

# Chapter 8: Asthma

## Key points

- There is a high prevalence of asthma symptoms in New Zealand compared with other developed countries, and there is some evidence that the prevalence of asthma is increasing.
- Overall, 15.5% of those aged between 15 and 44 years fulfilled the criteria for probable asthma. More women than men had probable asthma (18.0% and 12.9% respectively).
- The rate of asthma symptoms decreased with age for both men and women.
- Māori adults had the highest prevalence of probable asthma; European/Pākehā people had the next highest prevalence while Pacific people reported the lowest prevalence of probable asthma.
- People with probable asthma were more likely to assess their own health as fair or poor.
- People with asthma were more likely to have seen their GP six or more times and to have been admitted to hospital in the previous year than others.

## Introduction

During the 1970s and the 1980s there was an epidemic of asthma-related deaths and hospital admissions in New Zealand (Wickens et al 1998). Since 1989 there has been a decline in both deaths and hospitalisations from asthma. This is likely to be due to changes in management and treatment (especially a reduction in the use of fenoterol), and improved education of both medical professionals and the public (Kolbe et al 1994; Pearce et al 1995; Kemp and Pearce 1997). Despite this decline, there is still a high prevalence of reported asthma symptoms in New Zealand (Pearce et al 1993; Robson et al 1993; Crane et al 1994; Lewis et al 1997). There is also some evidence that the prevalence of asthma may be increasing in New Zealand and other developed countries (Burr 1987; Burney et al 1990; Balfe et al 1996; Sears 1997).

The diagnosis of asthma can be difficult. Ideally it involves a combination of clinical history, physical examination and lung function tests performed over time (Sears 1997). Because of this, there is likely to be a proportion of people in the population who are unaware that they have asthma, meaning it is impossible to ascertain the true absolute prevalence of asthma in the community using only a questionnaire (Fishwick et al 1997). However, survey questions can be used to identify people who are likely to have, or are susceptible to, asthma. This information can be used to give an approximate estimate of the prevalence of asthma, permits comparisons of the prevalence of asthma between population groups, and allows the monitoring of trends over time.

The questions used in the 1996/97 Health Survey were taken from a standard international questionnaire used for identifying adults with asthma (Burney et al 1994). They were different from the questions used in the 1992/93 Health Survey (see Table 42), but had been used successfully in New Zealand previously (Crane et al 1994; Lewis et al 1997). The analysis in this section is restricted to adults aged between 15 and 44 years, who were divided into three 10-year age bands (15–24 years, 25–34 years and 35–44 years). This is because the diagnosis of asthma is most accurate in younger adults as some of the signs and symptoms of asthma (such as shortness of breath at night) can be caused by other diseases which become increasingly common in older people (for example, heart failure, chronic obstructive airways disease).

The operational definition of asthma used for this analysis is a positive response to any of the three asthma-related questions shown in Table 42. This is the same definition used in a study by the Wellington Asthma Research Group (WARG) (Lewis et al 1997). The WARG study, carried out between 1991 and 1993, examined the prevalence of asthma symptoms among over 25,000 New Zealand adults aged between 20 and 44 years. In this chapter, people who fulfil the operational definition of asthma are referred to as having *probable asthma*.

Unless otherwise stated, age- and sex-standardised rates, and 95% confidence intervals in parentheses, are given in the text. Tables at the end of this section show key standardised and unstandardised estimates. More detailed tables related to this section are available on the Ministry of Health website ([www.moh.govt.nz](http://www.moh.govt.nz)).

