
Geographical variations of asthma and asthma symptoms among schoolchildren aged 5 to 8 years and 12 to 15 years in Palestine: the International Study of Asthma and Allergies in Childhood (ISAAC)

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Background: Many studies demonstrated the existence of geographic differences, within and between countries, in the prevalence of asthma, rhinitis, and eczema. However, in Palestine, there are no comprehensive Palestinian data to compare with those from other regional and international centers.

Objective: To describe the prevalence of asthma and asthma symptoms in schoolchildren in two districts (Ramallah and North Gaza) in Palestine.

Methods: After a two-stage stratified systematic sampling, approximately 14,500 schoolchildren, from the first and second grades of elementary school (ages 5 to 8 years) and eighth and ninth school grades (ages 12 to 15 years), were invited to participate in a survey using International Study of Asthma and Allergies in Childhood phase III questionnaires and protocols.

Results: In general, younger children were reported to have a higher 12-month wheezing prevalence rate than older children (9.6 and 7.2%, respectively), and more physician-diagnosed asthma (8.4 and 5.9%, respectively). However, nocturnal cough and exercise-related wheezing were higher in the older age group compared with younger children. Younger children living in North Gaza district showed slightly higher prevalence rates for asthma and asthma symptoms, but older children had higher rates in Ramallah district. After adjustment using logistic regression analysis, male sex, living in inland areas, and younger age were shown to predict 12-month wheezing and physician-diagnosed asthma.

Conclusions: Palestinian children have asthma symptoms rates that are similar to several countries in the Mediterranean region such as Spain and Turkey, but still lower than other Middle East countries such as Saudi Arabia and Israel.

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INTRODUCTION

Asthma is a major public health problem that is increasing in most industrialized^{1,2} and economically developed countries.^{3–6} Several hypotheses have evolved to explain this phenomenon,^{7–11} but none of these could fully explain the ongoing increase in asthma incidence and prevalence worldwide. The third phase of the International Study for Asthma and Allergies in Childhood (ISAAC) aimed to examine time

trends in the prevalence and severity of asthma, allergic rhinoconjunctivitis, and atopic eczema in countries that participated in ISAAC phase I,^{1,2} and to describe these disorders in countries which did not participate in the first phase.

Many studies demonstrated the existence of geographic differences, within and between countries, in the prevalence of asthma, rhinitis, and eczema.^{12–17} Prevalences of self-reported wheezing did not vary markedly among several economically developed English-speaking countries such as New Zealand, Australia, and the United Kingdom.¹⁷ Within the United Kingdom, the prevalence of self-reported asthma symptoms was high among 12- to 14-year-old children, with little geographical or urban/rural variations.¹² However, in Israel, asthma rates were lower in higher altitude districts than in coastal districts with high levels of air pollution.¹⁴ Several studies¹⁸ tried to address these variations by comparing countries with widely differing prevalences, eg, United Kingdom versus Albania,¹⁹ West versus East Germany,²⁰ and Sweden versus Estonia.²¹

Our previous questionnaire study in the Ramallah district of Palestine showed that in children aged 6 to 12 years the

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prevalence of wheezing symptoms in the previous 12 months was 8.8%, and that of physician-diagnosed asthma was 9.4%.²² Asthma and asthma symptoms were more frequent in children from refugee camps than children in villages and cities. Thus, physician-diagnosed asthma was almost twice as prevalent in refugee camps compared with other places. In contrast, the lowest levels of asthma were seen in the deprived villages (12-month wheezing 5.9%). These rates did not differ markedly from those found in a limited study carried out in 1998, which showed prevalence rates of 10.5% for previous 12-month wheezing in urban areas of Ramallah (excluding refugee camps),²³ and 5.5% in a West Bank village called Anin. In our previous study in Ramallah we did not evaluate these conditions in the late childhood phase.²²

The Gaza Strip is located on the Mediterranean Sea coast and has a hot and humid climate during the summer and a mild climate during the winter.^{24,25} In contrast, the West Bank is a hilly region of 2,400 feet altitude, and has cold winter conditions and mild summer weather.^{24,25} The Gaza Strip has a very high population density, a high proportion of refugees, and more poverty than the West Bank (poverty index: 41.3 and 17.1%, respectively).^{24,26} There are no national Palestinian data, especially from Gaza Strip, to compare with those from other regional and international centers using the unified ISAAC protocol.

Our study purpose was to have a comprehensive evaluation of the prevalence of asthma and asthma symptoms in the

Palestinian schoolchildren in early and late childhood. In this paper we present and analyze the prevalence of asthma and asthma symptoms in schoolchildren aged 5 to 8 years and 12 to 15 years in two districts, the Gaza Strip and the West Bank. Further, we checked some of the hypotheses that had evolved in our previous study in the Ramallah district.²²

MATERIALS AND METHODS

Study Population

According to the Palestinian Ministry of Education-Planning Department, there are 167 schools in Ramallah district, of which 133 have primary level classes containing approximately 15,000 children in the first and second grades, and 11,000 children in the eighth and ninth grades. In North Gaza district there are 51 schools with approximately 19,000 children in the first and second grades, and an additional 19 schools with 14,000 children in the eighth and ninth grades. In Palestine, children aged 6 to 7 years are mainly present in the first and second grades and children aged 13 to 14 years are mainly attending the eighth and ninth grades. However, these classes also contain some children outside those ages, mainly because some private and village schools accept children younger than 6 years to start school, consequently affecting the age of children in higher grades. Further, other causes might also have a role such as re-sitting a year of some

