The Management of Children's Asthma in Primary Care

Are There Ethnic Differences in Care?

Volume One: Thesis

Suzanne Marie Crengle

A thesis submitted for the degree of Doctor of Philosophy,
The University of Auckland, 2008

Abstract

Background

Asthma is a common problem in New Zealand, and is associated with significant morbidity and costs to children, their families, and wider society. Previously published New Zealand literature suggested that Māori and Pacific children were less likely than NZ European children to receive asthma medications and elements of asthma education, had poorer knowledge of asthma, and experienced greater morbidity and hospitalisations. However, none of the previous literature had been specifically designed to assess the nature of asthma care in the community, or to specifically answer whether there were ethnic disparities in care. A systematic review of studies published in the international literature that compared asthma management among different ethnic groups drawn from community-based samples was undertaken. The results of this review suggested that minority ethnic group children were less likely to receive elements of asthma medication use, asthma education and self-management (action) plans.

Objectives

The primary objectives of the study were to:

- describe the use of medications, medication delivery systems, asthma education, and self-management plans in primary care for Māori, Pacific, and Other ethnic group children
- ascertain whether there were any ethnic disparities in the use of medications, medication delivery systems, asthma education, and self-management plans in primary care after controlling for differences in socio-economic position and other potential confounders.

Secondary objectives were to:

- describe the asthma-related utilisation of GP, after hours medical care, emergency departments, and hospital admissions among Māori, Pacific, and Other ethnic group children with asthma
- ascertain whether differences in medication use, the provision of asthma education, and the provision of self-management plans explained ethnic differences in health service utilisation.

Methods

A cross-sectional survey was conducted in Auckland, New Zealand. The caregivers of 647 children who were aged 2–14 years, had a diagnosis of asthma or experienced 'wheeze or whistling in the chest', and had experienced symptoms in the previous 12 months were identified using random residential address start points and door knocking. Ethnically stratified sampling ratios were used to ensure that approximately equal numbers of children of Māori, Pacific and Other ethnicity were enrolled into the study. A face-to-face interview was conducted with the caregivers of these children. Data was collected about: socio-demographic factors; asthma morbidity; asthma medications and delivery devices; exposure to, and experiences of, asthma education and asthma action plans; and asthma-related health services utilisation.

Results

In this study, the caregivers of 647 eligible children were invited to participate and 583 completed the interview, giving an overall completion rate of 90.1%. There were no ethnic differences in completion rates.

The overall use of inhaled corticosteroid medications had increased since previous New Zealand research was published. Multivariable modelling that adjusted for potential confounders did not identify ethnic differences in the use of inhaled corticosteroids or oral steroids. Some findings about medication delivery mechanisms indicated that care was not consistent with guidelines.

About 15% of participants reported they had not received asthma education from a primary care health professional. After adjusting for potential confounders there were no ethnic differences in the likelihood of having received asthma education from a health professional. Among those participants who had received education from a primary care health professional, significantly fewer Māori and Pacific caregivers reported receiving education about asthma triggers, pathophysiology and action plans. Lower proportions of Pacific (77.7%; 95% confidence interval (95%CI) 70.3, 85.1) and Māori (79.8%; 95% CI 73.6, 85.9) caregivers were given information about asthma triggers compared to Other caregivers (89.2%; 95% CI 84.9, 93.6; p=0.01). Fewer Māori (63.6%; 95% CI 55.7, 71.4) and Pacific (68.1%; 95% CI 60.1, 76.1) caregivers reported receiving information about pathophysiology (Other 75.9%; 95% CI 69.5, 82.3; p=0.05). Information about asthma action plans had been given to 22.7% (95% CI 15.5, 29.9) of Pacific and 32.9% (95% CI 25.3, 40.6) of Māori

compared to Other participants (36.5%; 95% CI 28.6, 44.3; p=0.04). In addition, fewer Māori (64.2%; 95% CI 56.1, 72.3) and Pacific (68.5%; 95% CI 60.1, 77.0) reported that the information they received was clear and easy to understand (Other 77.9%; 95% CI 71.8, 84.1; p=0.03). About half of those who had received education from a health professional reported receiving further education and, after adjustment for potential confounders, Pacific caregivers were less likely to have been given further education (odds ratio 0.57; 95% confidence interval 0.33, 0.96).

A minority of participants (35.3%) had heard about action plans and, after adjustment for potential confounders, Pacific caregivers were less likely to have heard about these plans (odds ratio 0.54; 95% confidence interval 0.33, 0.96). About 10% of the sample was considered to have a current action plan.

The mean number of visits to a GP for acute and routine asthma care (excluding after-hours doctors and medical services) in the previous twelve months were significantly higher for Pacific (3.89; CI 3.28, 4.60) and Māori (3.56; CI 3.03, 4.16) children than Other ethnic group children (2.47; CI 2.11, 2.85; p<0.0001).

Multivariable modelling of health service utilization outcomes ('number of GP visits for acute and routine asthma care in the previous twelve months', 'high use of hospital emergency departments', and 'hospital admissions') showed that adjustment for potential confounding and asthma management variables reduced, but did not fully explain, ethnic differences in these outcomes.