**Table 42:** Questions on asthma asked in the 1992/93 Household Health Survey and 1996/97 New Zealand Health Survey

1992/93 Household Health Survey	<ul style="list-style-type: none"> <li>• Have you ever been told by a doctor you have asthma?</li> <li>• (If yes) which of the following do you use?               <ul style="list-style-type: none"> <li>– A peak-flow meter to blow into that shows if your asthma is getting worse?</li> <li>– Medication or drugs taken only when you are having an asthma attack?</li> <li>– Medication or drugs taken every day to help prevent asthma attacks long-term?</li> </ul> </li> </ul>
1996/97 New Zealand Health Survey	<ul style="list-style-type: none"> <li>• In the last 12 months, have you been woken by an attack of shortness of breath at any time?</li> <li>• In the last 12 months, have you had an attack of asthma?</li> <li>• Are you currently taking any medicine for asthma, including inhalers, aerosols or tablets?</li> </ul>

## Results

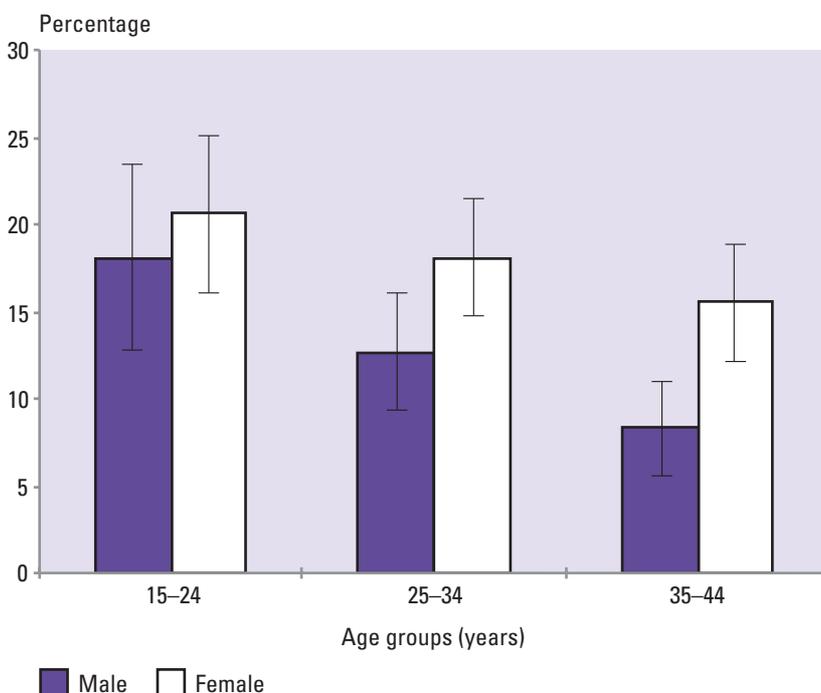
### Prevalence of probable asthma

#### *Asthma by age and sex*

There were 687 people aged between 15 and 44 years who fulfilled the criteria for probable asthma in the 1996/97 Health Survey. This was equivalent to an estimated 15.5% (13.7–17.3) of the New Zealand population in this age group. More women (18.0%; 15.8–20.2) than men (12.9%; 10.5–15.3) had probable asthma ( $p < 0.01$ ; see Figure 40). The rate of probable asthma decreased significantly with age for both men and women ( $p < 0.01$ ). For example, men aged 15–24 years had more than double the rate of probable asthma compared with men in the 35–44-year-old age group (18.1%; 12.8–23.4 and 8.3%; 5.6–11.0 respectively). The comparable numbers for women were 20.6% (16.1–25.1) in the 15–24-year-old age group and 15.5% (12.2–18.8) in the 35–44-year-old age group.

These results were very similar to those from the WARG study (Lewis et al 1997), which found that 15.2% of New Zealanders aged between 20 and 44 years fulfilled the operational definition for asthma (13.2% of males and 17.0% of females). The reasons for higher prevalence rates of asthma among women are not well understood; however, possible explanations include environmental, genetic or hormonal factors (Crane et al 1994). In contrast, the 1992/93 Health Survey found that approximately equal proportions of males and females had been told by a doctor that they had asthma. This may be because children and older people were included in this analysis.

**Figure 40:** Probable asthma among those aged 15–44 years, by age and sex



Note: Error bars indicate 95% confidence intervals. For further explanation of graphs, see Appendix 2: Notes to Figures and Tables.

