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Pharmacological management of children's asthma in general practice: findings from a community-based cross-sectional survey in Auckland, New Zealand

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Abstract

Aim To describe the pharmacological management of children's asthma and to assess whether there were ethnic differences in pharmacological management.

Methods A community-based, cross-sectional, interviewer administered face-to-face survey. The sample (n=583) included the caregivers of 221 Māori, 173 Pacific, and 189 European/other children. Data collected included sociodemographic information, and medications received and medication delivery devices used in the 12 months prior to interview. Descriptive and logistic regression analyses to investigate ethnic differences in pharmacologic management were undertaken.

Results Spacer devices were used by 80% of children under 7 years of age and 34% of children 7 years or over. No ethnic differences in the use of these devices were observed. Māori (58%) and Pacific (65%) were significantly ($p<0.0001$) more likely to have been given a nebuliser (European/other 34%). Most (96%) children received inhaled beta-agonists and there were no ethnic differences for these medications. Overall, 69% of children had received inhaled corticosteroids (ICS) and there were no significant ethnic differences in receipt of these medications. However, only 68–78% of children in the moderate, severe, and very severe morbidity groups reported inhaled corticosteroids use in the previous 12 months, suggesting that this group is being under-treated. Morbidity stratified analyses suggested that Māori and Pacific children who had experienced severe morbidity in the previous 12 months were less likely to have received ICS.

Conclusions Some aspects of the pharmacological management of asthma are more consistent with recommendations in evidence-based guidelines than previously reported in NZ. The proportion of children with asthma who were receiving beta agonists and ICS were higher than that previously reported in NZ and the reported use of anticholinergics was low. However, other findings show there is still room for further improvements to be made, particularly with respect to the use of inhaled corticosteroids among children who experience significant morbidity, the use of nebulisers, and the use of spacer devices. The implementation of clinical quality assurance activities that support primary health organisations and providers to monitor and improve the delivery of evidence-based asthma care could further improve asthma outcomes.

Asthma is a significant issue for children in New Zealand. Ethnic-specific estimates of the prevalence of asthma symptoms among children aged 6 to 7 years and adolescents aged 13–14 years have been reported using data collected in the

International Study of Asthma and Allergies in childhood (ISAAC).[1-3] ISAAC Phase III data estimated the prevalence of 'current wheeze' among children were European/Pākehā 21%, Māori 29%, and Pacific 25%. Among adolescents the prevalence of 'current wheeze' were European/Pākehā 29%, Māori 30%, and Pacific 21%.[4]

Asthma hospitalisations are higher for Māori and Pacific children. Between 2003-2005, hospitalisations rates (per 100 000) for Māori children were significantly higher than for non-Māori in the 1 to 4 year age group (Māori 1877, non-Māori 1175; odds ratio 1.60) and in the 5-14 year age group (Māori 329, non-Māori 232, odds ratio 1.42).[5]

Ethnic differences in prevalence do not fully account for ethnic differences in asthma hospitalisations.[3] Other factors hypothesised as contributors to ethnic disparities in asthma outcomes include differences in access to care, asthma education and knowledge and differences in medications.[6-9] Prior to the collection of data for this study some publications included information about asthma-related medication use by ethnicity[9-12] and three found ethnic differences in medication use.[9,10,12] However, none of these studies were designed to specifically address the questions 'are there ethnic differences in the pharmacological management of children's asthma?' The study from which the data presented in this paper is drawn was specifically designed to examine the management of children's asthma in primary care and asthma-related health service utilisation by Māori, Pacific and European/other children. This paper presents findings about pharmacological delivery mechanisms and pharmacological management.

Methods

We conducted a cross-sectional survey in Auckland, New Zealand (NZ). The caregivers of eligible children were invited to participate in the survey. Children were eligible if: aged 2 to 14 years; and had experienced asthma symptoms in the 12 months prior to interview; and they had a doctor diagnosis of asthma or had experienced wheeze or whistling in the chest. The University of Auckland's Ethics Committee approved the study.