Māori children experienced 22% more GP visits and Pacific children 28% more visits than Other children (p=0.05). Other variables that were significantly associated with a higher number of GP visits were: regular source of care they always used (regression coefficient (RC) 0.24; p<0.01); lower household income (RC 0.31; p=0.004) and having a current action plan (RC 0.38; p=0.006). Increasing age (RC -0.04; p=0.003), a lay source of asthma education (RC -0.41; p=0.001), and higher scores on asthma management scenario (RC -0.03; p=0.05) were all associated with a lower number of GP visits.

Pacific (odds ratio (OR) 6.93; 95% CI 2.40, 19.98) and Māori (OR 2.60; 95% CI 0.87, 8.32) children were more likely to have used an emergency department for asthma care in the previous twelve months (p=0.0007). Other variables that had a significant effect on the use of

EDs in the multivariable model were: not speaking English in the home (OR 3.72; 95% CI 1.52, 9.09; p=0.004), male sex (OR 2.43; 95% CI 1.15, 5.15; p=0.02), and having a current action plan (OR 7.85; 95% CI 3.49, 17.66; p<0.0001). Increasing age was associated with a reduced likelihood of using EDs (OR 0.90; 95% CI 0.81, 1.00; p=0.05).

Hospitalisations were more likely in the Pacific (OR 8.94; 95% CI 2.25, 35.62) and Māori (OR 5.40; 95% CI 1.28, 23.06) ethnic groups (p=0.007). Four other variables had a significant effect on hospital admissions in the multivariable model. Participants who had a low income (OR 3.70; 95% CI 1.49, 9.18; p=0.005), and those who had a current action plan (OR 8.39; 95% CI 3.85, 18.30; p<0.0001) were more likely to have been admitted to hospital in the previous 12 months. Increasing age (OR 0.88; 95% CI 0.80, 0.98; p=0.02) and parental history of asthma (OR 0.39; 95% CI 0.18, 0.85; p=0.02) were associated with reduced likelihood of admission.

Conclusions

The study is a robust example of cross-sectional design and has high internal validity. The study population is representative of the population of children with asthma in the community. The three ethnic groups are also considered to be representative of those ethnic groups in the community. The study, therefore, has good representativeness and the findings of the study can be generalised to the wider population of children with asthma in the Auckland region.

The results suggested that some aspects of pharmacological management were more consistent with guideline recommendations than in the past. However, given the higher burden of disease experienced by Māori and Pacific children, the lack of observed ethnic differences in the use of preventative medications may reflect under treatment relative to need. There are important ethnic differences in the provision of asthma education and action plans. Future approaches to improving care should focus on interventions to assist health professionals to implement guideline recommendations and to monitor ethnic disparities in their practice. Asthma education that is comprehensive, structured and delivered in ways that are effective for the people concerned is needed.

Acknowledgements

Professor Bruce Arroll and Dr Paul Brown have been the supervisors for this PhD thesis. Thank you both for your guidance and patience.

The Health Research Council of New Zealand funded the research project on which this thesis is based.

It is important to acknowledge the people who agreed to participate in the research project. The data represents their lived experiences, and I am very grateful that they chose to contribute this information to the project. Thank you all.

Associate Professor Cameron Grant and Dr Colin Tukuitonga were co-investigators on the research project. Professor Rod Jackson gave advice on aspects of multivariable modelling. For this, and for the part they have played in assisting with the development of my research skills, I thank them very much.

Ms Binki Taua and Ms Mavis Roberts were fantastic research coordinators. Their contribution, and that of the team of people who recruited and interviewed participants, was pivotal to the successful implementation of the project. Ms Shirley Cormack did a wonderful job proof reading my efforts.

Ms Elizabeth Robinson first became involved with this project when it was an idea that was still to bear fruit. She has been involved ever since, providing patient and wise biostatistical advice. Professor Innes Asher has been a much valued expert advisor about children's asthma, and Associate Professor Shanthi Ameratunga has provided expert epidemiological advice. Over the years, all three have been active reviewers of this thesis and have also been extremely important sources of inspiration, encouragement, and at times, comfort. Many, many thanks.

Associate Professor Papaarangi Reid has been remarkable for her patience, her determination that I will complete this thesis, and her willingness to allow me the space and time to do so. Likewise, Drs Elana Curtis and Rhys Jones, and my other colleagues at Te Kupenga Hauora

Māori have supported this endeavour and soldiered on while I worked on my thesis. Words cannot express my gratitude.

Thanks are also due to my friends, at home and overseas, who have listened to me moan and cheered me on. Sammy and Rosie have been devoted, although not particularly helpful, companions.

Finally, I wish to acknowledge, with much love, my parents who have unreservedly and whole-heartedly supported all my academic aspirations. Thanks Jenny and Bryan!

He mihi nui, he mihi tino aroha ki a koutou katoa.

Kua ea.

