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Allergic conditions in 5–8-year-old Maltese schoolchildren: Prevalence, severity, and associated risk factors [ISAAC]

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Allergic conditions, especially asthma, seem to be increasingly common worldwide. The International Study of Asthma and Allergies in Childhood (ISAAC) was the first study carried out worldwide using standardized questionnaires in order to create a reliable global map of childhood allergy. The Maltese Islands were one of the centres that participated in this study and in this article the data obtained from 3,506 5–8-year-old children from 24 state schools (78.5% response rate), and also data obtained from some added 'local' questions addressed to the same children, were analyzed in order to evaluate the problem of allergic conditions in Maltese schoolchildren. Of the participants, 19.1% were wheezers 'ever,' while 8.8% were current wheezers. Of the latter, 15.9% experienced nocturnal wheezing at least once a week and 13.3% had a wheezing episode of sufficient severity to limit speech. Nasal problems were present in 23.4% of these children, and in 20.7% of all respondents these symptoms persisted up to the year of answering the questionnaire. Hay fever had been diagnosed in 14.7% of all the children. Seven per cent of respondents had a recurrent, itchy rash (suggestive of eczema) for at least 6 months of their lives and 5.5.% had it currently. The prevalence of wheezing and eczema were slightly lower than the global mean, unlike rhinitis which in Malta was commoner than the world average. Multiple variables, such as gender, breast-feeding, passive smoking, family history of atopy, pets, soft furnishings, and living next to busy roads, were factors that affected the prevalence and severity of the allergic conditions studied. In conclusion, allergic conditions are very common in Maltese schoolchildren and cause great hardship to these same youngsters. The results of this study should serve as a stimulus to try to decrease this suffering through better management of these conditions, measures to control identified detrimental factors (such as passive smoking), and further research on asthma, allergic rhinitis and eczema.

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The prevalence of asthma and other allergic conditions, such as allergic rhinitis and eczema, is increasing worldwide (1–3). This has far-reaching implications in terms of the quality of life of the people affected (4), the mortality from asthma (5), and the direct medical and indirect social costs on the country's economy (6).

Various asthma prevalence studies have been conducted in many parts of the world but as these have rarely been carried out in a standardized

manner, results between different countries or indeed between different parts of the same country could not reliably be compared. In Phase I of the International Study of Asthma and Allergies in Childhood (ISAAC) study, standardized questionnaires were developed and distributed to two age-groups of children in participating countries (7).

In this article we report our analysis of the ISAAC phase I written questionnaire survey of 5–8-year-old schoolchildren in the Maltese Islands. We also included the answers to some additional questions that analyzed factors which might contribute to the prevalence and severity of the allergic conditions of these children (8).

The Maltese Islands are an archipelago in the middle of the Mediterranean (14° east latitude and 35° north latitude), with two main populated islands – Malta and Gozo. Malta has an area of 246 km^2 and a population of 330,000, while Gozo is smaller with an area of 67 km^2 and a population of approximately 30,000. These densely populated small islands are inhabited almost solely by Maltese people and there are no other ethnic groups of note.

Materials and methods

Questionnaires

The ISAAC standard questionnaire consisted of three main sections, each involving questions relating to the prevalence and severity of wheezing, rhinitis, and eczema, respectively. These questionnaires had been validated in previous studies (7). As the great majority of Maltese parents speak English fluently, they were given a choice of answering either a Maltese or an English version of the questionnaire. The Maltese version of the questionnaire had been back-translated as a validity check, before the questionnaires were printed. At the end of the standard questionnaire, we opted to add a separate list of questions regarding factors that were of 'local' interest and which might contribute to the allergic conditions of children in Malta. These questions related to a family history of allergy, breast-feeding, passive smoking, the presence of soft furnishings in the bedroom and pets in the house, and the amount of traffic in the street where the children lived.

Sampling and data collection

Twenty-four state primary schools from Malta and Gozo were randomly chosen. We opted to use the state schools as our sampling frame, as we were interested in the local geographical representation of allergic conditions in Maltese and Gozitan children. The selected age-group for the international arm of the ISAAC study was 6–7 years but for the national analysis our center decided to analyze all the data obtained and thus our figures included data from a 5–8-year-old age-range of children. The schools were scattered all over the two islands, and the total number of children within the two school years which included the largest number of 6–7-year-olds was 4,465. This constituted 59.1% of children within this age-group attending state schools in the Maltese Islands. The sampling frame from each school ranged from 22 to 370 children. When all children in the chosen classes were included in the calcu-lation, the total response rate was 78.5, as 3,506 children participated in the study. Sixty-eight per cent of the participants were from the 6–7-year age-group, while 32% were from the 5- and 8-year age-groups. Of all the participants, 51.6% were boys.