Eligible children were identified using random residential address start points with cluster sampling of consecutive dwellings to the right of each start point. The householder was asked if there was an eligible child in the household and, if there was, the study was explained and the child's caregiver was invited to participate. If no one was at home, dwellings were visited on different days and at different times on up to three occasions. At the time of recruitment, the child's ethnicity data was obtained from the caregiver using a modified version of a NZ census ethnicity question. Multiple ethnic group choices were possible. Where multiple groups were nominated, the ethnicity data was prioritised into Māori, Pacific and European/other groups using Statistics New Zealand's prioritisation process.[13, 14] An ethnically stratified sampling ratio was applied to eligible children to identify those who would be enrolled into the study. The sampling ratios were used so that approximately equal numbers of Māori, Pacific and European/other children would be enrolled into the study. Only one eligible child from each household was enrolled in the study.

Data were collected in the home during a face-to-face interview with the child's main caregiver, after written informed consent was obtained. All interviewers were provided with study protocols outlining the study and the administration of the questionnaire, and were trained to administer the questionnaire in a standardised manner. During the interview, data were collected that described the child's ethnicity, household sociodemographics, asthma-related health service utilisation in the previous 12 months, and the medications and medication delivery systems used in the previous 12 months. Asthma morbidity in the previous 12 months was assessed using a morbidity scale designed and validated in New Zealand.[15] Data were collected between June 1999 and May 2001.

Medication delivery system outcomes were: use of inhalers, spacer devices, nebulisers, and oral medications. The following medication outcomes were used: inhaled beta-agonists, inhaled anticholinergics, inhaled corticosteroids, cromoglycates, and oral steroids. The time period used for all outcomes was 'in the 12 months prior to interview'.

Caregiver-reported ethnicity data was collected during the interview following the same processes employed to collect and categorise ethnicity data during recruitment. Possible confounders were identified *a priori* and included in multivariable analyses. The confounders were age, sex, measures of socioeconomic position (SEP), whether the child had a regular source of primary care, and parental prior knowledge of asthma due to a history of asthma in a parent or the child's sibling. Four measures of SEP were employed: household income, the caregiver's highest education level, parental occupation, and the NZ Index of Deprivation 1996 (NZDep96) decile. The NZDep96 is a small geographic area based measure of socioeconomic deprivation.

Sample size estimates were based upon published estimates of the proportions of NZ children receiving preventive medications.[9] A sample of 170 children in each ethnic group was sufficient to have at least 80% power at the 0.05 significance level to detect ethnic differences in the proportions receiving preventive medications, assuming a prevalence of 4% for Pacific, 13% for Māori, and 25% for European/other ethnic group children.

Data were double entered using Epi-info and analysed using the survey procedures in SAS-PC software (version 9.2; SAS Inc. Cary, NC, USA). Estimates were adjusted for design effects associated with clustering and weighted for the number of eligible children in each household. Initially chi-square tests for categorical variables and analysis of variance for continuous variables were used to investigate ethnic differences. Logistic regression modelling was employed to further explore the association between ethnicity and the outcome variables after adjustment for potential confounding variables (age, sex, four measures of SEP, whether the child had a regular source of primary care, parental history of asthma, and sibling history of asthma).

Results

Of the 649 eligible children invited into the study, data were collected from 583 (90%) (Figure 1). The caregivers of 64 enrolled children did not complete the interview. Reasons for non-completion were caregivers no longer wanting to participate in the interview (n=45; 70%), not being contactable for an interview (n=9, 14%), having moved (n=6, 9%) or were ineligible (n=4, 6%). There were no significant differences in either the distribution of ethnicity or NZDep96 decile among completers and non-completers. The children whose caregivers were enrolled into the study but did not complete the interview were younger than those who did complete (8.7 versus 9.8 years; p=0.009) (data not shown).

Study sample demographics and source of primary care (Table 1)—The study sample (n = 583) included 221 (38%) Māori, 173 (30%) Pacific and 189 (32%) European/Other children. Males accounted for 55% of the sample. The mean age of the child at the time of interview was 7.6 years. Neither sex nor age varied with ethnicity.

Significant ethnic differences were observed in all four measures of socioeconomic position. Higher proportions of the Māori and Pacific ethnic groups lived in more deprived NZDep96 decile areas, had household incomes of $40,000 or below, had caregivers with no high school qualification, and were in occupations associated with lower socioeconomic position.