In response to the specific questions on asthma, 9.1% (7.9–10.3) of 15–44-year-olds reported that they had been woken at night by shortness of breath (SOB), 9.8% (8.2–11.4) reported that they had had an attack of asthma in the last year, and 9.9% (8.5–11.3) reported that they were currently on medication for asthma. Women were significantly more likely to report an attack of asthma (11.3%; 9.5–13.1;  $p < 0.05$ ) and to be on medication for asthma (12.4%; 10.4–14.4;  $p < 0.0001$ ) than men (8.2%; 6.0–10.4 and 7.2%; 5.4–9.0 respectively). Increasing age was significantly associated with a reduced chance of having an attack of asthma and currently being on medication for asthma (both  $p < 0.001$ ; see Table 43).

In this survey, people met the criteria for probable asthma if they answered any of the asthma questions positively. However, those most likely to have asthma are those who answered all three questions positively (Fishwick et al 1997). Of those who answered yes to any of the asthma questions, 41% (36.3–46.1) responded positively to only one question, 31% (26.3–36.1) to two questions and 28% (22.5–32.7) to all three questions. There were no significant age or sex differences in this pattern of response.

**Table 43:** Positive responses to specific asthma questions, by age and sex: percent (95% confidence intervals)

People with probable asthma						
Question	Male % (95% CI)	Female % (95% CI)	15–24 years % (95% CI)	25–34 years % (95% CI)	35–44 years % (95% CI)	Total % (95% CI)
Woken by attack of SOB	7.9 (6.1–9.7)	10.2 (8.6–11.8)	10.3 (7.8–12.8)	9.1 (7.3–10.9)	7.9 (5.7–10.1)	9.1 (7.9–10.3)
Asthma attack last 12 months	8.2 (6.0–10.4)	11.3 (9.5–13.1)	13.1 (9.8–16.4)	9.1 (7.3–10.9)	7.4 (5.2–9.6)	9.8 (8.2–11.4)
Current asthma medications	7.2 (5.4–9.0)	12.4 (10.4–14.4)	13.3 (10.6–16.0)	9.7 (7.7–11.7)	6.9 (4.9–8.9)	9.9 (8.5–11.3)
Answered 'yes' to 1 asthma question	44.2 (35.6–52.8)	39.1 (33.0–45.2)	35.0 (26.2–43.8)	46.4 (38.4–54.4)	43.6 (33.0–54.2)	41.2 (36.3–46.1)
Answered 'yes' to 2 asthma questions	30.3 (20.9–39.7)	31.8 (25.9–37.7)	39.4 (30.4–48.4)	25.6 (19.5–31.7)	26.2 (16.4–36.0)	31.2 (26.3–36.1)
Answered 'yes' to 3 asthma questions	25.5 (17.1–33.9)	29.1 (23.2–35.0)	25.7 (16.9–34.5)	28.0 (20.0–36.0)	30.2 (17.7–42.7)	27.6 (22.5–32.7)

Note: Age- and sex-adjusted rates are given. Unadjusted rates are very similar.

