

Asthma Prevalence in European, Maori, and Pacific Children in New Zealand: ISAAC Study

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Summary. The International Study of Asthma and Allergies in Childhood (ISAAC) demonstrated that the highest prevalence of asthma in the world is in English-speaking countries, including New Zealand. In this paper, we compare asthma symptom prevalence in the three major ethnic groups (Maori, Pacific, and European) in the six participating centers in New Zealand. Hospital admission rates for asthma are higher among Maori and Pacific children compared to European children. The working hypothesis was that there were important differences in prevalence of asthma symptoms or diagnosis between ethnic groups which might explain these observed differences in asthma morbidity. In each center in 1992–1993, we sampled approximately 3,000 children at each of the age brackets 6–7 years and 13–14 years. There were 37,592 participants. Maori children had higher rates of diagnosed asthma and reported asthma symptoms than Pacific children in both age groups (diagnosed asthma in 6–7-year-olds: Maori, 31.7%; Pacific, 21.2%; 95% confidence interval on difference (CID), 7.2, 13.8; $P < 0.001$; 13–14-year-olds: Maori, 24.7%; Pacific, 19.2%; CID 2.5, 8.5; $P < 0.001$; recent wheeze in 6–7-year-olds: Maori, 27.6%; Pacific, 22.0%; CID, 2.6, 8.6; $P < 0.001$; 13–14-year-olds: Maori, 30.8%; Pacific, 21.1%; CID, 4.8, 14.5; $P < 0.001$). European children had rates intermediate between those of Maori and Pacific children (6–7-year-olds) or similar to those of Maori children (13–14-year-olds), but had the lowest prevalence of night waking with wheeze in both age groups (e.g., 6–7-year-olds: European, 2.6%; Maori, 5.8%; Pacific, 5.7%; European-Maori CID: $-4.2, -2.2, P < 0.001$; European-Pacific CID: $-4.7, -1.7, P < 0.001$; Maori-Pacific CID: $-1.7, 1.8, P = 1.0$). The pattern of differences closely resembled that in a 1985 Auckland study, despite a 1.5–1.7-fold overall increase in prevalence. In conclusion, there are important differences in asthma prevalence among Maori, Pacific, and European children. These differences are small compared to worldwide variation, but their pattern is stable over time. The higher rate of severe asthma symptoms that Maori and Pacific children

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report may be one reason for the increased asthma morbidity in these groups. Further studies are needed to determine the reasons for these apparent differences in asthma severity. **Pediatr Pulmonol.** 2004; 37:433–442. © 2004 Wiley-Liss, Inc.

Key words: asthma; wheezing; child; adolescence; prevalence; ethnic groups.

INTRODUCTION

The International Study of Asthma and Allergies in Childhood (ISAAC)¹ demonstrated that the highest prevalence of reported asthma symptoms in the world is in English-speaking countries, including the UK, New Zealand (NZ), Australia, the US, and Canada, as well as some parts of Latin America.^{2,3} We previously showed that the prevalence of reported asthma diagnosis and symptoms is similar across the six participating NZ centers.⁴

To date, there have been few studies of ethnic differences in asthma prevalence in NZ. Previous studies found higher asthma morbidity and mortality among Maori and Pacific children and adults than among European people. The Maori experience excess asthma morbidity and a higher hospital admission rate compared to non-Maori.^{5–8} Pacific children and adults have higher hospital admission rates than do European people in the same age groups.^{6,7}

We do not know if these differences in asthma morbidity are due to differences in asthma prevalence or severity, or are due to other factors such as access to medical care and management of asthma. It is therefore important to consider ethnic differences in asthma prevalence rates in the NZ ISAAC study,⁴ since this is the largest and most comprehensive study of prevalence of asthma symptoms in NZ children to date. A similar study performed in Auckland in 1985^{9,10} enabled us to see if the prevalence rates and ethnic differences in asthma symptoms and diagnosis had changed between 1985–1993.

The purpose of this paper is to compare the prevalence and severity of asthma symptoms in Maori, European, and Pacific 6–7-year-olds and 13–14-year-olds in NZ, and to assess the consistency of these comparisons over time. We hypothesized that asthma prevalence would differ between ethnic groups, and would explain at least in part the differences in asthma morbidity. We also hypothesized that these differences and the prevalence rates would be similar to those reported in the 1985 Auckland study.