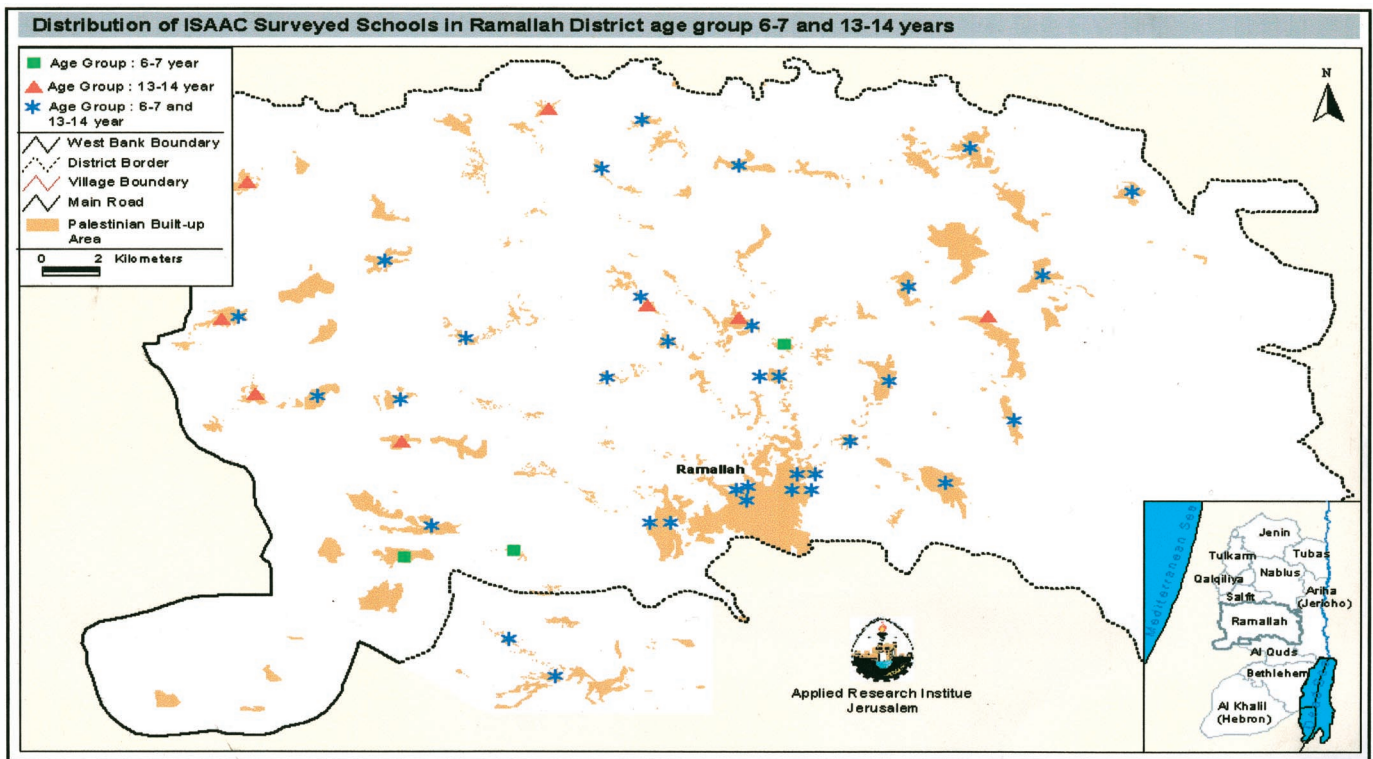


Figure 1. Distribution of participating schools in Ramallah district, by age group in 2000/2001 survey in Palestine.

children and the immigration of many families to Palestine in the past 7 years.

Study Design and Data Collection

A two-stage stratified systematic sampling strategy was used to reach the required sample size. 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 full study design and sample size calculation used in our previous survey for children aged 6 to 12 years²² was applied here separately for each district and for each age group (6 to 7 years and 13 to 14 years) as recommended by the ISAAC protocol.^{27,28}

From our previous survey in Ramallah district on children aged 6 to 12 years,²² collected data of all children in the first and second grades (12 schools, n = 912) were used in this survey. An additional 29 schools selected from the school list in Ramallah district were invited to participate. Eventually, for first and second grade children, a total of 41 schools in Ramallah district (n = 4,709) and 12 schools from North Gaza district (n = 4,120) were included in this survey. For children in the eighth and ninth grades, 41 schools in Ramallah district (n = 4,358) and 10 schools in North Gaza districts (n = 4,050) were included. Figures 1 and 2 show the location of the participating schools. For logistic reasons the survey periods were different for the two age groups. The older age

groups were evaluated between October and December of 2000, whereas the younger age groups were evaluated in the period March to April of 2001.

Questionnaires

The ISAAC phase III parents-administered translated questionnaire used in our previous survey was used for children in the first and second grades.²² The same questionnaire, with some changes to fit with ISAAC phase III recommended version for children aged 13 to 14 years, was used for children in the eighth and ninth grades. A pretest was carried out in two schools (100 children), one school from each district, to test the older children's ability to understand the questionnaire wording. A page was attached to the questionnaire for recording feedback from children regarding wording, phrasing and layout of the questionnaire. Some layout changes were made after the pilot. The pilot results were not included in the final survey.