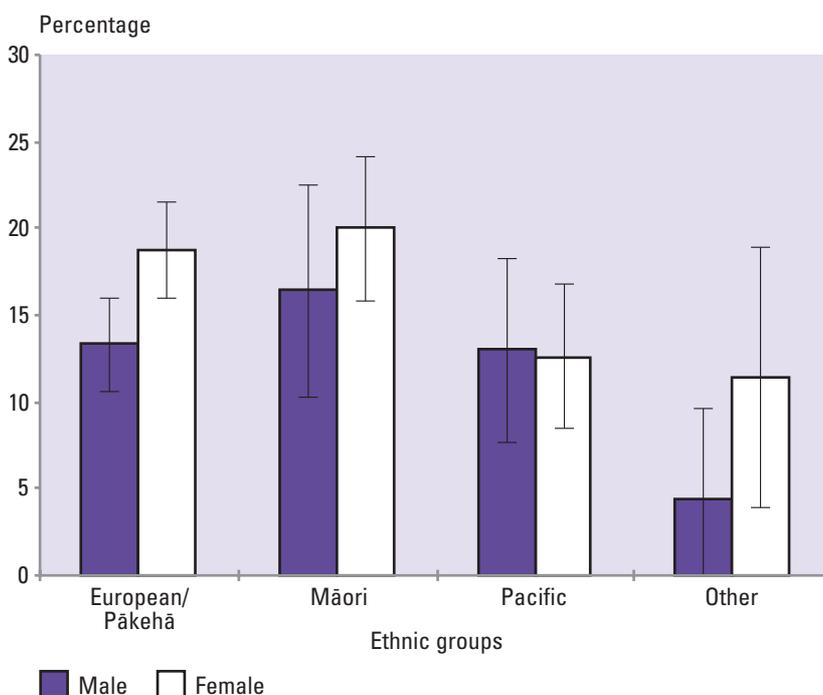
### Asthma by ethnicity

In the 1996/97 Health Survey there were statistically significant differences in rates of probable asthma between ethnic groups among those aged 15–44 years ( $p < 0.05$ ). The highest rates were among Māori and European/Pākehā women, one in five of whom had probable asthma (20.0%; 15.9–24.1 and 18.7%; 16.0–21.4 respectively), compared with 12.6% (8.5–16.7) of Pacific women. Around one in six Māori men (16.4%; 10.3–22.5) had probable asthma; with the proportions for European/Pākehā and Pacific men being 13.3% (10.6–16.0) and 13.0 (7.7–18.3) respectively (see Figure 41).

There were no statistically significant differences across ethnic groups in terms of likelihood of having been woken at night with shortness of breath, or having had an attack of asthma. Pacific people were found to be significantly less likely to report being on medication for asthma (7.5%; 5.0–10.0,  $p < 0.05$ ); with 10.8% (9.0–12.6) of European/Pākehā and 10.0% (7.6–12.4) of Māori

reporting being on asthma medication. There were no statistically significant differences across ethnic groups in terms of whether people who were defined as probable asthmatics responded positively to one, two or all three of the asthma-related questions (see Table 44).

**Figure 41:** Probable asthma among those aged 15–44 years, by ethnicity and sex (age-standardised)



Note: Error bars indicate 95% confidence intervals. For further explanation of graphs, see Appendix 2: Notes to Figures and Tables.

**Table 44:** Positive responses to specific asthma questions, by ethnicity: percent (95% confidence intervals)

Question	People with probable asthma			
	European/Pākehā % (95% CI)	Māori % (95% CI)	Pacific % (95% CI)	Total % (95% CI)
Woken by attack of SOB	9.0 (7.4–10.6)	11.9 (9.4–14.4)	7.7 (5.2–10.2)	9.1 (7.7–10.5)
Asthma attack last 12 months	10.3 (8.5–12.1)	9.2 (6.1–12.3)	8.3 (5.6–11.0)	9.9 (8.3–11.5)
Current asthma medications	10.8 (9.0–12.6)	10.0 (7.6–12.4)	7.5 (5.0–10.0)	10.2 (8.8–11.6)
Answered 'yes' to 1 asthma question	39.8 (33.3–46.3)	52.0 (40.2–63.8)	39.4 (26.3–52.5)	41.0 (35.9–46.1)
Answered 'yes' to 2 asthma questions	31.6 (25.7–37.5)	24.1 (15.9–32.3)	36.2 (22.9–49.5)	31.1 (26.0–36.2)
Answered 'yes' to 3 asthma questions	28.5 (22.0–35.0)	23.9 (15.5–32.3)	24.4 (12.8–36.0)	27.9 (22.6–33.2)

Note: Age- and sex-adjusted rates are given. Unadjusted rates are very similar.