A parental history of asthma was more common (p=0.002) among Māori (51%) than European/other (47%) and Pacific (33%). A sibling history of asthma was also more common (p<0.01) among Māori (45%) than the Pacific (34%) and European/other

ethnic groups (30%). Just over half of the total sample reported they had a regular source of primary care that was used all the time, with the remainder reporting they did not have a regular source of care (6%) or used other GPs in addition to their regular source of care (43%). There were no significant ethnic differences in the use of a regular source of care.

Figure 1. Summary of enrolment and completion of interviews

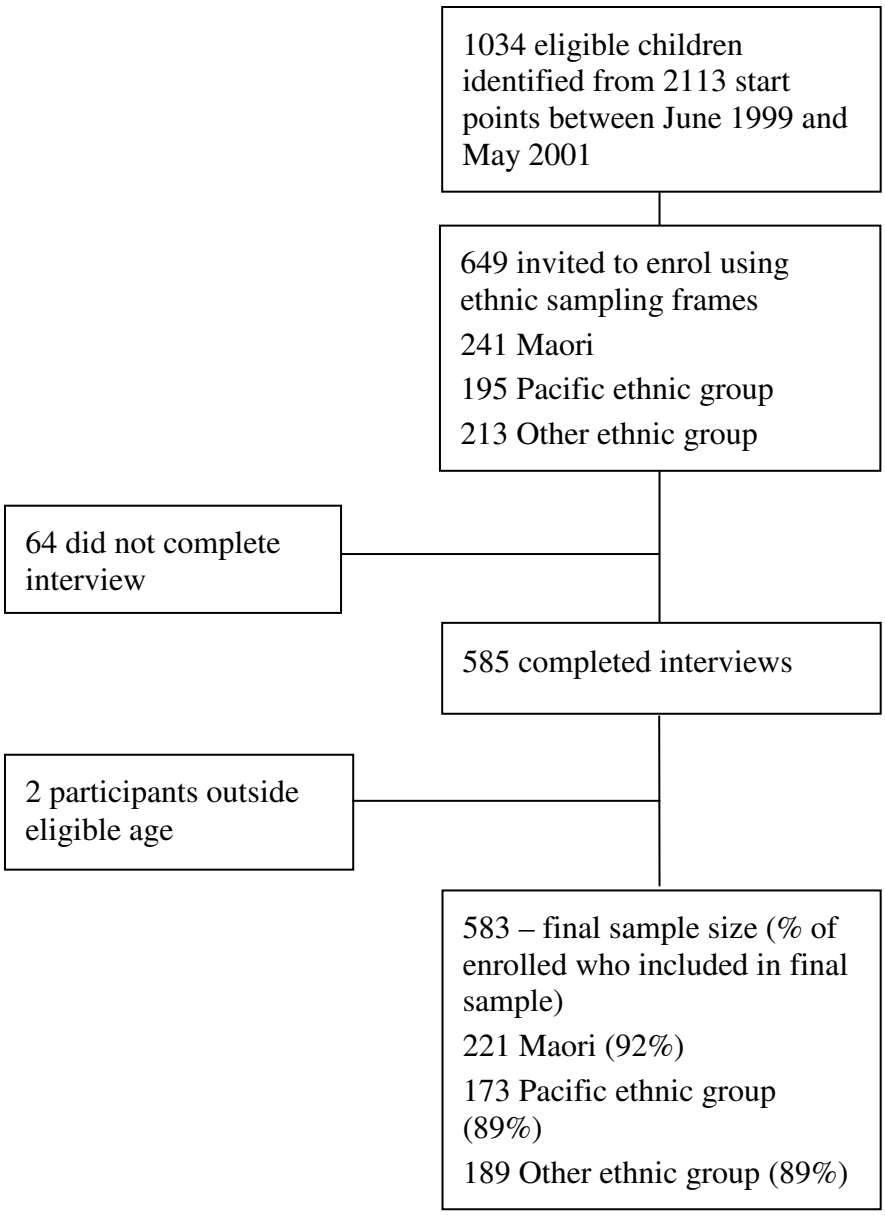

Table 1. Associations between ethnicity and sociodemographic variables

Variables	Māori		Pacific		European/other		Total	
	n	% (95%CI)	N	% (95%CI	n	% (95%CI)	n	% (95%CI)
Ethnicity (N=583)	221	38	173	30	189	32	583	100
Sex (N=583)								
Male	118	53 (46, 60)	92	53 (46, 61)	115	60 (53, 67)	325	55 (51, 60)
Female	103	47 (40, 54)	81	47 (39, 54)	74	40 (31, 47)	258	45 (40, 49)
NZDep96 decile (N=583) ***								
1-7	98	44 (37, 52)	71	42 (34, 50)	154	81 (75, 87)	323	55 (50, 61)
8-10	123	56 (48, 63)	102	58 (50, 66)	35	19 (13, 25)	260	45 (39, 50)
Total household income (N=510) ***								
≤ $40,000	124	63 (56, 70)	93	65 (57, 73)	50	32 (24, 39)	267	53 (48, 58)
> $ 40,000	71	37 (30, 44)	53	35 (28, 44)	119	69, (61, 76)	243	47 (42, 52)
Caregiver's education level (N=578) **								
No high school qualification	35	15 (10, 20)	29	17 (11, 23)	9	5 (2, 9)	73	12 (10, 15)
High school qualification	73	35 (28, 42)	74	43 (36, 51)	61	33 (26, 40)	208	37 (33, 41)
University or other tertiary institution	112	50 (43, 57)	68	40 (32, 48)	117	62 (55, 69)	297	51 (47, 55)
NZSEI occupational class (N=574) ***								