Older children filled the questionnaires during class hours under the supervision of their class teacher, and younger children took the questionnaire home to have it filled in by their parent or guardian and returned it within a week. Older children who were absent on the school-visiting day filled the questionnaire on another day and younger children were left a copy with the class responsible.

Permission for visiting schools was obtained from the Palestinian Ministry of Education, the Palestinian Ministry of

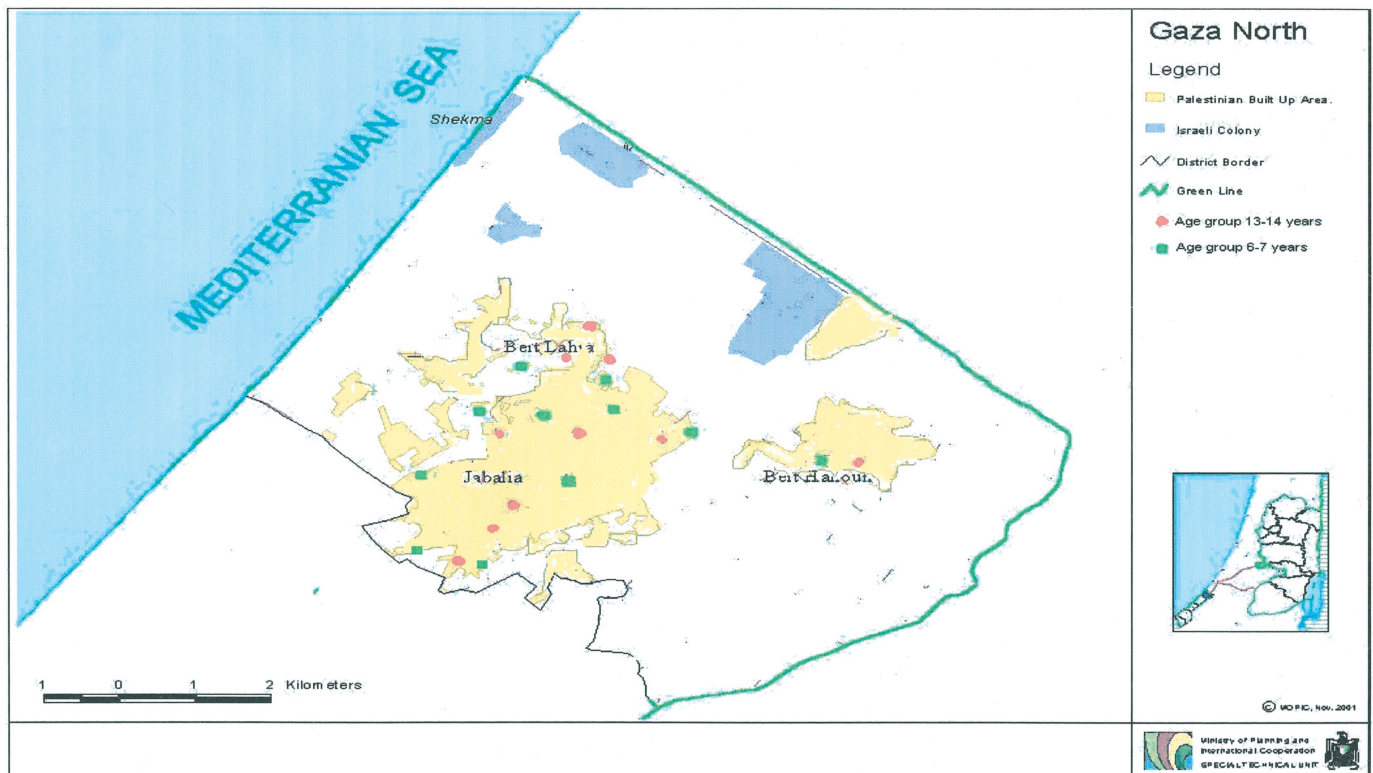


Figure 2. Distribution of participating schools in north Gaza district, by age group in 2000/2001 survey in Palestine.

Health, the United Nations Relief and Works Agency School Education department, and private schools authorities. The Al-Quds University ethical committee also approved the study. A written parental informed consent form was attached to the questionnaire for the first and second grade children, to be signed by the child's parent or guardian. For children in the eighth and ninth grades, informed consent was obtained through the schools' administrations.

Statistical Analysis

EPI-INFO²⁹ and SPSS³⁰ were used for data entry, cleaning, and analysis. "Missing values" for any one question did not exceed 4%, and the distribution of the missing values did not differ significantly between variables. This is why denominators used for prevalence calculations vary to a small degree between tables. Residence place was classified according to the operational definition for cities, villages, and refugee camps of the Palestinian Central Bureau of Statistics.

Two-tailed Pearson χ^2 test was used to compare the prevalence rates of asthma and asthma symptoms. Crude odds ratios for wheezing and asthma and adjusted odds ratios (AOR) were used in the multivariate logistic regression models, one per each age group and one for the pooled data, to evaluate the strength of association with the various independent demographic variables (place of birth, child's sex, age groups categories, place of residence, district of residence).