The results for Pacific people contrast with data from other sources, where Māori and Pacific people have traditionally had higher rates of asthma mortality and hospitalisations than other ethnic groups in New Zealand (Wickens et al 1998; Mitchell 1991). In addition, surveys which have looked at the prevalence of asthma symptoms across ethnic groups have found that Māori and Pacific adults tend to have more asthma symptoms than European/Pākehā adults. For example, the WARG study found that Māori (22.1%) and Pacific people (20.6%) were more likely to meet the operational definition for asthma than people from other ethnic groups (14.3%). In their study, further analysis showed that Māori and Pacific people were no more likely to report having had an attack of asthma in the previous year or to be on asthma medication than people from other ethnic groups, but they were more likely to report symptoms consistent with asthma, such as shortness of breath and wheezing (Crane et al 1994). The 1992/93 Health Survey found that more Māori (16%) reported that they had been told by a doctor that they had asthma than European/Pākehā people (13%).

Interestingly, other studies have shown that the prevalence of asthma among Māori children is similar to that of non-Māori children (Pomare et al 1992), but their asthma seems more serious, both with more complications and a more prolonged course. This means that the prevalence of asthma does not decline with age for Māori as with other ethnic groups. It is likely that this difference is due both to differences in exposure to risk factors for asthma (such as tobacco smoke, viral respiratory infections and other allergens) as well as to poorer access to health services and preventive medications (Garrett et al 1989; Pomare et al 1992).

#### *Asthma by family income, education and NZDep96 score\**

There was a significant difference in the rate of probable asthma between the highest and lowest family income groups ( $p=0.01$ ). There were no significant differences in rates of probable asthma across education or NZDep96 quartile groups. Previous studies of children in New Zealand have shown no socioeconomic gradient in the prevalence of asthma (Mitchell et al 1989; Sears et al 1996). However, a recent study carried out using the data from the WARG study showed increasing asthma prevalence rates among adults in the most deprived areas of New Zealand, which was not explained by differences in age, sex or ethnic distribution (Salmond et al 1998). Studies from other countries have also shown higher rates of asthma symptoms or asthma-related hospital admissions among adults in lower socioeconomic groups (Littlejohns and Macdonald 1993; Eachus et al 1996; Watson et al 1996).

#### *People with asthma who smoke*

It is of concern that around a third (32.3%; 26.6–38.0) of people aged between 15 and 44 years with probable asthma smoke. This is equivalent to nearly 86,000 people in New Zealand.

#### *Asthma by self-rated health status*

Less than half (41.8%; 36.3–47.3) of the probable asthmatics in the 15–44 years age group considered their health to be excellent or very good, compared with more than two-thirds (67.1%; 64.9–69.3) of others. One in five (19.8%; 15.3–24.3) probable asthmatics reported that their health was fair or poor, compared with around 1 in 13 (7.5%; 6.1–8.9) others (see Table 45).

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\* The NZDep96 score measures the level of deprivation in the area in which a person lives, according to a number of census variables, such as the proportion of people in that area who earn low incomes or who receive income support benefits, are unemployed, do not own their own home, have no access to a car, are single-parent families, or have no qualifications. The scores are divided into quartiles from 1 (least deprived) to 4 (most deprived). For more details, see Chapter 1: The Survey.

**Table 45:** Self-rated health status, by asthma status, for those aged 15–44 years: percent (95% confidence intervals)

	Excellent/very good % (95% CI)		Good % (95% CI)		Fair/poor % (95% CI)	
	Unadj	Adj*	Unadj	Adj*	Unadj	Adj*
Probable asthmatic	42.4 (36.9–47.9)	41.8 (36.3–47.3)	37.5 (32.0–43.0)	38.4 (32.3–44.5)	20.0 (15.5–24.5)	19.8 (15.3–24.3)
Non-asthmatic	67.1 (64.9–69.3)	67.1 (64.9–69.3)	25.4 (23.2–27.6)	25.5 (23.3–27.7)	7.5 (6.1–8.9)	7.5 (6.1–8.9)