1 and 2	10	5 (2, 8)	11	7 (3, 11)	43	23 (17, 29)	64	11 (8, 14)
3	12	5 (2, 8)	14	9 (4, 14)	36	19 (13, 25)	62	11 (8, 13)
4	33	15 (10, 19)	27	15 (10, 21)	47	25 (19, 31)	107	18 (15, 21)
5 and 6	96	45 (38, 52)	79	46 (38, 54)	41	22 (16, 28)	216	38 (33, 42)
Not in the labour force	68	31 (24, 37)	36	23 (16, 30)	21	12 (7, 17)	125	22 (19, 26)
Parental history of asthma (N=582) **								
Yes	112	51 (44, 58)	56	33 (26, 40)	87	47 (40, 55)	255	44 (40, 48)
Sibling history of asthma (N=582) *								
Yes	92	45 (39, 52)	54	34 (27, 42)	53	30 (23, 37)	199	37 (33, 41)
Use of routine source of primary medical care (N=580)								
Always uses RSC	97	45 (38, 52)	92	54 (46, 61)	106	56 (48, 63)	295	51 (47, 56)
Has RSC and uses other GPs	105	47 (40, 55)	67	39 (32, 47)	77	42 (35, 49)	249	43 (39, 48)
No RSC	97	8 (4, 11)	13	7 (3, 11)	5	3 (0, 5)	36	6 (4, 8)

Morbidity in previous 12 months (N=577)****								
Very mild	57	25 (19, 31)	53	29 (22, 36)	67	35 (28, 42)	177	29 (26, 33)
Mild	55	25 (19, 31)	37	23 (16, 30)	60	32 (25, 40)	152	27 (23, 31)
Moderate	50	23 (17, 29)	42	24 (18, 31)	35	19 (13, 25)	127	22 (18, 26)
Severe	34	17 (12, 22)	25	15 (10, 21)	12	6 (3, 12)	71	13 (10, 16)
Very severe	23	10 (6, 14)	14	8 (4, 12)	13	8 (3, 12)	50	9 (6, 11)
Mean age at interview (years) (N=583)	221	7.4 (6.9, 7.8)	173	7.4 (6.9, 7.9)	189	7.9 (7.5, 8.4)	583	7.6 (7.3, 7.8)
Age (years)	221		173		189			
Median		7.0 (6.4, 7.5)		7.5 (6.8, 8.2)		8.0 (7.4, 8.6)		
Min, Max		2.0, 14.0		2.0, 13.9		2.0, 14.0		

* p<0.01; ** p=0.0002; *** p<0.0001; ****p=0.02.

Medication delivery systems used in the previous 12 months (Table 2)—The use of inhalers with or without spacer devices was reported by 95% of participants. There were no significant ethnic differences in the use of this device. Spacer devices were used by 80% of children ≤6 years of age and 34% of those aged ≥7 years of age.