Table of contents

VOLUME ONE: THESIS

VOLUME TWO: APPENDICES

List of tables

List of figures

Abbreviations

95% CI	95% confidence interval
β_2 agonists	β_2 adrenoreceptor agonists
A&E	Accident and Emergency
A&M	Accident and Medical Centre
AHMC	After hours medical care
CG prioritised	Caregiver prioritised ethnicity
DHB	District Health Board
ED(s)	Emergency department(s)
GMS	General Medical Services benefit
GP	General Practitioner
HRC	Health Research Council of New Zealand
IOM	Institute of Medicine
ISAAC	International Study of Asthma and Allergies in Childhood
KMR	Kaupapa Māori Research
LABA	Long acting β_2 agonists
LTRA	Leukotriene receptor antagonists
MDIs	Metered dose inhalers
M:nM	Māori:non-Māori (ratio of Māori to non-Māori)
MPH	Master of Public Health
NAEPP	National Asthma Education and Prevention Program
ns	Not significant
NZE	New Zealand European
OR	Odds ratio
PAH	Potentially avoidable hospitalisations
NZ	Aotearoa/New Zealand
NZDep96	The New Zealand Index of Deprivation 1996
NZSEI	The New Zealand Socio-economic Index of Occupational Status
PEFR	Peak expiratory flow rate
PHO	Primary health organisation
RCT	Randomised controlled trial
RC	Regression coefficient
RR	Relative risk

SEP	Socio-economic position
SNZ	Statistics New Zealand
TRRHAEP	Te Rōpū Rangahau Hauora a Eru Pōmare
TWOWT	Te Whānau o Waipareira Trust
ToW	Treaty of Waitangi
UK	United Kingdom
USA	United States of America

Chapter 1 Introduction

The purpose of this introduction is to provide the reader with contextual information relating to the research project described in this thesis, to outline the content of the thesis, and to present the study's aims and objectives.

The introduction begins with an outline of how ethnic disparities in the management of children's asthma came to be the topic of this thesis. This is followed by an overview of contexts that are central to understanding the thesis but are not the specific focus of the thesis. The section on primary care briefly describes the primary care sector in Aotearoa/New Zealand (NZ) at the time the data for this study was collected and outlines subsequent changes to the sector. An outline of Kaupapa Māori Research theory provides the reader with an understanding of the epistemological and methodological approaches that underpin the work presented here. As ethnicity was the major explanatory variable in the study, the definition of ethnicity and the classification and use of ethnicity data is described. The aims and objectives of the study described in this thesis are presented in the final section of the introduction.

Chapter 2, entitled 'Asthma', commences with an overview of the prevalence, impact and outcomes associated with asthma. This is followed by a description of asthma, including the pathophysiology, symptoms, signs and clinical presentations. Asthma management is then outlined and includes, where available, a summary of NZ literature about asthma that was available prior to the commencement of data collection for this thesis.

Chapter 3 presents the results of a systematic review of the literature about ethnic disparities in asthma management. The methods used in the study presented in this thesis are described in Chapter 4, and Chapter 5 documents the results of the project. The results are discussed and conclusions drawn in Chapter 6.

Volume Two contains the appendices associated with this thesis.

1.1 The topic of this thesis

After five years working as a hospital-based junior doctor, I spent two years working as a General Practitioner (GP) in two 'private'[1] general practices. These seven years were characterised by an increasing desire to work more directly in Māori health. The health sector reforms announced in 1991 by the then Minister of Health, Simon Upton, provided Māori organisations with increased opportunities to enter the health sector as health service providers (Upton, 1991). In November 2002 I moved to Te Whānau o Waipareira Trust (TWOWT) where, in collaboration with Ms Marion Hakaraia and Dr Nikki Turner, I planned, established, and subsequently worked in the general practice and community health programmes delivered by TWOWT. The delivery of community health programmes in combination with a general practice service was very unusual in the so-called 'mainstream' primary care sector. My involvement in the development, implementation, and on-going delivery of TWOWT's health services raised my awareness of public health, and was accompanied by a growing sense that a life-time working as a GP would be insufficient to bring about significant improvements in Māori health outcomes and eliminate ethnic disparities in health. While continuing to work for TWOWT, I commenced my Master of Public Health (MPH) degree in 1995, and became aware of apparent ethnic disparities in the management of children's asthma during one of the courses I completed for this degree.

Ethnic disparities in health care are fundamentally unjust, unethical, result in significant economic costs to society, affect population groups that do not experience the disparity[2], are avoidable and, where they exist, are amenable to change (Woodward & Kawachi, 2000). Furthermore, these disparities are breaches of human rights (United Nations General Assembly, 1948), children's rights (United Nations General Assembly, 1959) and the rights of indigenous peoples (United Nations General Assembly, 2008). In the Aotearoa/New Zealand context disparities in the health of Māori are also breaches of Article 3 of the Treaty

[1]The National Primary Medical Care Survey 2001 defined 'private' general practices as practices operating within a small business model. Private practices were not 'community governed not-for-profit' services and/or did not meet the Ministry of Health's criteria for Māori provider funding.

[2]For example, population groups who otherwise have low infectious disease risk are more vulnerable to these diseases because the prevalence of the diseases in disadvantaged groups results in increased exposure of the low risk groups to these diseases.

of Waitangi (ToW)[3]. If clear evidence of ethnic differences in quality of care exists, initiatives to remove the disparities, including quality assurance activities, are indicated.