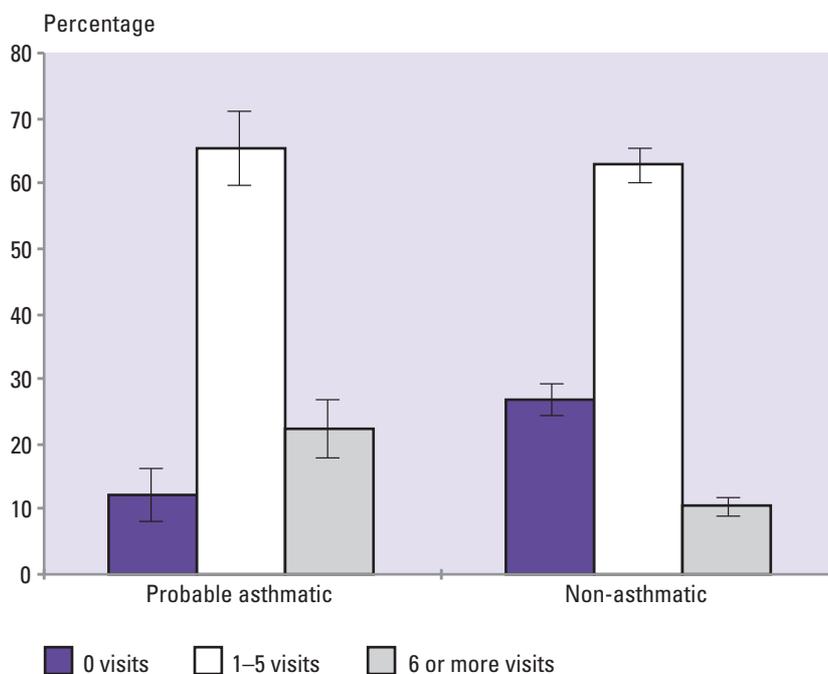
\* Adjusted rates are adjusted for age and sex.

Note: For further explanation of Tables, see Appendix 2: Notes to Figures and Tables.

### *Asthma by health service utilisation*

People aged 15–44 years with probable asthma were more than twice as likely to have seen their GP six or more times in the last year than people without (22.3%; 18.0–26.6 and 10.5%; 9.1–11.9 respectively). Only 12.2% (8.3–16.1) of people with probable asthma had not seen their GP in the last 12 months compared with 26.7% (24.3–29.1) of people in this 15–44-year-old age group without asthma (see Figure 42). It is not clear to what extent the high rate of GP consultations amongst those with asthma reflects monitoring and obtaining repeat prescriptions, or asthma-related morbidity itself. People with probable asthma were also more likely to have been admitted to hospital in the last year (18.5%; 12.8–24.2) than those without asthma (12.2%; 10.6–13.8).

**Figure 42:** Number of GP visits in last year among 15–44-year-olds, with and without asthma (age- and sex-standardised)



Note: Error bars indicate 95% confidence intervals. For further explanation of graphs, see Appendix 2: Notes to Figures and Tables.

**Table 46:** Probable asthma among those aged 15–44 years, by sociodemographic variables: percent (95% confidence intervals)