METHODS

The methods of ISAAC Phase One in NZ have been published,^{1,4} and will only be briefly summarized here. Six NZ centers participated in ISAAC Phase One, an international survey of asthma and allergies in children, which was conducted from 1992–1993. Three centers were major urban areas, i.e., the Auckland metropolitan area, Wellington City area, and Christchurch City area. The other three centers were rural areas centered on a provincial town: Bay of Plenty, Hawke's Bay, and Nelson.

We obtained approval for the study from regional ethics committees.

In each center, we selected primary and secondary schools containing 6–7-year-old children or 13–14-year-old young people, respectively, by sequential random sampling among all schools in the relevant geographical area, until 3,000 children had been sampled in each age group, or all schools in the sampling frame had been sampled. All children of these age groups in the sampled schools were included in the sample. We sought permission from the schools, and sent information sheets to all parents of sampled children. Parents of younger children consented by completing the questionnaire; for the older group, parents and the teenagers themselves were given the opportunity to decline the study.

The participating 6–7-year-old children took home a questionnaire regarding asthma, eczema, and allergic rhinitis for their parents or guardians to complete. The 13–14-year-olds filled out their own questionnaires, and also answered questions relating to a video of asthma symptoms in young people. The written questionnaires and video were standardized for ISAAC worldwide.

We defined ethnicity by the parents' designation of the child or the young person's self-reported identity (Appendix). This corresponds to the method used in the NZ Census of 1991. In this paper, the designation "European" means people identifying themselves as of European ancestry, equivalent to *pakeha* in Maori or whites in American usage. The designation "Pacific" means people indicating Polynesian ancestry and affiliation, other than Maori, including people from Samoa, Tonga, Niue, Tokelau, Fiji, and the Cook Islands. Respondents who identified more than one ethnic group were considered to be Maori, if Maori was one of the groups identified, Pacific, if Pacific Island ethnicity but not Maori ethnicity was included, and European only if neither Maori nor Pacific identification were mentioned. Those who answered "Other" or did not answer were not included in this analysis.

We described differences between ethnic groups by 95% confidence intervals on the pairwise differences in prevalence (CID), and by χ^2 probabilities based on 2×2 contingency tables. Because the unit of sampling (schools) is different from the unit of analysis (individuals), tests of significance were calculated using appropriate adjustment of sample sizes. We used $P < 0.05$ as our cutoff for statistical significance. In the rest of this paper, we refer to reported wheezing in the last 12 months as "recent wheeze."

Comparison of asthma symptoms among different NZ centers was reported previously.⁴ In the current paper, we compared data from urban and provincial centers in the three ethnic groups to see whether there were similar patterns of ethnic differences in these two types of center.

We compared our results for 6–7-year-olds in the Auckland center with a study of 8–10-year-old children in Auckland in 1985.^{9,10} That age group lies between the two age groups in the present study. Like the children in the Auckland study, the 6–7-year-olds in the present study were prepubertal children, and were studied by parent-completed questionnaire, whereas the 13–14-year-olds were studied by self-completed questionnaire. Although we were comparing slightly different ages, there were no significant differences across age between 8–10 years old in the Auckland study. The geographical sampling area in 1985 was the same as the Auckland sample in the present study, but in 1985 only every second European child sequentially sampled in class lists was studied. This does not affect the comparisons between ethnic groups, except to decrease the size of the European sample in 1985, and hence the power of comparisons. Ethnicity was asked for and defined in a similar way (see Appendix). The Appendix shows the particular questions we compared in the two studies. We described the change in rates between the two studies by the ratio of the 1993 prevalence figures to the relevant 1985 prevalence figures. These ratios were treated as relative risks (with time as the exposure) to estimate 95% confidence intervals (CI). This enabled us to determine by what proportion the prevalence of certain responses had changed. The effect of cluster sampling (design effect) was not taken into account in this comparison, as we did not have access to the raw data relating to individual clusters for the 1985 study.