RESULTS

Final Population and Response Rate

According to the ISAAC protocol, children aged 6 to 7 years and 13 to 14 years, or all children in the selected grades that contain these age groups, have to be screened.²⁸ In the first and second grades 13% of children were aged 5 years and 8 years, and in the eighth and ninth grades 15% of children were aged 12 years and 15 years. An additional analysis was carried out for children aged strictly 6 to 7 years, and for children aged strictly 13 to 14 years. The rates in these groups

did not show any significant difference from those in the wider age ranges 5 to 8 years and 12 to 15 years (data not shown). Consequently, in Ramallah and North Gaza district, all children aged 5 to 8 years of age ($n = 3,746$ and $3,579$, respectively), and all those aged 12 to 15 years ($n = 3,796$ and $3,234$, respectively) were included in the analysis. Few children who did not answer one of the stem questions, eg, "12-month wheezing," and those outside ages 5 to 8 years (1% in both districts) and 12 to 15 years (3% in Ramallah, and 11% in North Gaza) were excluded from analysis. The high percentage of exclusion in North Gaza in the older age group was attributable to the removal of one school from the analysis ($n = 200$). In the data cleaning process, abnormally high reporting of "wheezing ever" (46%) and "wheezing in the previous 12 months" (35%) were found in that school. This overreporting was suspected to be attributable to leading questions by one of the instructors at that school. To verify this, a team consisting of a physician, a nurse, and a field worker later visited 20% of the children who had reported symptoms. The team examined them and filled out the same questionnaire with some additional questions. This showed that only 1% of the children who had initially reported wheezing symptoms had this disorder. Consequently, the data from this manifestly aberrant school were not included.

Therefore, the total response rate for this survey was 87% (84% in the younger age group, and 90% in older children). The mean age was 7.0 years (standard deviation 2.4) for the younger children and 13.8 years (standard deviation 0.9) for the older group with almost equal male to female ratios in the two groups.

Univariate Analysis

Figure 3 shows that in each district younger children had a higher 12-month wheezing prevalence than older children (9.6 and 7.2%, respectively), and more physician-diagnosed asthma (8.4 and 5.9%, respectively). However, reported nocturnal cough and exercise-related wheezing were more fre-

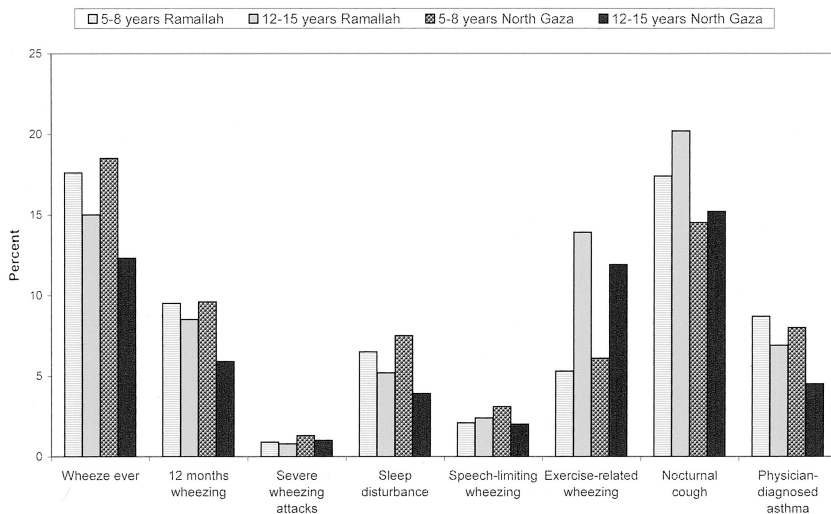


Figure 3. Differences in asthma and asthma symptoms prevalence rates between the two districts for the two age groups in Palestine in 2000/2001.

Table 1. Prevalence (%) of Asthma and Asthma Symptoms by Age Group, District, and Place of Residence in Palestine in 2000/2001

	12-15 years																			
	5-8 years				Palestine				North Gaza				Ramallah				North Gaza			
	Palestine		Ramallah		North Gaza		Palestine		North Gaza		Ramallah		North Gaza		Ramallah		North Gaza			
	city	camp	village	city	camp	village	city	camp	village	city	camp	village	city	camp	village	city	camp	village		
Number of subjects	1,964	1,899	3,462	485	586	2,675	1,479	1,313	787	3,115	1,488	2,427	1,256	348	2,192	1,859	1,140	235		
Wheezing ever	17.1	20.2	17.4†	16.4	21.0	17.0†	17.4	19.9	18.4	11.5	14.8	15.9*	13.4	14.2	16.0	10.3	15.0	15.3†		
12-month wheezing	8.9	10.3	9.5	7.4	12.0	9.4	9.4	9.6	10.0	6.1	7.2	8.9†	8.1	7.8	8.9	4.8	7.0	9.0*		
Nocturnal cough	14.0	15.2	17.7†	14.0	19.3	17.7†	14.0	13.3	17.6†	16.3	17.6	20.1†	20.4	20.9	20.1	13.6	16.6	20.1†		
Exercise-related wheezing	6.0	6.0	5.4	4.3	7.6	5.0†	6.5	5.3	6.8	12.3	11.8	14.6†	14.6	11.2	14.0	10.8	11.9	20.2*		
Physician-diagnosed asthma	7.4	9.6	8.3†	7.3	12.6	8.1†	7.5	8.3	8.7	5.2	6.4	6.5	6.4	10.1	6.7	4.4	5.3	4.7		

χ^2 significance: * $P < 0.001$, † $P < 0.01$, ‡ $P < 0.05$.

quent in the older age group compared with younger children. Younger children living in North Gaza district showed slightly, mainly nonsignificant, higher prevalence rates of symptoms than those from Ramallah, but this was not true for nocturnal cough and physician-diagnosed asthma. For older children, the differences between Ramallah district and North Gaza were opposite, with Ramallah exhibiting significantly higher rates.