Probable asthma			
	%		Pop est
	(95% CI)		
	Unadj	Adj*	
<b>Total</b>	15.5 (13.7–17.3)		256,408
<b>Sex</b>			
Male	12.9 (10.5–15.3)	12.9 (10.5–15.3)	105,086
Female	18.0 (15.8–20.2)	18.0 (15.8–20.2)	151,332
<b>Age</b>			
15–24 years	19.4 (15.7–23.1)	19.4 (15.7–23.1)	100,970
25–34 years	15.4 (13.0–17.8)	15.4 (13.0–17.8)	88,545
35–44 years	12.0 (9.6–14.4)	12.0 (9.6–14.4)	66,892
<b>Ethnicity</b>			
European/Pākehā	15.9 (13.7–18.1)	16.1 (13.9–18.3)	194,099
Māori	18.6 (14.9–22.3)	18.2 (14.7–21.7)	38,850
Pacific	12.6 (9.3–15.9)	12.8 (9.5–16.1)	12,975
Other	8.6 (3.3–13.9)	8.0 (3.3–12.7)	10,483
<b>Family income</b>			
0–\$20,000	21.8 (17.9–25.7)	21.7 (17.4–26.0)	40,501
\$20,001–\$30,000	15.8 (11.9–19.7)	16.2 (11.9–20.5)	28,418
\$30,001–\$50,000	15.8 (12.7–18.9)	16.3 (13.0–19.6)	54,897
\$50,001+	13.5 (9.8–17.2)	14.2 (10.1–18.3)	76,731
<b>NZDep96 score</b>			
1 (least deprived)	16.5 (11.4–21.6)	16.1 (11.4–20.8)	74,020
2	13.3 (10.6–16.0)	13.7 (10.8–16.6)	52,684
3	15.9 (13.0–18.8)	15.6 (12.7–18.5)	60,977
4 (most deprived)	16.1 (13.7–18.5)	15.8 (13.6–18.0)	68,727
<b>Smoking status</b>			
Current smoker	17.5 (14.6–20.4)	17.9 (15.0–20.8)	85,734
Ex-smoker	15.1 (10.6–19.6)	13.9 (9.6–18.2)	42,588
Never smoked	14.5 (12.1–16.9)	14.2 (12.0–16.4)	127,531
<b>Education</b>			
No qualification	17.2 (13.9–20.5)	16.8 (13.7–19.9)	64,157
School or post-school only	15.6 (13.1–18.1)	15.3 (12.8–17.8)	99,312
School and post-school	14.4 (11.7–17.1)	14.9 (12.0–17.8)	91,593

\* Adjusted rates are adjusted for age and sex, except when they are age-specific, in which case they are adjusted only for sex, or when they are sex-specific, in which case they are adjusted only for age.

Note: For further explanation of Tables, see Appendix 2: Notes to Figures and Tables.

**Table 47: Probable asthma among males aged 15–44 years, by age and ethnicity: percent (95% confidence intervals)**

Probable asthma			
Males	% (95% CI)		Pop est
	Unadj	Adj*	
<b>Total</b>	12.9 (10.5–15.3)	12.9 (10.5–15.3)	105,086
<b>Age</b>			
15–24 years	18.1 (12.8–23.4)		47,154
25–34 years	12.7 (9.4–16.0)		35,079
35–44 years	8.3 (5.6–11.0)		22,853
<b>Ethnicity</b>			
European/Pākehā	13.1 (10.4–15.8)	13.3 (10.6–16.0)	79,121
Māori	16.7 (10.0–23.4)	16.4 (10.3–22.5)	16,062
Pacific	12.8 (7.3–18.3)	13.0 (7.7–18.3)	6,559
Other	5.4 (0.0–12.3)	4.4 (0.0–9.7)	3,343

\* Adjusted rates are adjusted for age.

Note: For further explanation of Tables, see Appendix 2: Notes to Figures and Tables.

**Table 48: Probable asthma among females aged 15–44 years, by age and ethnicity: percent (95% confidence intervals)**

Probable asthma			
Females	% (95% CI)		Pop est
	Unadj	Adj*	
<b>Total</b>	18.0 (15.8–20.2)	18.0 (15.8–20.2)	151,322
<b>Age</b>			
15–24 years	20.6 (16.1–25.1)		53,816
25–34 years	18.1 (14.8–21.4)		53,466
35–44 years	15.5 (12.2–18.8)		44,040
<b>Ethnicity</b>			
European/Pākehā	18.6 (15.9–21.3)	18.7 (16.0–21.4)	114,978
Māori	20.2 (16.1–24.31)	20.0 (15.9–24.1)	22,788
Pacific	12.3 (8.4–16.2)	12.6 (8.5–16.7)	6,416
Other	11.9 (3.9–19.9)	11.4 (4.0–18.8)	7,140

\* Adjusted rates are adjusted for age.