RESULTS

The participation rate by ethnic group and age group is given in Table 1, along with 1991 NZ Census data. The overall response rates were 91% in 6–7-year-olds and 93% in 13–14-year-olds. Proportions of different ethnic groups in the participants very closely matched proportions in the relevant age bracket in the 1991 NZ Census. Ninety-eight percent of schools for the 6–7-year age group participated (range, 96–100% among centers), and 87% for the 13–14-year age group (range, 73–100%). The prevailing reason for schools declining was curricular pressure.

The number of schools sampled per center ranged from 45–83 for 6–7-year-olds, and from 12–35 for 13–14-year-olds. The mean number of sampled students per sampled school in each center ranged from 42–68 (overall mean, 49) for 6–7-year-olds, and from 83–227 (overall mean, 180) for 13–14-year-olds. The mean design effect for recent wheeze from school-based sampling was 1.3 for

TABLE 1—Participation by Ethnicity and Age Group¹

Ethnicity	6–7 years			13–14 years			NZ population 1991 Census ethnic distribution of 10–14-year-olds (%)
	Response rate (%)	Participants	Proportion of total sample (%)	Response rate (%)	Participants	Proportion of total sample (%)	
European	95.1	12,190	65.7	95.7	12,387	65.1	70.0
Maori	84.8	3,747	20.2	90.0	3,938	20.7	19.6
Pacific	83.8	1,412	7.6	94.4	1,407	7.4	6.5
Other	80.1	1,220	6.6	82.3	1,291	6.8	3.9
Total	90.9	18,569	100.0	93.4	19,023	100.0	

¹Response rates by ethnic group are calculated based on schools' assessment of ethnicity of individual nonparticipants.

TABLE 2—6–7-Year-Olds: Wheeze and Asthma

	Prevalence (%)			Difference in prevalence (95% confidence interval on difference), probability of the difference occurring by chance ¹		
	European	Maori	Pacific	European-Maori	European-Pacific	Maori-Pacific
Asthma ever	25.9	31.7	21.2	-5.8 (-7.9, -3.7) <i>P</i> < 0.001	4.7 (1.8, 7.5) <i>P</i> = 0.003	10.5 (7.2, 13.8) <i>P</i> < 0.001
Wheeze in last 12 months	24.2	27.6	22.0	-3.4 (-5.3, -1.6) <i>P</i> < 0.001	2.2 (-0.4, 4.8) <i>P</i> = 0.1	5.6 (2.6, 8.6) <i>P</i> < 0.001
>12 attacks of wheeze in last 12 months	2.5	2.4	2.0	0.1 (-0.6, 0.7) <i>P</i> = 0.9	0.5 (-0.4, 1.3) <i>P</i> = 0.3	0.4 (-0.5, 1.4) <i>P</i> = 0.4
Sleep disturbed due to wheeze ≥ 1 nights per week	2.6	5.8	5.7	-3.2 (-4.2, -2.2) <i>P</i> < 0.001	-3.2 (-4.7, -1.7) <i>P</i> < 0.001	0.0 (-1.7, 1.8) <i>P</i> = 1.0
in last 12 months						
Speech limited due to wheeze in last 12 months	4.4	6.9	6.9	-2.4 (-3.5, -1.4) <i>P</i> < 0.001	-2.5 (-4.1, -0.9) <i>P</i> < 0.001	-0.1 (-1.9, 1.8) <i>P</i> = 0.9

¹Differences with *P* < 0.05 are in bold type. Precision of probability given to greater of {1 significant digit, or 3 decimal points}.

TABLE 3—13–14-Year-Olds: Wheeze and Asthma: Written Questionnaire

	Prevalence (%)			Difference (95% confidence interval on difference), probability of the difference occurring by chance ¹		
	European	Maori	Pacific	European-Maori	European-Pacific	Maori-Pacific
Asthma ever	25.2	24.7	19.2	0.5 (-1.4, 2.4) <i>P</i> = 0.6	6.0 (3.3, 8.7) <i>P</i> < 0.001	5.5 (2.5, 8.5) <i>P</i> < 0.001
Wheeze in last 12 months	31.7	30.8	21.1	0.9 (-2.3, 4.1) <i>P</i> = 0.6	10.6 (6.2, 14.9) <i>P</i> < 0.001	9.6 (4.8, 14.5) <i>P</i> < 0.001
>12 attacks of wheeze in last 12 months	4.1	3.0	1.3	1.0 (0.1, 2.0) <i>P</i> = 0.03	2.8 (1.8, 3.8) <i>P</i> < 0.001	1.8 (0.6, 2.9) <i>P</i> = 0.01
Sleep disturbed due to wheeze ≥ 1 nights per week in last 12 months	2.7	4.9	3.8	-2.1 (-3.2, -1.1) <i>P</i> < 0.001	-1.1 (-2.6, 0.4) <i>P</i> = 0.1	1.1 (-0.7, 2.8) <i>P</i> = 0.2
Speech limited due to wheeze in last 12 months	8.0	8.7	7.5	-0.7 (-2.0, 0.7) <i>P</i> = 0.3	0.5 (-1.4, 2.4) <i>P</i> = 0.6	1.1 (-1.0, 3.3) <i>P</i> = 0.3