The ISAAC protocol recommended that at least half of the study population should be investigated before the main pollen season. The data for this study was collected between March and June and as a result the study was carried out during different seasons, with more than half of the study being complete before the main pollen season in April and May.

Consent

The parents of the participating children were sent an information sheet about the study, and answering the questionnaire obviously indicated consent. A contact telephone number was available for the parents in the event that they had any queries about the study.

Ethical approval

The study was approved by the Ethics Committee of the Malta Medical Council.

Statistical analysis

The data from the questionnaires were double-entered, by data-input clerks, into Epi-info, a computer program for the capture and processing of epidemiological data. The data sets were then validated and consolidated by a single data manager. Results were analyzed and tested for statistical significance through the calculation of chi-square values and odds ratios. The Student's *t*-test (for the difference between rates) and Fisher's exact test were used when appropriate.

Table 1. Responses to core questions on asthma, rhinitis, and eczema

Responses	Total (%)	Boys (%)	Girls (%)	p-value
Reponses for asthma				
Wheeze 'ever'	19.1	20.1	17.9	
Wheeze in the last 12 months	8.8	8.9	8.7	
Diagnosed asthma	7.5	8.4	6.5	<0.03
Exercise-induced wheeze	4.1	4.2	3.9	
Nocturnal cough	19	19.3	18.8	
Responses for rhinitis				
Nasal problem 'ever'	23.4	24.3	22.5	
Nasal problem in the last 12 months	20.7	21.4	19.9	
Diagnosed rhinitis	14.7	14.8	14.6	
Associated itchy eyes	34.8	33.8	36	
Responses for eczema				
Recurrent rash 'ever'	7	7.1	6.9	
Recurrent rash in the last 12 months	5.5	5.6	5.4	
Diagnosed eczema	4.4	4.1	4.7	

Results

Responses to the questionnaire on wheezing

The most significant results are shown in Tables 1 and 2. Night-time cough was a common symptom (which occured in 19% of children) and was as specific as exercise-induced wheezing, both to one-time and to current wheezers ($p < 0.0001$).

Effect of multiple variables on asthma prevalence and symptoms (Table 3)

Of wheezers 'ever', 71.7% had an atopic relative while only 45.8% of non-wheezers had one ($p<0.0001$). The same applied to current wheezers (48.5% versus 35.7%, $p<0.001$). Wheezers who had an atopic relative were more prone to have exercise-induced symptoms ($p<0.0001$), nocturnal cough ($p<0.0001$), and be labeled as asthmatic ($p<0.0001$).

The mothers of 41.9% of participating children had breast-fed them. Of these breast-fed children, 20.8% were wheezers 'ever', which was similar to the prevalence rate in non-breast-fed children (18.5%). Among the breast-fed wheezers, 41.7% remained wheezing in the past year while in the non-breast-fed group this rate of persistent wheezing was 49% ($p = 0.06$).

Of all the respondents, 49.6% were passive smokers. Children who had wheezed at some time-point in their life were not more likely to be passive smokers than non-wheezers, but the passive smokers were more likely to have continued wheezing in the previous year ($p<0.004$).

Children who lived in roads that their parents described as being busy with passing traffic were no more often one-time or current wheezers than those living in quiet roads. However, these wheezers were more likely to experience very severe attacks of asthma ($p<0.001$) and be labeled as

Table 2. Severity of symptoms*

	Total (%)	Boys (%)	Girls (%)
Severity of wheezing			
1–3 wheezing attacks in the last 12 months	74.7	70.2	79.6
4–12 wheezing attacks in the last 12 months	15.6	20.5	10.2
>12 wheezing attacks in the last 12 months	2.6	1.9	3.4
Sleep never disturbed by wheezing	48.1	44.7	51.7
Sleep disturbed by wheezing <1 night/week	27.6	31.7	33.1
Sleep disturbed by wheezing >1 night/week	15.9	16.8	15
Severe asthmatic episodes in the last 12 months	13.3	14.2	12.2
Severity of rhinitis			
Did not affect daily activity	34.8	36.3	33
Daily activity affected a little	45.3	44.1	46.7
Daily activity affected moderately	11.7	13.9	9.2
Daily activity affected a lot	4.3	2.3	6.5
Severity of itchy rash			
Rash never keeps child awake	53.6	59.8	46.7
Rash keeps child awake <1 night/week	18	15.7	20.7
Rash keeps child awake >1 night/week	8.2	6.7	9.8

*Expressed as the percentage of respondents with current symptoms of allergic condition.