Medication delivery using a nebuliser was reported by 53% of the total sample. Statistically significant ethnic differences ($p<0.0001$) were observed with more Māori (58%) and Pacific (65%) than European/other (34%) children received nebulised bronchodilators. Significant ethnic differences ($p<0.01$) in the delivery of medications in syrup form were also observed; (Māori 14%, Pacific 8%, European/other children 5%).

Table 2. Medication delivery systems used in previous 12 months by ethnicity

Variables	Māori		Pacific		European/other		Total	
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI
Had used an inhaler ± spacer (N=583)	211	95 92, 98	163	95 91, 98	179	95 92, 98	553	95 93, 97
Had used a spacer among children ≤6 years of age (N=265)	91	79 71, 87	59	76 66, 86	65	84 76, 93	215	80 75, 85
Had used a spacer among children ≥7 years of age (N=318)	30	30 21, 40	32	34 24, 43	43	38 29, 47	105	34 28, 40
Had used a nebuliser (N=583)*	124	58 52, 65	111	65 57, 73	63	34 27, 41	298	53 48, 57
Had used syrup medication (N=583)**	29	14 9, 19	14	8 4, 12	10	5 2, 8	53	9 7, 12

* $p<0.0001$; ** $p<0.01$.

Asthma medications used in the previous 12 months (Table 3)—The use of inhaled beta-agonists was almost universal with 96% of children receiving these types of medications. Sixty-nine percent of children had received an inhaled corticosteroid (ICS).

Logistic regression modelling identified significant interactions between ethnicity and morbidity for the outcomes 'inhaled beta-agonists in the previous 12 months' ($p<0.0001$) and 'inhaled corticosteroids in the previous 12 months' ($p<0.0001$). Consequently, morbidity stratified ethnic-specific prevalence estimates of having received these medication types were calculated. With regard to beta-agonists the pattern of use across morbidity levels varied slightly by ethnicity.

Among Māori, use of beta-agonists was lower at the extremes of morbidity than in the 'middle' morbidity levels. The very high overall use of these medications and the small size of the observed differences suggest that this finding is of limited clinical importance (data not shown). In relation to ICS, fewer Māori and Pacific children who had experienced severe morbidity in the previous 12 months had received ICS (Figure 2).

Figure 2. Percentage (and 95% confidence intervals) who had received ICS in the previous 12 months by morbidity and ethnicity