¹Differences with *P* < 0.05 are in bold type. Precision of probability given to greater of {1 significant digit, or 3 decimal points}.

TABLE 4—13–14-Year-Olds: Wheeze and Asthma: Video Questionnaire

	Prevalence (%)			Difference (95% confidence interval on difference), probability of the difference occurring by chance ¹		
	European	Maori	Pacific	European-Maori	European-Pacific	Maori-Pacific
Wheeze in last 12 months	17.6	21.7	18.3	−4.1 (−6.1, −2.2) $P < 0.001$	−0.7 (−3.5, 2.1) $P = 0.6$	3.4 (0.3, 6.5) $P = 0.04$
Woken with wheeze in last month	3.3	6.1	5.9	−2.8 (−3.9, −1.7) $P < 0.001$	−2.6 (−4.3, −0.9) $P < 0.001$	0.2 (−1.7, 2.2) $P = 0.8$
Severe asthma in last month	4.1	5.5	6.0	−1.5 (−2.5, −0.5) $P = 0.002$	−2.0 (−3.6, −0.4) $P = 0.006$	−0.5 (−2.3, 1.3) $P = 0.6$

¹Differences with $P < 0.05$ are in bold type. Precision of probability given to greater of {1 significant digit, or 3 decimal points}.

6–7-year-olds based on 367 schools, and 3.4 for 13–14-year-olds based on 119 schools. The small design effect for the younger children resulted in a small increase in confidence intervals on the differences compared with simple random sampling (e.g., CID increasing from from −7.5, −4.1 to −7.9, −3.7), but for the older children, the confidence intervals are appreciably wider (e.g., CID increasing from 8.3, 12.9 to 6.2, 14.9).

Tables 2–4 show the prevalence of responses in the major categories of wheeze and asthma by ethnicity and age group.

Prevalence of Reported Asthma Symptoms and Diagnosis

In the 6–7-year-old children, the prevalence of recent wheeze in Maori children was higher than in European children and Pacific children ($P < 0.001$ for both comparisons). Maori children also had the highest prevalence of reported asthma ever diagnosed, followed by European and then Pacific children ($P \leq 0.003$ for all three comparisons).

Among 13–14-year-old young people, there was very little difference between prevalence of recent wheeze in Europeans and Maori, but both were markedly higher ($P < 0.001$) than the prevalence in Pacific children. In the same way, the prevalence of reported asthma ever was very similar in European and Maori young people, but the prevalence in Pacific young people was lower than either ($P < 0.001$). In the video questionnaire, students saw footage of a child with wheeze, and were asked to identify if they had had breathing like that in the previous 12 months. This prevalence was lower in all ethnic groups than the prevalence of recent wheeze in the written questionnaire, but the Maori reported more wheeze in the video response question than the other two groups (Maori vs. Europeans, $P < 0.001$; Maori vs. Pacific, $P = 0.04$).

Asthma Severity

More Than 12 Attacks of Wheezing in the Previous 12 Months

For 6–7-year-olds, the prevalence of more than 12 attacks of wheezing in the previous 12 months did not differ among ethnic groups. Among 13–14-year-olds, the rate was highest among European young people (vs. Maori, $P = 0.03$; vs. Pacific $P < 0.001$), and the rate among Maori young people was higher than that in Pacific young people ($P = 0.01$).