While my reading had suggested there may be ethnic differences in asthma care, the published NZ research had not been designed to specifically answer this question. This gap in the literature led me to submit a project grant application (*The primary care management of childhood asthma*) to the Health Research Council of New Zealand (HRC) in late 1997. Co-investigators[4] on the project were Ms Elizabeth Robinson (biostatistician), Dr Cameron Grant (paediatrician), and Dr Colin Tukuitonga (Public Health Medicine, Pacific Health). The application was funded, and commenced in 1998.

During the course of the project I was awarded a Harkness Fellowship in Health Care Policy and was based at Johns Hopkins School of Public Health, Baltimore, Maryland, USA from the 1st of September 1999 until the 31st of August 2000. When I left NZ the data collection phase of the project was underway. I remained available to the research coordinator, with back-up from the locally based co-investigators available if required. Data collection continued while I was away without apparent problems. The work I undertook during my Harkness Fellowship focused on health services research, and ethnic disparities in health. On my return I decided to enrol in a Doctor of Philosophy degree, and was granted permission to enrol for this degree using *The primary care management of childhood asthma* research project.

---

[3]The Treaty of Waitangi was signed in 1840 and is considered to be the 'founding document' of New Zealand. The signatories to the Treaty were the British Crown (Queen Victoria, through her representative) and Māori. In contemporary times the Crown is represented by the NZ Government. There are three articles within the Treaty. The Articles define and describe the relationship between Māori and the Crown. Two language versions of the Treaty were written: one in Māori and the other in English. The use of words in the Māori version that were not synonymous with the meaning of the comparable words in the English version has resulted in dissension and debate about both the intent and the application of the Treaty. This debate has centred on Articles One and Two of the Treaty.
Both English and Māori versions of Article Three guaranteed Māori 'all the rights and privileges of British subjects'. Implicit in this undertaking was the notion that there would be no major disparities between Māori and other New Zealanders, with the obligation being on the Crown to exercise 'royal protection' should such discrepancies arise (Durie, 1994). For further discussion of the Treaty of Waitangi the reader is referred to Orange (1987) and to Walker (1990).

[4]All investigators are based at the School of Population Health, Faculty of Medicine and Health Sciences, University of Auckland.

1.2 Primary care

Primary health care services provide health promotion, disease prevention, screening, and the diagnosis and management of disease and illnesses in community-based settings. These services provide the first level of contact with the health system. The primary care workforce may include doctors, nurses, midwives, community workers, pharmacists and others who work as a team to provide care (Declaration of Alma-Ata, 1978).

In NZ, primary health care has historically been delivered using a small business model with the practices owned and operated by GPs (private GPs). Government subsidisation of patient costs for primary care began in 1941 through the General Medical Services benefit (GMS). Initially set at 75%[5] of the usual cost for a GP visit, the subsidy was not increased until 1991. By this time the GMS contributed a very small part of the fee for a GP consultation with the majority of the fee paid by the patient and, to a much lesser degree, by private insurance schemes (Raymont, Lay-Yee, Davis, & Scott, 2004). Several variations in the traditional small business model private GP provider have been developed.

In 1941 the government established 'special medical areas'. Located in remote regions or in areas serving populations that struggled to pay for services, these areas had difficulty attracting medical practitioners. Designated special medical areas provided GP services and pharmaceuticals free of charge and employed publicly salaried doctors. The number of special medical areas was progressively reduced from 34 in 1941 to 12 in 1993 (Crampton, Lay-Yee, & Davis, 2004).

Non-profit, community-governed medical services emerged in the late 1980s. In 1987 the trade union movement established a number of clinics that were governed by the community, were non-profit, and delivered more affordable health care to low income families (Crampton, Lay-Yee, & Davis, 2004; Raymont, Lay-Yee, Davis, & Scott, 2004).

In 1991 Māori involvement in the delivery of health services was limited to one marae based GP service and a larger but limited number of community-based health promotion and

[5]Seven shillings and six pence.

education programs (Durie, 1994). The health sector reforms that were announced in 1991 and implemented in 1992/93 provided substantial opportunities for Māori to be more involved in health service delivery. In 2004 there were around 240 funded Māori providers delivering a range of primary health care, dental, and community health (health promotion and education) services. However, the provision of primary medical care services was limited and only a small number of Māori providers delivered GP services (Crengle, 2000; Crengle, Lay-Yee, & Davis, 2004).

Māori providers are governed and operated by Māori organisations, espouse Māori values and approaches in their vision and delivery of services, offer a range of health, dental, and health promotion and education services, and have lower fee structures than private GP services. Further detail on the structure, functions, and modus operandi of Māori providers can be found in Crengle (2000) and Crengle, Lay-Yee, & Davis (2004).

At the time this study was conducted the primary care sector could be subdivided into Māori providers (owned and operated by Māori organisations), community governed not-for-profit services (such as the Union Health Centres), and 'private' general practice services. The majority of practices were 'private', and the workforce consisted of doctors, nurses, and administrative staff. In addition to these staff, Māori and community governed not-for-profit services usually employed community health workers and could include a range of other allied health professionals (Crengle, Lay-Yee, & Davis, 2004).

