the literature, several studies have shown a relationship between urbanization and asthma. In Scotland [35], Kenya, Ghana [7, 36], and Saudi Arabia [37] asthma occurred more frequently in children living in urban than those living in rural areas. This was also seen among Xhosa children living in urban shanty towns [38], Zimbabwean children in Harare urban areas [38], Kenyan children in urban Nairobi [7], and in Ethiopian children in Jimma urban area [35], compared to children from remote rural areas. Conversely, the Ghanaian-urban-rich children had higher prevalence of exercise-induced bronchoconstriction and atopy than both urban poor and rural children [39]. The latter may be similar to the difference observed here between cities, camps and other rural areas. The findings of the present study suggest that people living in cities in Palestine have not really adopted, in general, the characteristics of what is called "westernized lifestyle" [40, 41]. Many villages, especially in the Ramallah district, are adopting a "semi-Westernized" lifestyle which is similar to those living in cities, especially in cases where villages are inhabited by migrants already having different lifestyles than the original residents.

The 12-months wheezing crude prevalence rate in this study was 8.9%, which ranks Palestine with countries having low asthma prevalence rates such as South Korea, Poland, Hong Kong, Algeria and others, but still higher than other countries such as Romania, China, Taiwan, Indonesia, Greece and Ethiopia [42]. Palestine still has one of the lowest prevalence rates when compared to other countries in the Middle-East region. High rates can be seen in countries such as Saudi Arabia [17], Kuwait [12], and the United Arab Emirates [14]. Furthermore, in Jordan, a neighbouring country where a high percentage of the population are of Palestinian origin, the reported wheezing prevalence was 8.3%, but physician-diagnosed asthma was half that of Palestine (4.1% and 9.3%, respectively) [13]. The difference in the physician-diagnosed asthma between the two countries might be due to variations in health prevention strategies including health education, or differences in healthcare provisions and services. In contrast, in Israel that shares the same outdoor environment as Palestine, asthma and asthma-symptom prevalence in children aged 13–14 yrs, was markedly higher than that of Palestine (12 months wheezing 17.9%) [15]. This might be due to disparity in genetics due to population diversity [33], differences in lifestyle [40], including dietary factors [43], or differences in the indoor environment and allergen exposures [44].

Asthma and migration

Although the number of immigrants was relatively small in the study population, children born in Palestine tended to have higher lifetime wheezing and 12-months wheezing prevalence rates (but not other asthma symptoms) than those born in either developing or more developed countries. These results are not consistent with those from previous studies, which showed that migration in the first year of life results in asthma prevalence having the characteristics of the community from which the child originated [45]. Also, migration from nonindustrialized to industrialized countries has been identified as a risk factor for Asian children moving to the UK and for Pacific islanders moving to Australia and New Zealand [31]. These associations may in fact be the result of type II error, but, to resolve this issue, studies with a bigger sample size should be carried out in Palestine to further investigate this and other associations.

To conclude, the results of this study indicated that children living in refugee camps in Palestine might be at high risk of developing asthma and asthma symptoms. This cross-sectional study had its limitations, since recall bias, and an objective valid test was not used to confirm the results of the questionnaire. This persuaded the authors to plan for a second-stage case-control study on "environmental and lifestyle determinants of childhood asthma in Palestine". These follow-up surveys will help to answer many unresolved questions, especially those related to asthma epidemiology in Palestine, and assist in the adoption of environmental strategies for primary and secondary prevention, which could be implemented in the study area and other countries worldwide.

Acknowledgements. The authors would like to thank the Ministry of Education and the Education Dept at the UNRWA, the field workers and school staff for facilitating the present study and the follow-up studies.

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