Table 1 shows that, in general, younger children living in refugee camps had more physician-diagnosed asthma, wheezing ever, and sleep-disturbing wheezing compared with those living in cities or villages, but not for other symptoms. However, among older children, those living in villages of North Gaza had significantly higher rates in comparison to those living in other places.

As shown in Table 2, males always had higher rates than females, irrespective of age. Comparing younger with older children, younger males from both districts had more 12-month wheezing rates and more physician-diagnosed asthma, but not more nocturnal cough and exercise-related wheezing. Being born outside Palestine did not show any significant effect when compared with being born within the country, except for physician-diagnosed asthma (6.0 and 7.3%, respectively) and wheezing ever (14.2 and 16.1%, respectively; data not shown).

Multivariate Logistic Regression Analysis

Table 3 shows that male sex had an important role in determining asthma and asthma symptoms in the pooled population and in the two age groups. The pooled data did not show any effect for district location on 12-month wheezing, but there was a 20% increased risk for asthma diagnosis if a child lived in Ramallah district, and an increased risk to report more symptoms in the younger children.

In the separate age models, the estimated risk for district location did not exceed a twofold risk (AOR < 2.0) in the older age group, and there was no excess risk in the younger age group. Place of residence and place of birth did not show any significant effect in any of the models. For children aged 5 to 8 years, residence in camps showed an association with wheezing ever (AOR 1.20, 95% confidence interval 1.04 to 1.40) and living in an inland district showed a significant association with nocturnal cough (AOR 1.28, 95% confidence interval 1.13 to 1.46; data not shown).

DISCUSSION

This is the first survey that describes the burden of asthma in schoolchildren from the two relevant regions of Palestine, namely the West Bank and the Gaza Strip. The strengths of this study are the relatively large sample size, the high response rate, and the use of the internationally used and validated ISAAC protocol and questionnaire. The size of the sample gives a power to detect a difference of 1% level and 90% power.

Our study results show that Palestine has similar prevalence rates to several countries in the Mediterranean region

Table 2. Prevalence (%) of Asthma and Asthma Symptoms by Age Group, District, and Gender in Palestine in 2000/2001

	5–8 years						12–15 years					
	Palestine		Ramallah		North Gaza		Palestine		Ramallah		North Gaza	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Number of subjects	3,290	4,035	1,723	2,023	1,567	2,012	3,028	4,002	1,868	1,928	1,160	2,074
Wheezing ever	20.8	15.8*	19.8	15.8†	22.0	15.9*	15.4	12.5*	15.1	14.9	15.9	10.3*
12-month wheezing	11.1	8.3*	10.7	8.6‡	11.5	8.1*	8.2	6.6†	8.9	8.1	7.1	5.2‡
Nocturnal cough	17.2	15.2‡	18.0	16.9	15.9	13.5‡	19.6	16.6†	21.8	18.8‡	16.1	14.6
Exercise-related wheezing	6.2	5.3	5.5	5.2	7.0	5.5‡	14.9	11.5*	17.3	10.7*	11.3	12.2
Physician-diagnosed asthma	9.7	7.3*	9.4	8.2	10.2	6.4*	7.9	4.4*	8.4	5.5*	7.1	3.4*

χ^2 significance: * $P < 0.001$, † $P < 0.01$, ‡ $P < 0.05$.

such as Spain,^{31,32} Greece,³³ and neighboring countries such as Jordan,³⁴ but lower rates than other industrialized and economically developed^{35,36} and Middle East countries.^{6,14,37}

Geographic Variations, Socioeconomic Factors, and Asthma

The major finding of this study is that younger age children living in the coastal areas of Palestine, in general, were more frequently reported to have asthma and asthma symptoms than those residing in higher altitude inland areas. This was not observed in older age children. Several studies showed differences in asthma and its symptoms between coastal and inland areas, but others either failed to demonstrate such differences or had contradictory results.^{12,38,39} In Latin America, hot and humid tropical latitudes areas indicated higher prevalence rates for asthma,³⁸ and in Australia, coastal cities had higher rates than dry inland cities.³⁹ In Israel, however, a country that shares the same climate as Palestine, coastal cities showed very high prevalence rates for wheezing in children aged 13 to 14 years, compared with other cities in the northern and central parts.¹⁴ In comparison, North Gaza is located on the same shore and only a few kilometers from the studied Israeli cities, but showed much lower prevalence rates than the industrial cities of Israel. Consequently, our results suggest that other factors such as ethnicity, socioeconomic factors, outdoor pollution, and lifestyle determinants have a more important role in determining asthma than geographic location itself.

In our previous survey of children aged 6 to 12 years in the Ramallah district, we found that living in refugee camps was associated with higher asthma rates than living in other urban or rural areas.²² In this survey, which includes the data from the 912 children of our previous survey,²² this was still true for younger children residing in the Ramallah district, but the association was not found in either older children of both districts, nor in younger children living in the North Gaza district. We have no definitive explanation for this observation, but we speculate that differences in socioeconomic conditions between the Ramallah and North Gaza districts could explain it. In the Ramallah district people are adopting a more westernized lifestyle, and they have lower poverty rates than in North Gaza (9.9 and 35.4%, respectively, in

1998),²⁶ and refugee camps are mainly separated from cities and villages, so differences in lifestyles and indoor environment could still be noticed. Further, these results might be compatible with the “hygiene hypothesis,”¹¹ as the population in the Gaza Strip is very young, with high density, and of large family size compared with the Ramallah district population. No obvious differences in outdoor environment among villages, cities, and refugee camps are apparent in the North Gaza district, and refugee camps are located within the cities and villages, and sometimes it is not possible to separate the different types of residential areas within the district. In addition, the urbanization phenomenon in the past 20 years affected mainly the rural areas and led to more similarity in lifestyles among the different residential locations, which was much more pronounced in the Gaza Strip.