In 2001 the government announced the implementation of the primary health care strategy. Key differences between the 'old' primary care sector and that envisioned in the strategy included (Minister of Health, 2001):

- The development of primary health organisations (PHOs) that are funded by District Health Boards (DHBs) for the provision of primary health services to the community under their care. PHOs are required to be not-for-profit organisations.
- Primary care practitioners were encouraged to join PHOs but this was not mandatory.
- A focus on communities and people, including the involvement of the community in the governance of the PHOs.
- Increased emphasis on prevention, health education, and population health.
- Increased teamwork and the incorporation of other health professionals into the primary health team.

- A shift from fee-for-service GMS based funding to needs-based funding for population care (capitation).

The data presented in this thesis were collected prior to the implementation of these reforms. For the purposes of this thesis primary care is defined as health care delivered in a general practice setting by doctors and nurses. Although current primary health organisations have the scope to employ asthma educators, at the time of this study asthma educators were situated within secondary care services. The possible impact of the reforms on the quality of care delivered to children with asthma is considered in the Discussion (Chapter 6).

Primary care has the opportunity to be most effective when care is sought from one GP the majority of the time – a regular source of care. A number of advantages are associated with the 'regular source of care' relationship, including opportunities for developing: the professional-patient relationship; an in-depth understanding of the person and their medical conditions; and continuity and coordination of care over time (Starfield, 1998). Paediatric asthma guidelines make a number of recommendations regarding the management of children's asthma. These recommendations reinforce the importance of an appropriately trained regular source of primary care, and the need for routine review of both acute and chronic asthma (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

1.3 Kaupapa Māori theory and research practice

This section contains a brief overview of Kaupapa Māori Research (KMR) which is followed by a discussion of KMR and this thesis.

1.3.1 An overview of Kaupapa Māori Research

Unsatisfactory and unsafe experiences of research resulted in Māori developing a critique of the methodologies and practices that had driven that research, and the development of new theoretical and practical approaches to research – broadly termed Kaupapa Māori Research. There is "no Kaupapa Māori 'recipe' and to attempt to construct one would be antithetical to the fundamentals of Kaupapa Māori" (International Research Institute for Māori and Indigenous Education (IRI) & Te Rōpū Rangahau A Eru Pōmare, 2000 p.1). Rather, Kaupapa Māori Research is a methodological approach encompassing a set of principles that reflect the

theoretical approach underpinning and informing the research process (Smith, 1999). The principles of KMR are:

- Location within the wider context of tino rangatiratanga (self-determination). In the context of research this principle encompasses control of research and research processes, participation in all levels of research, and the delivery of information that will contribute to Māori development and autonomy (International Research Institute for Māori and Indigenous Education (IRI) & Te Rōpū Rangahau A Eru Pōmare, 2000; Smith, 1997; Smith, 1999).
- Connection with Māori philosophy and values and the incorporation of Māori attitudes, language, and ways of living in the world (Smith, 1999).
- Awareness and critique of the dominant accepted norms, assumptions, and power relationships and how these serve to maintain the 'status quo' that privileges the dominant (non-Māori) community and maintains disparities between Māori and non-Māori (Smith, 1999).
- The legitimacy and validity of Māori world views are taken for granted and seen as the norm, and KMR seeks to understand Māori knowledge and experience on its own terms (International Research Institute for Māori and Indigenous Education (IRI) & Te Rōpū Rangahau A Eru Pōmare, 2000; Smith, 1997; Smith, 1999).
- Moves Māori from the margin to the centre, allowing Māori concerns to be addressed, and provides information that addresses our self-identified priorities (Smith, 1999).
- The methods (practical techniques for gathering information in research projects) used to collect information are not prescribed and the method(s) most suitable for the task are employed. However, research practices must be culturally safe and appropriate.

The extension of KMR into quantitative research has largely been led by researchers working for, or previously associated with, Te Rōpū Rangahau Hauora a Eru Pōmare (TRRHAEP) based at the Wellington Medical School, University of Otago. For TRRHAEP, KMR: is an approach to the way Māori research is framed; prioritises Māori in the questions asked and the processes chosen; means Māori control of research; uses culturally safe processes; generates solutions for Māori from within Māori realities; and is imbued with a commitment to action and change (Harris, 2003). These principles are also embedded in the study presented in this thesis.

There is considerable debate about who can participate (as researchers) in KMR. Some commentators believe that such research can only be undertaken by researchers who are

Māori and identify as Māori researchers. That is, being a researcher who happens to be Māori is not sufficient to safely undertake KMR. Others believe that non-Māori can participate in KMR by providing a supporting role to the Māori researchers in the project. More recently the notion of KMR-consistent research has been raised in the context of a Master of Public Health degree dissertation. This project was undertaken by a non-Māori student with supervision from Dr Elana Curtis, a Māori researcher who undertakes KMR research. The work was undertaken within the framework of KMR but, in response to the student's non-Māori ethnicity, was described as KMR-consistent rather than KMR *per se* (Loring, 2007).