Sleep Disturbed Due to Wheezing One or More Nights a Week in the Last 12 Months, and Speech Limited Due to Wheeze in the Last 12 Months

For 6–7-year-old children, the prevalence rates of both frequent sleep disturbance due to wheeze and speech limitation due to wheezing were lower ($P < 0.001$) among European children than among Maori and Pacific children. For 13–14-year-olds, the European rate for frequent sleep disturbance due to wheezing was lower than the rate in the Maori ($P < 0.001$), but not the Pacific young people. However, in this age group, the differences between ethnic groups in relation to speech limitation due to wheezing were not distinguishable at the 0.05 level of probability.

Video Questionnaire (13–14-Year-Olds): Waking With Wheeze and Severe Asthma

The video showed examples of young people waking with wheeze and of experiencing a severe asthma attack. Fewer European young people reported such episodes than did Maori and Pacific young people ($P < 0.01$ for all four comparisons).

Comparisons Between Urban and Rural Centers

The group of three urban centers reflected the same patterns of ethnic differences as the sample as a whole (not

shown). For the group of three provincial centers, a similar pattern of ethnic differences was seen in some but not all reported symptom categories. However, Pacific children were underrepresented in the provincial centers, numbering only 122 in the younger age group, and 154 in the older age group.

Time Trends in Auckland

Considering only the Auckland children, all three ethnic groups in both age groups in 1993 reported higher rates of recent wheeze and of diagnosed asthma than 8–10-year-old Auckland children in 1985 (Fig. 1). Compared to the children in 1985, Auckland 6–7-year-olds in 1993 had prevalence rates of recent wheeze 1.5 (CI: 1.3, 1.8) times higher in European children, 1.5 (CI: 1.2, 1.8) times higher in Maori children, and 1.5 (CI: 1.1, 1.9) times higher in Pacific children. The prevalence of asthma rose to 1.7 (CI: 1.5, 2.0) times higher for Europeans, 1.8 (CI: 1.5, 2.3) times higher for Maori, and 1.7 (CI: 1.2, 2.2) times higher for Pacific children. Thus, reported prevalence increased by similar proportions in all three ethnic groups. The only comparable marker of severity was the prevalence of frequent wheeze (more than 12 episodes in the previous year). The prevalence of frequent wheeze increased in Maori children (1.5-fold; CI: 0.8, 3.0) and Pacific children (2.1-fold; CI: 0.8, 5.7), and slightly decreased in European children (0.9-fold; CI: 0.5, 1.4), but these changes were not distinguishable as the confidence intervals were wide.

DISCUSSION

This study compared the prevalence and severity of asthma symptoms reported by written and video questionnaire in NZ's three main ethnic groups. The study included 6–7-year-olds and 13–14-year-olds from six centers across NZ, with very high participation rates. The prevalence differences identified in this study should be considered in the light of differences seen across ISAAC internationally. Prevalence for wheeze in the previous 12 months among 6–7-year-olds ranged from 22.0% (Pacific) to 27.6% (Maori), and among 13–14-year-olds from 21.1% (Pacific) to 31.7% (European). National prevalence rates for this item across all ISAAC countries ranged from 2.2% (Indonesia) to 32.2% (UK).² Among countries including NZ and culturally similar countries (Australia, Republic of Ireland, and the UK), there was a much narrower range of prevalence (29.1–32.2%). The NZ ethnic differences are thus intermediate in size, but may nonetheless point to important differences in risk factors and morbidity between ethnic groups.

Limitations of the study should be recognized. In the 6–7-year-old age group, the response rate was lower

among Pacific and Maori families than among European families. It is unlikely that there are systematic biases due to the different ethnic group response rates, as prevalence rates of recent wheeze and reported asthma ever were higher among Maori children, but lower among Pacific children than among European children.

Prevalence of Asthma Ever and of Recent Wheeze

The pattern of differences in prevalence of asthma and recent wheeze between the three ethnic groups can be expressed as:

Pattern 1: Maori > European ≥ Pacific (6–7-year-olds and 13–14-year-olds, video questionnaire); and
Pattern 2: Maori = European > Pacific (13–14-year-olds, written questionnaire).