Several studies have shown an effect of socioeconomic level, deprivation, and impoverished urban households in increasing the risk for asthma.^{40–42} In the British-Scottish study, geographic variation of persistent wheeze was attributed to poverty either by itself or through a less adequate management of asthma among the poorer families, especially in the inner-city areas.¹⁶ The latter factor does not seem to apply to the Palestinian situation, because refugees have generally better access to health care facilities compared with villages and cities in both districts. As Roberto Rona explains, “asthma could be related to structural poverty—that is, characteristics that are essential to being poor—or characteristics that are associated with the poorest groups in a country.”⁴⁰ Eventually, gene-environment interaction could possibly explain some of these findings, taking into consideration socioeconomic differences within the country.

This study showed that children in both districts had at least a double prevalence rate of nocturnal cough, especially in the older children, when compared with physician-diagnosed asthma rates. This finding was seen in several developing countries such as Kuwait,³⁷ Latin American countries,³⁸ and among Israeli Arabs but not Jews.¹⁴ However, in other economically developed industrialized countries the difference was not considerable.¹² This might reflect underdiagnosis of asthma among Palestinian children, or overreporting of nocturnal cough attributable to the fact that this symptom can

Table 3. Multivariate Logistic Regression for Asthma and Asthma Symptoms for Each Age Group in Palestine in 2000/2001

	Wheezing ever			12-month wheezing			Nocturnal cough			Exercise-related wheezing			Physician-diagnosed asthma		
	COR	AOR	95% OR	COR	AOR	95% OR	COR	AOR	95% OR	COR	AOR	95% OR	COR	AOR	95% OR
Pooled data-Palestine															
Gender (male)*	1.35	1.33	(1.22-1.46)	1.33	1.31	(1.16-1.47)	1.18	1.15	(1.05-1.25)	1.27	1.29	(1.15-1.44)	1.56	1.51	(1.31-1.72)
District residence*	—	—	—	1.17	1.15	(1.02-1.30)	1.34	1.23	(1.11-1.36)	—	—	—	1.24	1.20	(1.05-1.37)
Age groups*	1.38	1.36	(1.23-1.49)	1.34	1.32	(1.17-1.49)	0.84	0.86	(0.78-0.94)	0.40	0.40	(0.35-0.45)	1.46	1.45	(1.27-1.65)
Place of residence*:															
Cities	0.79	0.84	(0.76-0.94)	0.76	0.81	(0.70-0.93)	0.80	0.86	(0.77-0.97)	—	—	—	0.79	0.96	(0.81-1.14)
Refugee camps	1.08	1.08	(0.96-1.21)	0.97	0.97	(0.83-1.12)	0.86	0.96	(0.84-1.09)	—	—	—	1.11	1.25	(1.05-1.50)
5-8 years															
Gender (male)*	1.40	1.40	(1.23-1.57)	1.37	1.36	(1.16-1.59)	—	—	—	—	—	—	1.37	1.37	(1.16-1.62)
District residence*	—	—	—	—	—	—	1.25	1.25	(1.10-1.41)	—	—	—	—	—	—
Place of residence*:															
Cities	0.99	0.98	(0.85-1.14)	—	—	—	—	—	—	—	—	—	0.89	0.88	(0.72-1.09)
Refugee camps	1.21	1.22	(1.06-1.41)	—	—	—	—	—	—	—	—	—	1.19	1.20	(0.99-1.46)
12-15 years															
Gender (male)*	1.27	1.24	(1.08-1.43)	1.27	1.21	(1.01-1.46)	1.20	1.15	(1.01-1.31)	1.36	1.37	(1.19-1.58)	1.85	1.75	(1.42-2.14)
District residence*	—	—	—	1.49	1.44	(1.19-1.74)	1.40	1.35	(1.19-1.53)	—	—	—	1.50	1.36	(1.10-1.68)
Place of residence*:															
Cities	0.69	0.70	(0.60-0.82)	—	—	—	—	—	—	0.82	0.84	(0.72-0.98)	—	—	—
Refugee camps	0.92	0.89	(0.75-1.07)	—	—	—	—	—	—	0.79	0.75	(0.62-0.92)	—	—	—

* Reference categories: female gender, living in coastal district, rural residence, and older age group.

COR, Crude odds ratio; AOR, adjusted odds ratio.

Forward likelihood ratio using logistic regression model was used to predict factors associated with wheezing symptoms. Only variables that stayed in the models and were associated with the outcome variables are presented.

also be a consequence of other diseases such as pneumonia or bronchitis.

Effect of Age, Sex, and Migration

The overall picture in this study shows that younger and male Palestinian children have more asthma and asthma symptoms than older and female children. However, in both areas, older children reported more cough at night and exercise-related wheezing, which might be related to specific exposures at this age, such as smoking, rather than asthmatic symptoms per se, which could confound the association between district of residence and asthma symptoms. Unfortunately, this survey questionnaire did not include such questions. It should also be noted that the questionnaire was completed by parents of young children and by the older children themselves, and this complicates any comparisons between the age groups. Further, older children spend most of the daytime at schools or playing outside the house, so a higher reporting of exercise-related wheezing is expected among these children.