1.3.2 The application of Kaupapa Māori Research to the study presented in this thesis

A primary aim of the research project used in this thesis was to determine whether there were ethnic disparities in asthma management. The project is located within KMR theory, and uses epidemiologic method, quantitative data, and a disparities analytic approach to present the information collected from participants and draw conclusions about the study's findings. Disparities analysis seeks to identify differences in outcomes and contribute to actions to reduce identified disparities. The author of this thesis positions herself as a Māori health researcher. The study is a collaborative project; that is, the other investigators are of Pacific and NZ European ethnicity. My role as principal investigator, in combination with the support of Māori in an advisory group and the Māori project staff, has ensured that Māori control of the research has been maintained.

Previous studies that have been located within KMR and used quantitative methods to undertake disparities analysis have compared Māori with non-Māori (Harris, 2003; Robson & Harris, 2007). This project includes the Pacific ethnic group in addition to Māori and Other reflecting the intention to identify ethnic disparities, awareness that pre-existing evidence suggested that Pacific peoples also experienced disparities in management, and the collaborative nature of the research team. Although the analysis presented in this thesis could have been limited to the Māori and Other ethnic groups, this seemed unethical given the aims of the study and the fact that Pacific data had been collected. However, there is no intent to suggest that KMR can be blithely applied to Pacific peoples, and to do so would be reproducing the problematic theoretical and behavioural approaches that led to the development of KMR. Nevertheless, there are elements of KMR as embodied in this study

that can be usefully applied to the inclusion of Pacific people in this study, particularly the use of non-deficit analysis and equal explanatory power (see below).

Pre-existing evidence described lower levels of various drugs, action plans, and aspects of asthma knowledge in Māori and Pacific people, and one author concluded that ethnic differences in management were likely due to doctors' practice varying depending on the ethnicity of the child (Mitchell, 1991). However, none of the studies had been designed to specifically address the question of ethnic differences in management. This led to the development of the current study, which seeks to investigate whether there are ethnic differences in the management of children's asthma by GPs in the community. Of particular note here is the placement of Māori (and Pacific) experience in the centre of the research enquiry, the acceptance of Māori (and Pacific) experience as the norm, the posing of research questions that identify and address Māori (and Pacific) health needs, and the focus on the action of GPs and the outcomes for children rather than focusing on the role or actions of the children, parents, and family. This framing reflects both KMR principles and a central tenet of disparities analysis – non-deficit analysis.

Contrary to the positivist view, data is not neutral and does not speak for itself (Reid, 2001). Rather, data is (re)presented and discussed by researchers who frame and present the data according to their world view. Indigenous peoples and minority groups are often negatively (re)presented in statistics in a way that reflects an underlying ideology which positions these groups as 'other' (relative to the dominant majority). This approach has been described as 'othering', 'deficit thinking', 'deficit analysis', and 'victim blaming' (Harris, 2003; Reid, Robson, & Jones, 2000; Smith, 1999) and results in '…a way of thinking about social problems that locates their origins in the purported deficits and failings of their victims rather than in the social institutions and practices that had brought about and sustained their victimization' (Lykes, Banuaziz, Liem, & Morris (1996 p. 7) cited in Harris (2003 p. 14)). This location of the 'problem' with the 'other' leads to a narrow range of explanations for disparities which focus on the 'other's' behaviour, genes, culture, socio-economic position, and ways of interacting with services. The role and effects of society, institutions, systems and services are excluded from analysis and critique (Harris, 2003; Reid, Robson, & Jones, 2000). The use of non-deficit analysis refocuses attention from the 'other' to society, institutions, systems and services; an approach that is consistent with population health approaches that incorporate all the influences on health from individual to structural determinants (Harris, 2003).

In quantitative studies, statistical power and sample size are critical to the ability to detect differences between groups in the study and to measure effects with suitable precision. Studies that do not have suitable power and sample sizes are unable to draw reliable and rigorous conclusions. Explanatory power has been identified as an important issue for KMR-located quantitative projects (Robson, 2002).

Robson (2002) identified problems in previous studies whose samples had much smaller numbers of Māori than non-Māori. Although these studies were often able to identify significant differences in health outcomes for Māori and non-Māori, the small sizes of the Māori samples limited further analysis of Māori data. While these studies were able to examine 'total sample' and non-Māori data in detail and identify possible contributing factors, the smaller sample sizes limited the ability to do so for Māori. This is problematic, as the factors contributing to health outcomes may differ for Māori and non-Māori, and the inability to identify these factors for Māori also limits our understanding of disparities and the factors that underlie these disparities (Harris, 2003; Robson, 2002). Policy, population health, and health service recommendations and interventions are informed by the results of research. The application of findings that are dominated by non-Māori data may result in recommendations and interventions that do not adequately address Māori-specific contributing factors and Māori health needs. As a result these recommendations and interventions may not have any impact on reducing disparities, and risk increasing disparities if they are more effective for the non-Māori population (Harris, 2003; Reid, Robson, & Jones, 2000; Robson, 2002).