Table 3. Effects of multiple variables on the reported symptoms and diagnosis of asthma, rhinitis, and eczema

	Male gender	Breast-fed	Passive smoking	Busy road	Pets	Atopic relative	Blankets
Wheeze 'ever'	NS	NS	NS	NS	NS	3.16*** (2.60–3.85)	0.79*** (0.67–0.95)
Wheeze in the last 12 months	NS	NS	1.57** (1.13–2.17)	NS	NS	1.72** (1.18–2.52)	NS
Nocturnal wheeze	NS	NS	NS	NS	NS	NS	NS
Bad attack	NS	NS	NS	2.95** (1.24–7.22)	NS	NS	NS
Exercise-induced wheeze	NS	NS	NS	NS	NS	3.81*** (2.44–5.98)	0.64* (0.45–0.90)
Cough in the last 12 months	NS	NS	NS	1.34* (1.12–1.60)	NS	2.58*** (2.13–3.12)	NS
Diagnosed asthma	1.32* (1.02–1.72)	NS	NS	1.39* (1.06–1.83)	0.76* (0.58–0.99)	3.61*** (2.62–4.98)	0.66** (0.51–0.85)
Rhinitis 'ever'	NS	NS	NS	1.22** (1.03–1.44)	0.79** (0.67–0.93)	2.54*** (2.13–3.02)	0.75** (0.64–0.88)
Rhinitis in the last 12 months	NS	NS	NS	2.05* (1.26–3.35)	NS	NS	NS
Itchy eyes	NS	NS	NS	NS	NS	NS	NS
Diagnosed hay fever	NS	NS	NS	NS	0.75** (0.62–0.91)	4.21*** (3.33–5.33)	0.68*** (0.56–0.82)
Itchy rash 'ever'	NS	NS	NS	NS	NS	2.21*** (1.64–2.96)	NS
Itchy rash in the last 12 months	NS	NS	NS	NS	NS	NS	NS
Diagnosed eczema	NS	NS	NS	NS	NS	2.96*** (1.99–4.41)	NS

Results are expressed as adjusted odds ratios (95% confidence interval): *$p<0.05$, **$p<0.001$, ***$p<0.0001$.
NS, not statistically significant.

asthmatics ($p<0.05$). Of the respondents who lived on such busy roads, 21.2% suffered from night-time cough as compared to 16.8% of those who lived in quieter roads ($p<0.05$).

Wheezers 'ever' and diagnosed asthmatics were less likely to have blankets in their bedroom ($p<0.0001$). Pets in their house did not seem to influence the prevalence rates or severity of wheezing, but were less common in the houses of asthmatics ($p<0.05$). Diagnosed asthmatics also had blankets less often on their beds than children who had never been labeled as asthmatic ($p<0.001$).

The Maltese Islands had a lower cumulative (19.2% versus 22.6%) and current (8.8% versus 11.7%) (9) prevalence rate of wheezing when compared to the global mean for this age-group. They also had a lower rate than the worldwide mean for self-reported or diagnosed asthma (7.5% versus 11%).

Responses to the questionnaire on rhinitis

The second parts of Tables 1 and 2 show the most important results from the rhinitis questionnaire, Seasonal symptoms peaked in March/April/May when $\approx 53\%$ of respondents experienced symptoms. The symptoms were least prevalent in summer and then started to increase again in September.

Effect of multiple variables on rhinitis prevalence and symptoms (Table 3)

Children who had suffered from nasal problems were more likely to have an atopic relative ($p<0.0001$), but the same did not apply to those with current rhinitis. These same children were also diagnosed as suffering from hay fever more often than children without a family history of allergy ($p<0.0001$).