Our results are consistent with studies in Italy⁴³ and Latin American countries³⁸ that showed higher prevalence rates of asthma symptoms in children aged 6 to 7 years, but not for exercise-related wheezing. However, our results are incompatible with other studies such as those on Australian children.⁴⁴ It is believed that children can "outgrow" their asthma,⁴⁵ especially the less troublesome asthma,⁴⁶ whereas the Melbourne study showed that troublesome asthma at age 7 years continued until age 14 years and adulthood.⁴⁷

In this study, male children proved to be at greater risk to report asthma and asthma symptoms, even after adjustment for age. This association of asthma with sex effect had been studied extensively.⁴⁸ Some published studies that used the same ISAAC protocol did not show consistent results for the relationship between sex and asthma. For example, in Italy, the older age group showed higher rates among females,⁴³ but there was no significant difference in the Latin America countries,³⁸ Spain,³¹ or Turkey.⁴⁹ This could be related to biologic and physiologic differences, or may be attributed to social influences, which may lead to over- or underreporting of symptoms in either sex.

Place of birth in this survey showed some association with asthma in the univariate analysis, but could not predict asthma or its symptoms after adjustment. Our previous survey showed that children born in Palestine tended, unexpectedly, to have higher lifetime wheezing and 12-month wheezing prevalence rates (but not other asthma symptoms) than those born in either developing or more developed countries.²² However, the numbers were low, and now with this large sample size where 10% (n = 1,449) were born outside Palestine, we could not show any association between place of birth and asthma.

CONCLUSION

We speculate that in Palestine, which is defined as a transition-economy country, the substantial variation in lifestyle, urbanization, and inequalities in income could affect asthma

prevalence. The increased standard of living may be important and might have an important role in asthma determination, ie, changes in diet and reductions in early childhood diseases such as acute respiratory infections, which is among the top 10 causes for morbidity and mortality among Palestinian children. This survey helped in developing and clarifying some of the hypothesis for asthma prevalence in Palestine, but there is a need for further studies for the evaluation of risk factors associated with the development of asthma among those children.

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REFERENCES

1. Austin JB, Kaur B, Anderson HR, et al. Hay fever, eczema, and wheeze: a nationwide UK study (ISAAC, international study of asthma and allergies in childhood). *Arch Dis Child* 1999;81:225–230.
2. Faniran AO, Peat JK, Woolcock AJ. Prevalence of atopy, asthma symptoms and diagnosis, and the management of asthma: comparison of an affluent and a non-affluent country. *Thorax* 1999;54:606–610.
3. Sears MR. Epidemiology of childhood asthma. *Lancet* 1997;350:1015–1020.
4. Weissman DN. Epidemiology of asthma: severity matters. *Chest* 2002;121:6–8.
5. von Mutius E. The increase in asthma can be ascribed to cleanliness. *Am J Respir Crit Care Med* 2001;164:1106–1107.
6. Al Frayh AR, Shakoor Z, Gad El Rab MO, Hasnain SM. Increased prevalence of asthma in Saudi Arabia. *Ann Allergy Asthma Immunol* 2001;86:292–296.
7. Becker AB, Chan-Yeung M. Primary prevention of asthma. *Curr Opin Pulm Med* 2002;8:16–24.
8. Melbostad E, Eduard W, Magnus P. Determinants of asthma in a farming population. *Scand J Work Environ Health* 1998;24:262–269.
9. Dold S, Wjst M, von Mutius E, et al. Genetic risk for asthma, allergic rhinitis, and atopic dermatitis. *Arch Dis Child* 1992;67:1018–1022.
10. Sengler C, Lau S, Wahn U, Nickel R. Interactions between genes and environmental factors in asthma and atopy: new developments. *Respir Res* 2002;3:7.
11. Strachan DP. Family size, infection and atopy: the first decade of the "hygiene hypothesis." *Thorax* 2000;55(Suppl):S2–S10.
12. Kaur B, Anderson HR, Austin J, et al. Prevalence of asthma symptoms, diagnosis, and treatment in 12–14 year old children across Great Britain (international study of asthma and allergies in childhood, ISAAC UK). *BMJ* 1998;316:118–124.
13. Burr ML, Limb ES, Andrae S, et al. Childhood asthma in four countries: a comparative survey. *Int J Epidemiol* 1994;23:341–347.
14. Shohat T, Golan G, Tamir R, et al. Prevalence of asthma in 13–14 yr-old schoolchildren across Israel. *Eur Respir J* 2000;