Note: For further explanation of Tables, see Appendix 2: Notes to Figures and Tables.

## References

- Balfe D, Crane J, Beasley R, et al. 1996. The worldwide increase in the prevalence of asthma in children and young adults. *Continuing Med Educ J* 14: 433–42.
- Burney PGJ, Chinn S, Rona RJ. 1990. Has the prevalence of asthma increased in children? Evidence from the national study of health and growth 1973–86. *BMJ* 300: 1306–10.
- Burney PG, Luczynska C, Chinn S, et al. 1994. The European Community Respiratory Health Survey. *Eur Respir J* 7: 954–60.
- Burr ML. 1987. Is asthma increasing? *J Epidemiol Community Health* 41: 185–9.
- Crane J, Lewis S, Slater T, et al. 1994. The self reported prevalence of asthma symptoms amongst adult New Zealanders. *NZ Med J* 107: 417–21.
- Eachus J, Williams M, Chan P, et al. 1996. Deprivation and cause-specific morbidity: evidence from the Somerset and Avon survey of health. *BMJ* 312: 287–92.
- Fishwick D, Bradshaw L, Kemp T, et al. 1997. Respiratory questionnaire responses: how they change with time. *NZ Med J* 110: 305–7.
- Garrett JE, Mulder J, Wong-Toi H. 1989. Reasons for racial differences in A&E attendance rates for asthma. *NZ Med J* 102: 121–4.
- Kemp T, Pearce N. 1997. The decline in asthma hospitalisations in persons aged 0–34 years in New Zealand. *Aust NZ J Med* 27: 578–81.
- Kolbe J, Garrett J, Vamos M, et al. 1994. Influences on trends in asthma morbidity and mortality: the New Zealand experience. *Chest (suppl)* 106: S211–15.
- Lewis S, Hales S, Slater T, et al. 1997. Geographical variation in the prevalence of asthma symptoms in New Zealand. *NZ Med J* 110: 286–9.
- Littlejohns P, Macdonald LD. 1993. The relationship between severe asthma and social class. *Respir Med* 87: 139–43.
- Mitchell E. 1991. Racial inequalities in childhood asthma. *Soc Sci Med* 32: 831–6.
- Mitchell E, Stewart A, Pattermore P. 1989. Socioeconomic status in childhood asthma. *Int J Epidemiol* 18: 888–90.
- Pearce N, Beasley R, Crane J, et al. 1995. End of the New Zealand asthma mortality epidemic. *Lancet* 345: 41–4.
- Pearce N, Weiland S, Keil U, et al. 1993. Self-reported prevalence of asthma symptoms in children in Australia, England, Germany and New Zealand: an international comparison using the ISAAC protocol. *Eur Respir J* 6: 1455–61.
- Pomare E, Tutengaehe H, Ramsden I, et al. 1992. Asthma in Māori people. *NZ Med J* 105: 469–70.
- Robson B, Woodman K, Burgess C, et al. 1993. Prevalence of asthma symptoms among adolescents in the Wellington region, by area and ethnicity. *NZ Med J* 106: 239–41.
- Salmond C, Crampton P, Hales S, et al. 1998. Asthma prevalence and deprivation: a small area analysis. Manuscript submitted for publication.
- Sears M, Holdaway M, Flannery I, et al. 1996. Parental and neonatal risk factors for atopy, airway hyper-responsiveness, and asthma. *Arch Dis Child* 75: 392–8.
- Sears MR. 1997. Descriptive epidemiology of asthma. *Lancet* 350 (suppl II): 1–4.
- Watson JP, Cowen P, Lewis RA. 1996. The relationship between asthma admission rates, routes of admission, and socioeconomic deprivation. *Eur Respir J* 9: 2087–93.
- Wickens K, Fitzharris P, Crane J. 1998. Increasing asthma prevalence in New Zealand: understanding the causes. *NZ Public Health Rep* 5: 17–20.