Pattern 1 was also seen in the 1985 study in Auckland children¹⁰ for recent wheeze and diagnosed asthma. However, the similar sample in 1993 has a substantially higher prevalence rate in all three ethnic groups over the time period. The increase is approximately 1.5-fold for recent wheeze and 1.7-fold for asthma diagnosis, whereas there is no significant change in frequency of attacks. These findings should be interpreted in the light of the differences between studies. The 6–7-year-old children studied in 1993 were slightly younger than those studied in 1985, but there has been little demonstration of age-related changes within this range; if anything, one would expect a slightly higher cumulative prevalence of asthma with increasing age. The random exclusion of 50% of the European children in 1985 is unlikely to give rise to any systematic bias, as this analysis is entirely stratified by ethnic group. The proportion of Pacific children in the Auckland samples rose from 15% in 1985 to 22% in 1993. The 1993 sample may therefore include a greater proportion of Pacific children born in the Pacific Islands due to continuing migration. If a substantial proportion of the Pacific children in the sample were born in the Pacific Islands, and if children born in the Pacific Islands have a substantially lower prevalence of asthma symptoms and diagnosis than Pacific children born in New Zealand, then this may have partially contributed to a lower rate of symptoms and diagnosis among Pacific children. However, the 1996 Census recorded that only 13% of Pacific children in NZ had been born in the islands, and the proportion in the study is likely to be similar.

Notwithstanding these minor differences in study design, the possible effects of immigration, and the general increase in prevalence over time, the similarity of the pattern of ethnic differences in 1985 and in 1993 is striking. It suggests the possibility that interethnic differences are due to factors that did not change over the 8 years,

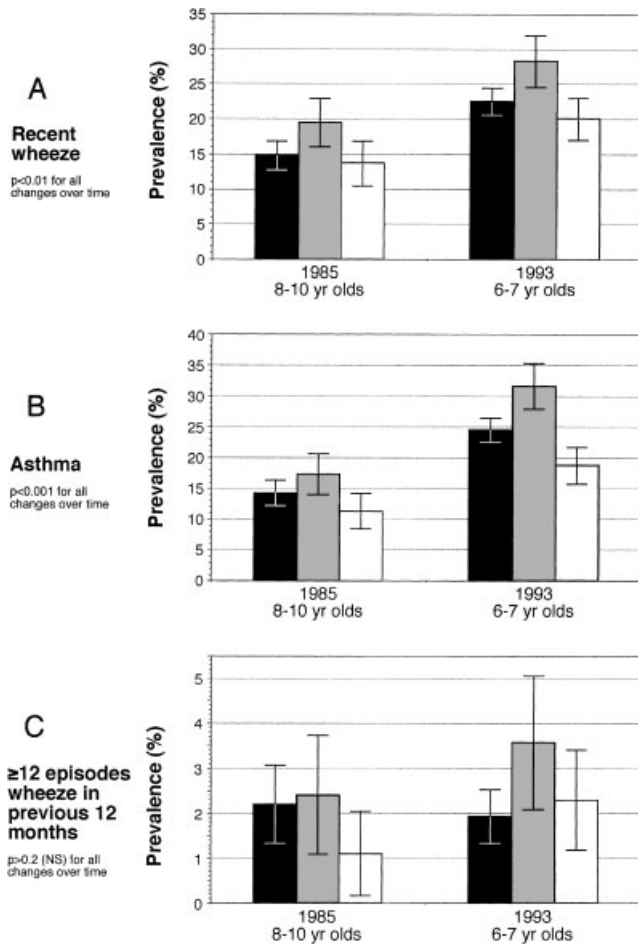


Fig. 1. Prevalence at two time points: 1985 study of 8–10-year-old children in Auckland,¹⁰ and 1993 ISAAC study of 6–7-year-old children in Auckland. A: Recent wheeze. B: Asthma. C: ≥ 12 attacks of wheeze in previous 12 months. Solid bars, European; shaded bars, Maori; open bars, Pacific. Error bars indicate 95% confidence intervals for individual prevalence rates.

and that are different from those that caused the general temporal increase in asthma prevalence over the same time period.