- 15:725–729.
15. Peat JK, van den Berg RH, Green WF, et al. Changing prevalence of asthma in Australian children. *BMJ* 1994;308:1591–1596.
 16. Duran-Tauleria E, Rona RJ. Geographical and socioeconomic variation in the prevalence of asthma symptoms in English and Scottish children. *Thorax* 1999;54:476–481.
 17. Venables KM, Farrer N, Sharp L, et al. Respiratory symptoms questionnaire for asthma epidemiology: validity and reproducibility. *Thorax* 1993;48:214–219.
 18. Pearce N, Pekkanen J, Beasley R. How much asthma is really attributable to atopy? *Thorax* 1999;54:268–272.
 19. Priftanji A, Strachan D, Burr M, et al. Asthma and allergy in Albania and the UK. *Lancet* 2001;358:1426–1427.
 20. Matricardi PM. Prevalence of atopy and asthma in eastern versus western Europe: why the difference? *Ann Allergy Asthma Immunol* 2001;87:24–27.
 21. Annus T, Bjorksten B, Mai XM, et al. Wheezing in relation to atopy and environmental factors in Estonian and Swedish schoolchildren. *Clin Exp Allergy* 2001;31:1846–1853.
 22. El-Sharif N, Abdeen Z, Qasrawi R, et al. Asthma prevalence in children living in villages, cities and refugee camps in Palestine. *Eur Respir J* 2002;19:1026–1034.
 23. Hasan MM, Gofin R, Bar-Yishay E. Urbanization and the risk of asthma among schoolchildren in the Palestinian Authority. *J Asthma* 2000;37:353–360.
 24. Census Final Results—Summary (Population, Housing, Buildings, Establishments). PCBS 1999; Ramallah, Palestine. <http://www.PCBS.org>. Accessed May 2002.
 25. Palestinian Ministry of Health Annual Report: 1999. Nablus, Palestine: Palestinian Ministry of Health, 2000.
 26. Poverty in the West Bank and Gaza. World Bank, Middle East and North Africa Region. West Bank, Palestine: World Bank reports, 2001.
 27. Asher MI, Keil U, Anderson HR, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *Eur Respir J* 1995;8:483–491.
 28. International study of asthma and allergies in childhood. Phase one manual. Auckland, New Zealand: ISAAC International Data Center, 1998.
 29. EPI-INFO version 6.04 software package. Atlanta, Georgia: Centers for Disease Control and Prevention (CDC), 1999.
 30. Statistical Package for the Social Sciences. Chicago, IL: SPSS Institute, 2002.
 31. Busquets RM, Anto JM, Sunyer J, et al. Prevalence of asthma-related symptoms and bronchial responsiveness to exercise in children aged 13–14 yrs in Barcelona, Spain. *Eur Respir J* 1996;9:2094–2098.
 32. Gonzalez DC, Sanchez GE, Garcia ML, et al. Prevalence and severity of asthma in 13–14-year-old children in Bilbao. *An Esp Pediatr* 1998;48:608–614.
 33. Anthracopoulos M, Karatza A, Liolios E, et al. Prevalence of asthma among schoolchildren in Patras, Greece: three surveys over 20 years. *Thorax* 2001;56:569–571.
 34. Abuekteish F, Alwash R, Hassan M, Daoud AS. Prevalence of asthma and wheeze in primary school children in northern Jordan. *Ann Trop Paediatr* 1996;16:227–231.
 35. von Mutius E, Fritzsche C, Weiland SK, et al. Prevalence of asthma and allergic disorders among children in united Germany: a descriptive comparison. *BMJ* 1992;305:1395–1399.
 36. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet* 1998;351:1225–1232.
 37. Behbehani NA, Abal A, Syabbalo NC, et al. Prevalence of asthma, allergic rhinitis, and eczema in 13- to 14-year-old children in Kuwait: an ISAAC study. *International Study of Asthma and Allergies in Childhood. Ann Allergy Asthma Immunol* 2000;85:58–63.
 38. Mallol J, Sole D, Asher I, et al. Prevalence of asthma symptoms in Latin America: the international study of asthma and allergies in childhood (ISAAC). *Pediatr Pulmonol* 2000;30:439–444.
 39. Haby MM, Peat JK, Marks GB, et al. Asthma in preschool children: prevalence and risk factors. *Thorax* 2001;56:589–595.
 40. Rona RJ. Asthma and poverty. *Thorax* 2000;55:239–244.
 41. Stevenson LA, Gergen PJ, Hoover DR, et al. Sociodemographic correlates of indoor allergen sensitivity among United States children. *J Allergy Clin Immunol* 2001;108:747–752.
 42. Ernst P, Demissie K, Joseph L, et al. Socioeconomic status and indicators of asthma in children. *Am J Respir Crit Care Med* 1995;152:570–575.
 43. Peroni DG, Piacentini GL, Zizzo MG, Boner A. Prevalence of asthma and respiratory symptoms in childhood in an urban area of north-east Italy. *Monaldi Arch Chest Dis* 1998;53:134–137.
 44. Robertson CF, Dalton MF, Peat JK, et al. Asthma and other atopic diseases in Australian children. Australian arm of the International Study of Asthma and Allergy in Childhood. *Med J Aust* 1998;168:434–438.
 45. Grol MH, Gerritsen J, Postma DS. Asthma: from childhood to adulthood. *Allergy* 1996;51:855–869.
 46. Oswald H, Phelan PD, Lanigan A, et al. Outcome of childhood asthma in mid-adult life. *BMJ* 1994;309:95–96.
 47. Phelan PD, Robertson CF, Olinsky A. The Melbourne asthma study: 1964–1999. *J Allergy Clin Immunol* 2002;109:189–194.
 48. Venn A, Lewis S, Cooper M, et al. Questionnaire study of effect of sex and age on the prevalence of wheeze and asthma in adolescence. *BMJ* 1998;316:1945–1946.
 49. Akcakaya N, Kulak K, Hassanzadeh A, et al. Prevalence of bronchial asthma and allergic rhinitis in Istanbul school children. *Eur J Epidemiol* 2000;16:693–699.

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