Children who lived in roads that were described as being busy with passing traffic had higher cumulative and current rates of nasal problems ($p<0.001$). Pets in the house and soft furnishings in the bedroom were less commonly present in the houses of children experiencing rhinitic symptoms ($p<0.0001$ and $p<0.001$, respectively).

The Maltese Islands had a slightly higher cumulative (23.5% versus 21.5%) and current (20.8% versus 18%) prevalence rate of nasal problems (10) when compared to the global mean for this age-group. They also had a higher rate than the worldwide mean for self-reported or diagnosed hay fever (14.8% versus 9.5%).

Responses to the questionnaire on eczema

The third parts of Tables 1 and 2 show the most important results from the questionnaire on eczema. Of children with a current, itchy rash, 75.3% had involvement of areas of their body that are usually quite typically affected by eczema, and 71.1% of these current sufferers reported that their rash had cleared some time during the last 12 months; 18.1% of children developed this rash before 2 years of age, 31.4% when 2–4 years of age, and 43.3% after reaching 5 years of age.

Effect of multiple variables on eczema prevalence and symptoms (Table 3)

A family history of atopy was the only factor that affected the prevalence of eczema, in that those children with atopic relatives had a higher cumulative prevalence rate of an itchy rash ($p<0.0001$) and were more often diagnosed as having eczema ($p<0.0001$).

The Maltese Islands had a lower cumulative (7% versus 12.8%) and current (5.6% versus 10.2%) prevalence rate of itchy rash (11) when compared to the global mean for this age-group. They also had a lower rate than the worldwide mean for self-reported or diagnosed eczema (4.4% versus 7.1%).

The presence of more than one allergic condition per child

Of wheezers 'ever', 47.5% also had nasal problems, while 62% of the current wheezers had nasal problems. Of one-time wheezers, 14.2% had eczema as did 23.7% of current wheezers, while 38.8% of children with eczema had wheezed at some time in their life. Of wheezers 'ever', 8.8% (n=59) had experienced all three allergic conditions studied, i.e. asthma, rhinitis, and eczema, at some point in their 5–8-year-old lives.

Discussion

The results obtained above demonstrate that allergic conditions affect a large number of young Maltese children. The data supplied by the parents of this group of 5–8-year-old children attending primary state schools situated around our islands, have a lot of (previously unstudied) information about the status of allergic diseases in the Maltese Islands.

Around one-fifth (19.1%) of all participating children were reported to have wheezed at some time in their life, while 45.9% of these were reported to still be wheezing in the previous year, giving a current rate of wheezing of 8.8%. This suggests that $\approx$ 50% of wheezers 'ever' had either been wheezing in the first year of life (when one cannot always label such symptoms as asthma as easily as in older age-groups) or that these infants had a 50% chance of not being persistent wheezers and were more likely to continue experiencing asthmatic symptoms into later life (12). There was no difference between the two sexes as far as cumulative and current prevalence rates were concerned, but boys were more likely to be labeled as asthmatic than girls. This is similar to other studies where, at this age, asthma tends to occur more frequently in boys (7,8). When compared to the global cumulative prevalence rates, Malta was situated just below the mean (19.1% versus 22.6%) (9), and this deficit was slightly greater for the current prevalence rate (8.8% versus 11.7%). This lag behind the average worldwide mean for this age-group was evident also for self-reported asthma. These figures suggest that the diagnosis of asthma in wheezing children in Malta follows a trend similar to that seen globally. The data also reassure us in that in this younger age-group we do not seem to have a greater prevalence of asthma in Malta than in most other countries. We compared our data to those of a study by Lenicker (13), carried out 10 years previously (in 1985) on a large cohort (n=4673) of 8-year-old Maltese children. In this study, the cumulative rate of wheezing was 8.1%, the current prevalence was 5.7%, and 2.7% of all respondents were labeled as asthmatics (13). When these figures were compared with our present prevalence rates, the cumulative rate of wheezing was found to have more than doubled. This massive rise in the number of asthmatic children over a decade is worrying but has been noted in a number of other countries such as the United States (14), New Zealand (15), Australia (16), Sweden (17), and England (18). Although many hypotheses have been put forward to explain this rise in asthma prevalence, no real conclusions have been drawn. In both the study of Lenicker (13) and the current study the ratio of asthma diagnosis to symptoms of wheeze was similar, as 2.7% of all respondents had been labeled asthmatic when the cumulative rate of wheezing was 5.7% in 1985, and presently 7.5% had diagnosed asthma when 19.1% of respondents were wheezers 'ever'. This demonstrates that the probability of doctors classifying wheezing as asthma has not increased over a 10-year period in Malta and thus is not a reason for the observed increase in the number of asthmatics diagnosed. In Lenicker's study, males were also more likely to suffer from asthma than were females (1,1,8), a situation similar to that observed in this present study.