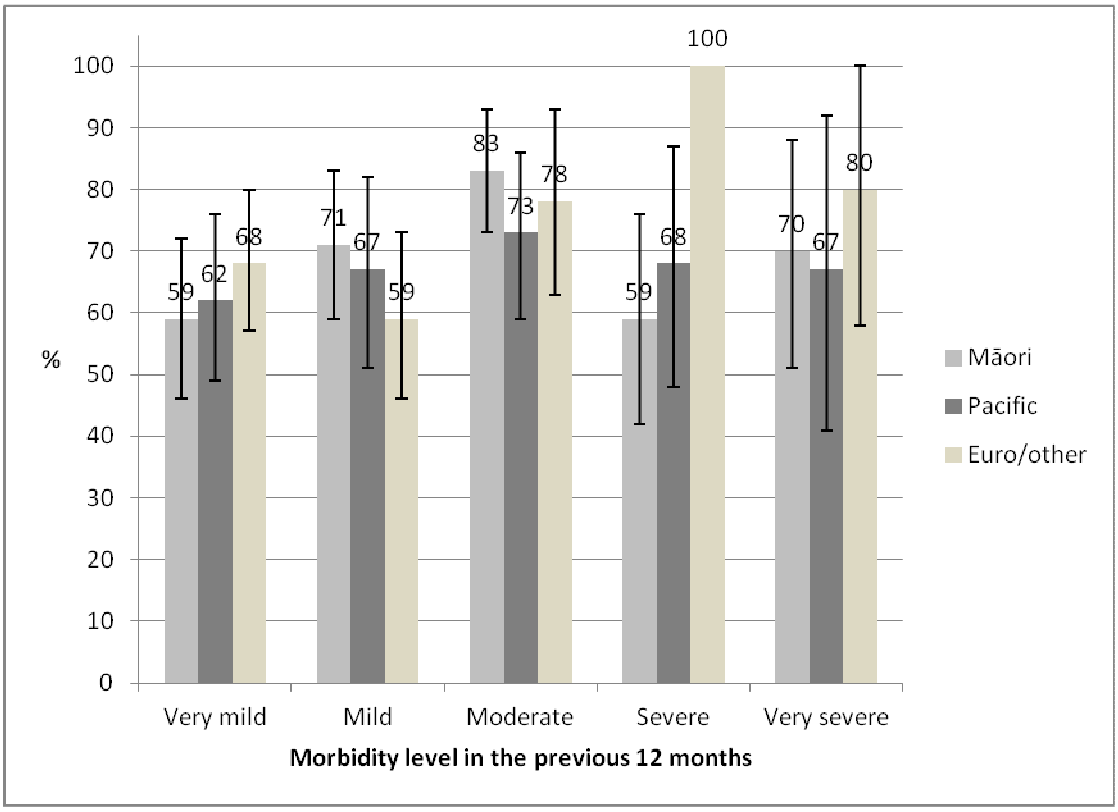

Table 3. Percent who had used medication in the previous year by ethnicity (N=583)

Variables	Māori		Pacific		European/other		Total	
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI
Inhaled beta- agonists	212	96 93, 99	168	97 95, 100	176	94 90, 97	556	96 94, 97
Inhaled anticholinergics	5	2 0, 4	4	2 0, 4	4	2 0, 4	13	2 1, 3
Inhaled corticosteroids	150	69 63, 75	114	67 60, 74	132	70 64, 77	396	69 65, 73
Cromoglycates	11	5 2, 7	5	3 0, 5	16	8 4, 12	32	5 4, 7
Oral steroids	32	15 10, 21	13	8 4, 13	29	16 10, 21	74	13 10, 16

Oral steroids had been given to 13% of children. Ethnic differences in the proportion receiving oral steroids approached statistical significance (p=0.06) (Māori 15%, European/other children 16%, Pacific 8%). Cromoglycates and inhaled anticholinergic medications were used by a small proportion and their use did not vary by ethnicity. Logistic regression analyses adjusting for age, sex, socioeconomic

position, and parental and sibling histories of asthma confirmed these findings for oral steroids, cromoglycates and anticholinergic medications (data not shown).

Discussion

In this study the use of inhaler devices with or without a spacer was almost universal and spacers were used with inhalers by the majority (≈ 80%) of children aged 6 years or less. The majority of children (96%) had received inhaled beta-agonists in the previous 12 months and 69% had received ICS. Consistent with the findings of Shaw et al,[11] there were no significant ethnic differences in the use of reliever or preventative asthma medications.

The results of this study suggest some aspects of the pharmacological management of asthma are more consistent with recommendations in evidence-based guidelines than previously reported in NZ. The proportion of children with asthma who were receiving beta-agonists and ICS were higher than that previously reported in NZ. Furthermore the low reported use of anticholinergics was consistent with recommendations for these drugs.

However, other findings suggested there is still room for further improvements to be made. Only 68–78% of children in the moderate, severe, and very severe morbidity groups reported ICS use in the previous 12 months, suggesting that this group is being under-treated. The use of nebulisers was no longer recommended except in extreme circumstances. However, one third of European/Other and over half of Māori and Pacific caregivers reported their child had received medications by nebuliser in the previous 12 months.

Spacer devices are recommended for the delivery of medication to children under 7 years and, ideally, for children up to 15 years of age.[16] In this study, about 80% of children under 7 years and 34% of the older age group reported use of spacer devices.

Some of the associations identified in this study suggest there may be ethnic differences in the quality of care including: the similarity in use of oral steroids in each ethnic group in the context of higher morbidity experience by Māori and Pacific children; the higher proportion of Māori and Pacific caregivers who report nebuliser use in the previous 12 months; and stratified analyses by morbidity suggesting Māori and Pacific children with severe morbidity may are less likely to receive preventative medications than Other ethnic group children.

Strengths and limitations of the study—This is the first study to have focused explicitly on whether there were ethnic differences in the management of children's asthma. Furthermore it is rigorously designed, and included sufficient numbers of Māori, Pacific and Other ethnic groups to examine the major outcomes for each group.

A very high proportion of participants completed the study and there were no ethnic differences in completion rates. Participants were recruited using a community-based sampling frame providing much greater representativeness than samples recruited from after-hours medical clinics, EDs and hospitals. As a result the findings are highly generalisable to non-participating children with asthma.