Equal explanatory power can be employed to address the issues associated with low Māori sample sizes in studies. The incorporation of equal explanatory power into study design allows researchers to undertake analyses to the same depth, and with the same power for Māori as for non-Māori. This usually requires Māori and non-Māori samples of similar size, a feature that must be taken into account when designing studies, particularly in relation to sampling strategies and analysis of data. The application of equal explanatory power and the results of studies that utilise equal explanatory power are more likely to provide detailed information about Māori and non-Māori outcomes and ethnic disparities, and will inform policy, population health, and health service recommendations and interventions that can be applied to Māori health development and reducing inequalities (Harris, 2003; Reid, Robson, & Jones, 2000; Robson, 2002). This study makes use of equal explanatory power. The study

was designed to examine the experiences of Māori and Pacific children with asthma. The sample size for each ethnic group was determined by power calculations based, where possible, on previously published information about the prevalence of components of asthma management within each ethnic group.

1.4 Ethnicity

Ethnicity is the explanatory variable in this study. This section provides a very brief overview of the definition of ethnicity and the issues associated with the collection and use of ethnicity data in NZ. The methods used to collect, classify, and analyse ethnicity data in this study are described in Section 4.6.1.

1.4.1 Definition of ethnicity and issues associated with the collection and use of ethnicity data

Prior to the 1986 census, for statistical purposes membership of the Māori population was based on a biological definition ('persons greater than half Māori blood', 'persons of half or more Māori blood'). Since 1986 the census has collected information about self-identified ethnicity.

The definition of ethnic group developed in 1988 by the Department of Statistics is still in use (see for example Ministry of Health, 2004; Robson & Harris, 2007). According to this definition (Ministry of Health, 2004 p.5) an ethnic group is:

> A social group whose members:
>
> - share a sense of common origin
> - claim a common and distinctive history and destiny
> - possess one or more dimensions of collective cultural individuality
> - feel a sense of unique collective solidarity.

Importantly, ethnic group affiliation (ethnicity) is self-identified, people may have more than one ethnic group, and ethnic affiliation is dynamic in nature. That is, an individual's ethnic affiliation(s) may change over time, or between different contexts (Cormack, 2007; Ministry of Health, 2001, 2004).

Ancestry, nationality, country of birth, citizenship, culture and race are different from ethnicity. Although distinct, these concepts are inter-related and may be influential in the development or expression of, but do not determine, a person's ethnic affiliation (Ministry of Health, 2001, 2004; New Zealand Health Information Service, 1996). The following definitions make the differences in these concepts explicit and are all sourced from Ministry of Health (2004; p.6).

> Ancestry comprises an individual's ancestors – the people from whom the individual is descended, the individual's forefathers, or the people who are regarded as the individual's forerunners.
>
> Culture is, broadly speaking, a person's way of life. It may include music, literature, dance, sport, cuisine, style of clothing, values and beliefs, patterns of work, marriage customs, family life, religious ceremonies, and celebration days or events that have particular cultural significance.
>
> Nationality can be defined as membership of, or the fact or state of belonging to, a particular nation. A group or set of people has the character of a nation.
>
> Country of birth is the country where a person is born, regardless of ethnic group. Both country and region of birth can contribute to ethnic affiliation.
>
> Citizenship is the status of being a citizen and having membership of a community, or having the rights and duties of a citizen.

Definitions and common understandings of 'race' have varied over time. Early thinking that classified different races as different species developed, in the 20th century, into ideology that classified different races as biological subspecies, and definitions of race from these times reflect this biological construction (Bhopal, 1998; Goodman, 2000; Williams, 1997). Race was defined and assigned to a group of people on the basis of phenotypic characteristics that were not strongly related to differences in genotype. As Williams writes,

> The race concept never rested on a firm scientific foundation. The origin of racial categories did not reflect a scientific understanding of

> subdivisions within human population groups. The concept of race predated modern scientific theories of genetics and carefully executed genetic studies. (Williams, 1997 p. 323)

With the advent of modern genetics, evidence accumulated suggesting that the biological construction of race was flawed. Anthropology and other social science definitions of race adapted to these findings and race was re-defined as a social construct rather than a biological one (Bhopal, 1998; Goodman, 2000; Jones, 2001; Krieger, 2000; LaVeist, 2000; Williams, 1997, 1999a; Williams, 1999b).

Despite the shift from biological to social construct, the classification of people into racial groups continues to be largely determined by the phenotype (a biological characteristic) of the individual. The social classification of race reflects societal processes and ideology more than individual or racial group characteristics.

> The race we measure in our studies is the same race that is noted by a taxi driver, a police officer, a judge in a courtroom, or a teacher in a classroom. That is, race is a social classification in our race-conscious society that conditions most aspects of our daily life experiences and results in profound differences in life chances … Race is a social construct, a social classification based on phenotype, that governs the distribution of risks and opportunities in our race-conscious society (Jones, 2001 p. 300).

> Race emerged as a socio-political construct useful not only to classify human variation but also to justify the exploitation of groups defined as inferior (Williams, 1997 p. 323).

The idea that race reflects biologic characteristics persists in some quarters of medical education; clinical practice and research; science; and wider society (Goodman, 2000; Williams, 1997, 1999a). Jones (2001) reviewed the use of 'race' in epidemiological research and identified the design and analytic strategies used in research where 'race' was included as a variable. She notes that many investigators describe the race-related research findings but do not analyse the cause of the differences because they consider the findings to be biologically determined, reflecting the epidemiologists own construction of race as a biological rather than social construct (Jones, 2001). The persistence of biological

determinism explanations among epidemiologists has resulted in an overemphasis on 'genetic' explanations of racial/ethnic disparities. This overemphasis is accompanied by a failure to consider the role of other mechanisms in the development and maintenance of observed disparities (Jones, 2001; Krieger, 2000; LaVeist, 2000; LaVeist, Bowie, & Cooley-Quille, 2000).