Of the variables which might be affecting asthma symptoms, living in a busy road and a family history of allergic conditions seemed to be the ones that had the most adverse influence. Children living in what their parents described as a busy road were more likely to be symptomatic wheezers and experienced severe asthma attacks more often. This could be a result of the effect of pollutants such as nitrogen dioxides (19), sulfur dioxides (20), high kerbside ozone levels (21), particulate matter (22), and diesel fumes, on the already inflamed respiratory tract mucosa.

Children whose relatives suffered from an allergic condition had a much greater chance of wheezing at some time during their life and of persisting to wheeze, at least to the age of 5–8 years. Doctors also seemed to find it easier to label a child as asthmatic if there was a family history of allergic conditions. We did not ask what type of atopic condition the child's relative suffered from, so we cannot comment on whether a child was more likely to be asthmatic if their allergic relative

had asthma or rhinitis, or vice versa. While the tendency for atopy and asthma is inherited independently, the presence of atopy enhances the genetic susceptibility to asthma (23).

Passive smoking was the only indoor pollutant that seemed to have any effect on wheezing. Children who lived in houses with a smoker were not more likely to have wheezed at some time during their life but were more often current wheezers than children not regularly exposed to environmental tobacco smoke. This sidestream smoke seemed to promote the persistence of wheezing in these children, a phenomenon seen in other studies (24–26). However, our data did not suggest that these 5–8-year-old passive smokers had more symptoms of greater severity or more frequent nocturnal coughing than their counterparts, as demonstrated by other investigators in similar studies (27,28).

On studying the effects of other indoor factors such as animal dander and house dust mite, we observed that wheezers 'ever' tended to have fewer blankets in their bedroom than non-wheezers and that diagnosed asthmatics also had fewer blankets and were less often pet owners than non-asthmatics. We feel that this is a reflection of the education that Maltese parents are receiving, as they are carrying out the necessary recommended changes to the indoor environment by decreasing soft furnishings in the bedroom, which usually bear a heavy load of house dust mite, and also not keeping pets in the house.

One medical recommendation that a number of Maltese mothers are not following is breast-feeding their children. In our survey only 41.9% of children had been breast-fed. This mode of infant feeding did not seem to offer any added protection against the likelihood of wheezing 'ever'. There was a trend towards fewer of the breast-fed children being current wheezers, but this was not statistically significant. Further information about the duration of breast-feeding, which was not part of our questionnaire, might have affected this result. Other studies have demonstrated that although breast-feeding might have a role against wheezing in the first few months of life, it did not protect against the development of asthma in childhood (29).

Problems with the nose were not much more common than wheezing in this age-group, but seemed to be more persistent. In fact, 87.9% of children with rhinitis at some time during their life still had these symptoms in the year when the questionnaire was answered. The seasonal variation in the occurence of these nasal symptoms points to allergic rhinitis as being the major cause of these problems. In fact, almost two-thirds of these children with nasal problems were known to have been labeled as being afflicted with hay fever.

Eczema in the 5–8-year-old age-group was the only allergic condition that occured significantly less in children from the Maltese Islands when compared with the worldwide mean. The prevalence rates in both sexes were similar, but boys were more likely to develop this itchy rash before the age of 2 years than were girls. However, the majority of children of both sexes seemed to have a higher probability of getting this rash when older than 5 years of age.

In conclusion, we have seen that in the 5–8-year-old age-group, our prevalence rates for wheezing and rhinitis are quite similar to global means, while eczema seems to be less common in our islands. A family history of atopy and, to a lesser extent, living in a busy road seem to be variables that are most influential in the occurence of allergic conditions amongst our younger children. Passive smoking also affects the persistence of wheezing in these children. These data should form a reliable baseline for future comparative studies and should also lead to new studies into the possible causes of such high prevalence rates of allergy in the Maltese Islands.

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