There are a number of limitations to the design of the study reported here. Firstly, the study is a cross-sectional survey and, therefore, cannot make inferences about

causation. Participants were asked to recall information from the preceding 12 months, making the study vulnerable to recall bias. However, there is no evidence that recall bias would occur more frequently in any particular ethnic group so any recall bias should not affect the estimates of ethnic differences. Seasonal bias may also be found in studies of asthma but is unlikely in this study as recruitment occurred over a two year period, and the outcome variables used a 'last 12 months' timeframe.

We sought to identify what medications were provided by GPs. Participants may have reported what medications they had given to the child rather than those the doctor had provided (regardless of whether it had been given to the child or not) but we do not believe this is likely as participant information explicitly stated the focus was on the management of asthma by doctors, nurses and other health professionals in the community. As the study did not collect data about the dose of medications we are unable to assess whether medication doses were consistent with guideline recommendations.

Although the study had excellent completion rates in all ethnic groups, the mean age of non-completing children was lower than that of children who completed the interview. The impact of this is likely to be very small and will vary according to relationship between age and the specific outcome measure. Estimates of ethnic differences in outcomes will not be affected as there were no ethnic differences between the non-completing and completing groups, nor were there any differences in age across the three ethnic groups. Finally, the observed ethnic differences in preventive medication use were lower than those used for power calculations and this may have resulted in the current study being underpowered to identify ethnic differences in preventive medication use.

Implications for the health sector, health services and clinical practice—Asthma is a chronic condition that is associated with a high burden of disease and significant costs to the health sector and to the children and families who are affected by asthma. These are amenable to change through the provision of high quality primary care using readily available evidence based guidelines for managing asthma.

Reducing ambulatory sensitive hospitalisations is one of the Minister of Health's key targets for District Health Boards,[17] and improving access to and the effectiveness of 'mainstream' services is a key objective in the Māori Health Strategy.[18] The results of this study suggest there are opportunities for increased focus on the effective management of asthma as a means of reducing morbidity and the costs associated with this morbidity. At DHB and PHO levels asthma management should be explicitly incorporated into funding and service delivery strategies aimed at improving the outcomes of chronic diseases.

PHOs and individual providers should review their approaches to supporting and delivering high quality asthma care. Ensuring the care provided falls within the recommendations of evidence-based guidelines is important and has been shown to be beneficial.[19-21] The results of this study suggest that there is scope to improve practices associated with the provision of ICS, the use of spacer devices, and reducing the use of nebulisers. Clinical audit with feedback to individual clinicians is a useful tool for undertaking continuous quality improvement. Specific reporting of audit findings by ethnicity will assist providers to reduce any identified ethnic differences in their practice.

Other tools, for example on-screen reminders for aspects of asthma care, continuing medical education workshops, and the provision of electronic access to information for health professionals,[22–25] have been shown to be effective strategies to assist clinical decision making and improve practice and these could be further implemented in individual practices or across PHOs. Computerised decision-support tools to assist practitioners to align their practice with evidence-based recommendations are also being implemented and evaluated.[26–30] This array of strategies should be considered when developing DHB or PHO-wide approaches to improving the management of asthma.

Improving the management of asthma in primary care requires a team of primary care professionals who are well informed about asthma; the provision of asthma care that is consistent with guidelines; and practitioners who are able to communicate with their patients in an acceptable, appropriate and effective manner. Providing culturally competent care is also important for ensuring that Māori and Pacific peoples access and receive the highest quality of care. PHOs and individual practitioners must take responsibility for increasing the cultural competence of, respectively, the primary care workforce and themselves.

The data presented in this study was collected between June 1999 and May 2001, raising the question of whether the data and study findings remain valid. Publicly available data about asthma management in the PHO environment is limited. Furthermore, there have been no publications addressing the questions raised in this study in the years since data collection was completed. Published data about asthma admissions over the years 2003–2006[31,32] do not provide convincing evidence of sustained reductions in asthma hospitalisations or in ethnic inequalities in children's asthma hospitalisations.

We believe that the data remains salient and provides useful information to guide primary care practitioners and organisations in their efforts to improve asthma care, reduce asthma morbidity and facilitate reductions in ethnic inequalities in asthma outcomes.

Competing interests: None.

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