The temporal increase in reported symptoms and asthma implied by this study is very similar in all three ethnic groups, suggesting that the factors causing the increase in reported asthma are independent of ethnic differences in lifestyle, microenvironment, and other sociodemographic features. We cannot entirely exclude the possibility that the increase in reported symptoms and diagnosis is due to the recent increase in awareness of asthma symptoms, as well as increased diagnosis of asthma by medical practitioners. However, in order for this to be a valid explanation, awareness and diagnosis of asthma would have had to increase in all three ethnic groups to an equal extent, without in the least affecting the differences between ethnic groups in reported symptoms, a very unlikely occurrence. Many other studies in other countries documented similar increases in asthma symp-

toms and diagnosis over time.¹¹ A repeat of the 1985 study was undertaken in 1991 in Auckland European 8–10-year-old children only, using the same school classes sampled in 1985.¹² This study lends added credence to the notion of an increase in prevalence, as it showed a prevalence of recent wheeze among Auckland European children intermediate between the 1985 8–10-year-olds and 1993 6–7-year-olds (1985: 14.8% (CI: 12.7%, 16.9%); 1991: 18.7% (CI: 16.9%, 20.5%); 1993: 22.6% (CI: 20.7%, 24.4%)). ISAAC Phase Three will examine subsequent changes over time in children of the same ages and ethnicity in most of the centers that completed Phase One, and will give a clearer picture of temporal trends across the world.

Apart from the 1985 study, only a few earlier studies reported prevalence rates in relatively small samples of Maori and European children, and only in rural areas. One paper¹³ reported a higher prevalence of asthma symptoms in Maori vs. non-Maori rural adolescents in 1989. A second,¹⁴ in 1992, reported similar rates of recent wheeze or diagnosed asthma between Maori and European rural 8–13-year-olds. For teenagers from the three rurally based centers in the present study, we found no difference between European and Maori responses for recent wheeze and asthma in the standard questionnaire, but higher rates among Maori of reported wheeze in the previous year in the video questionnaire (data not shown). Thus in the rural setting, comparisons between the Maori and Europeans are not totally consistent.¹⁵ There have been no similarly powered studies able to compare ethnic groups in adults, but the prevalence differences between Maori and Europeans that have been observed in adults¹⁵ are larger than those observed in the current study.

Pacific children consistently had the lowest rates of reporting symptoms and asthma for both age groups, although the prevalence still ranks above the 80th percentile for the international ISAAC study.^{3,4} No Pacific Island nations participated in ISAAC Phase One. Available asthma prevalence data from Pacific countries are scarce. One study of asthma in Tahiti found no major differences in response to the question “Have you ever had attacks of asthma?” among Tahitian, Chinese, and European adolescents, although Europeans tended to have the lowest rates.¹⁶ Another study compared the prevalence of asthma in Tokelau children living in NZ with children still living in Tokelau, and found increased prevalence among the migrant children.¹⁷ Place of birth was not assessed in the present study.

Asthma Severity

Asthma severity is complex and difficult to quantify in questionnaire studies. There are several ways in which asthma can be deemed severe. Chronic interval symptoms interfere with sleep, exercise, and growth; frequent attacks

cause loss of time from school or work; and severe attacks pose a risk to life.¹⁸ Preventer therapy is directed at all of these aspects of severity, but is probably more effective in controlling chronic interval symptoms than in preventing episodic virus-triggered attacks.¹⁹ Thus, although the prevalence of frequent attacks reflects one aspect of severity, the prevalence of chronic interval symptoms is probably a better reflection of how well asthma is treated and controlled.

A markedly smaller proportion of European children than Maori or Pacific children had symptoms suggesting more severe interval asthma (waking with wheezing ≥ 1 night per week in both age groups, severe wheezing limiting speech in 6–7-year-olds, and waking with wheeze within the last month in 13–14-year-olds). A crude working figure of case-morbidity for frequent night waking can be calculated by the ratio of the number of cases waking with wheeze ≥ 1 night per week to the number of cases reporting “asthma ever.” This ratio is 10% in European 6–7-year-old children, compared to 18% in Maori and 27% in Pacific asthmatic children. For 13–14-year-olds, the figures are 11% in Europeans and 19% in both Maori and Pacific young people.

On the other hand, European teenagers had the highest reported rate of frequent asthma attacks (>12 in the previous 12 months). Pacific children, who reported higher rates of night waking with wheeze than Europeans, reported a lower prevalence of asthma and of frequent attacks. As we discussed above, one possible explanation is that European children obtain better maintenance asthma treatment and have fewer chronic symptoms in spite of a high rate of episodic viral wheeze, although other reasons could be envisaged.

The greater prevalence of severe chronic symptoms among Maori children and young people agrees with findings from an earlier study reporting increased asthma severity among Maori children despite similar asthma prevalence.⁵ Maori and Pacific children also have high hospital admission rates for asthma compared with European children.^{6,7,20} We do not know exactly why these differences occur, but we can examine the evidence relating to differences in common environmental risk factors for asthma severity such as exposure to tobacco smoke, and inadequate preventive treatment for asthma, although these were not assessed in the present study.

Many studies identified that severity of preexisting asthma or lower respiratory disease in children is increased by exposure to environmental tobacco smoke.^{21,22} In a 1993 study, smoking rates among pregnant Maori mothers (68.4%) were much higher than among European or Pacific mothers (23.0% and 23.6%, respectively).²³ These are likely to reflect smoking rates in mothers of young children. There are no data at present to indicate whether these different smoking rates are a major factor in the differing rates of chronic symptoms. The 1985 study

in Auckland children¹⁰ showed that the higher prevalence of respiratory symptoms in Maori was independent of parental smoking, but symptoms relating to chronic asthma severity were not specifically examined.

Differing medical treatments for asthma among Maori and Pacific children may be a factor leading to a greater prevalence of chronically severe asthma (as identified in the present study) and high hospital admission rates in these groups (as reported by previous studies).^{6,7} In the 1985 study of Auckland children,¹⁰ Maori children who had wheeze in the previous 12 months reported the use of bronchodilators as commonly as European children, but their use of preventer medication was much lower (13% of Maori children who reported recent wheeze vs. 25% of European children who reported recent wheeze; not significant owing to small numbers). Pacific children reported both lower use of bronchodilators and a very low use of preventer medications (8% of those reporting recent wheeze).

If relative undertreatment is a cause of high asthma morbidity among Maori and Pacific children, this may in turn be related to cultural or socioeconomic issues, including access to medical care. Inequalities in health-care may be acting as significant structural barriers to both the provision and uptake of health services. Cost and location of health services were two major factors related to health service access identified in the Maori Asthma Review.²⁴ In the 1985 study in Auckland, however, low socioeconomic status did not independently explain ethnic differences in any category of asthma symptoms or in bronchial hyperresponsiveness.¹⁰ Nonetheless, there was a significant trend for a lower use of reliever and prophylactic medications with decreasing socioeconomic group in the sample as a whole (all ethnic groups combined).²⁵

In conclusion, this study indicates that asthma symptom prevalence during early school age tends to be highest in Maori children, lowest in Pacific children, and intermediate in European children. In European teenagers, symptom prevalence is similar to that of Maori teenagers, whereas Pacific teenagers continue to have a lower prevalence. These differences are not as large as those seen across the world in the ISAAC study, but the pattern of differences (Maori $>$ European $>$ Pacific) is the same as that found in a previous study in 1985. The reasons for these differences need further study. In both younger and older children, symptoms suggesting chronic asthma severity are significantly higher in Maori and Pacific children than among European children. These differences in severity may help to explain the higher hospital admission rates for asthma among Maori and Pacific children. We suggest that factors underlying these differences should be further explored, including exposure to tobacco smoke, use of preventer medication, and issues of access to or uptake of good medical care.

APPENDIX—Comparison of Relevant Questions in Auckland 1985 Survey¹⁰ and ISAAC Study

Auckland survey of 8–10-year-olds, 1985	ISAAC study of 6–7- and 13–14-year-olds, 1993
Which race is your child? European Maori Pacific Islander: Specify _____ Other: Specify _____	To which ethnic group does your child (or for 13–14-year-olds: “do you”) belong? European Maori Pacific Island: Specify _____ Other: Specify _____
Has your child ever wheezed? (a whistling noise which comes from the chest) Yes No	Has your child had wheezing or whistling in the chest <i>in the last 12 months</i> ? Yes No
IF YES How long since the last wheezing occurred? Less than a month 1–12 months More than 12 months	
In the last 12 months, how frequent were the wheezing attacks? None Less than 4 attacks 4–12 attacks More than 12 attacks	How many attacks of wheezing has your child had <i>in the last 12 months</i> ? None 1–3 4–12 More than 12
Has your child ever been diagnosed as having asthma by a doctor, or at a hospital? Yes No	Has your child <i>ever</i> had asthma? Yes No

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