A paper published by Nelson et al. (1997) illustrates the focus on biologic difference and failure to consider other mechanisms as explanations for race-related findings. The authors attribute their finding that 'Blacks' have a higher prevalence of both 'physician diagnosed asthma' and 'probable undiagnosed asthma' in a socio-economically homogenous, integrated middle class community, to biologic differences. She notes that access to care, as measured by the percentage of each group who had a paediatrician as the primary care provider, was similar for both black and white children and goes on to state that 'given equal access to the same physicians in the area, it is unlikely that the observed differences in the prevalence of asthma are the result of differences in medical care or diagnostic criteria.' (Nelson et al., 1997 pp. 23-24). There is no assessment of the amount or quality of care received by each racial group, making it impossible for the authors to justify their assertion that medical care and diagnostic criteria were the same for each racial group.

In NZ the discourse relating to ethnicity reflects many of the same ideological and practical (mis)interpretations that are seen in relation to the concept of 'race'. Ethnicity is also a social construct. However, it continues to be confused with biological constructs. For example, some authors have used 'ethnicity' in genetic studies where 'ancestry' is more appropriate because 'ancestry' will enumerate people who have Māori genetic material but do not identify themselves as a member of the Māori ethnic group as well as those who do identify as a member of the Māori ethnic group. In other studies that use 'ethnicity', the authors discuss biologic mechanisms contributing to observed ethnic differences with limited or no consideration of other mechanisms that may contribute to the findings.

1.4.2 Racism as a determinant of health outcomes

Racism has been recognised as a determinant of health status, outcomes, and inequalities (Jones, 2001; Karlsen & Nazroo, 2002; Krieger, 2000; Krieger, Rowley, Herman, Avery, & Phillips, 1993; Krieger & Sidney, 1996; Reid, Robson, & Jones, 2000).

Jones defines and describes racism, particularly in relation to health (Jones, 2000). Jones' model describes three levels of racism: institutionalised, personally mediated, and internalised.

Institutionalised racism is defined as

> …differential access to the goods, services, and opportunities of society by race. Institutionalized racism is normative, sometimes legalized, and often manifests as inherited disadvantage. It is structural, having been codified in our institutions of custom, practice, and law, so there need not be an identifiable perpetrator. Indeed, institutionalized racism is often evident as inaction in the face of need (Jones, 2000 p.1212).

Personally mediated racism is defined as

> …prejudice and discrimination, where prejudice means differential assumptions about the abilities, motives, and intentions of others according to their race, and discrimination means differential actions toward others according to their race (Jones, 2000 pp. 1212-1213).

Internalised racism is defined as "acceptance by members of the stigmatized races of negative messages about their own abilities and intrinsic worth" (Jones, 2000 p. 1213).

Jones believes that, although all three types of racism have effects on health, the most important effects arise from institutionalised racism. Mitchell (1991) identified differences in prescribing practices for different ethnic groups (an expression of institutionalised racism) as the most likely cause of the higher asthma mortality and hospitalisation rates seen in Māori and Pacific children. More recently, institutionalised and personally mediated discrimination have been acknowledged as important determinants of health in NZ health policy documents (Ministry of Health, 2001, 2002b). This policy position has subsequently been supported by data collected in a large national cross-sectional survey conducted in 2002–2003. Harris et al. found that Māori reported the highest prevalence (34%) of 'ever' experiencing any of the forms of discrimination investigated in the survey. The prevalence was 28% among Asian,

25% among Pacific peoples, and 15% among European (Harris et al., 2006b). Further work by these authors examined the effects of self-reported discrimination and socio-economic deprivation on Māori health inequalities across four health indicators. They found that both deprivation and experiencing discrimination were independently associated with poorer outcomes across all four indicators. Furthermore, adjustment for discrimination and deprivation fully accounted for the observed ethnic disparities in all four indicators (Harris et al., 2006a).

1.4.3 Ethnicity data in New Zealand

Although the definition of ethnicity has not been changed for twenty years there have been significant variations in the manner in which ethnicity data has been collected and used over those twenty years. These variations have adversely affected the accuracy, completeness, reliability and validity of (particularly Māori) ethnicity data. The utility of the data for comparison and time series analyses has also been compromised by regular changes to the ethnicity question and changes to methods used for classifying and using ethnicity data (Ajwani, Blakely, Robson, Atkinson, & Kiro, 2003; Blakely, Kiro, & Woodward, 2002; Blakely, Robson, Atkinson, Sporle, & Kiro, 2002; Pōmare et al., 1995; Robson & Harris, 2007; Robson & Reid, 2001; Smartt, Marshall, Kjellstrom, & Dyall, 2002; Te Rōpū Rangahau a Eru Pōmare, 2000; Thomas, 2001).

In recent years strategies such as workforce training and ethnicity data protocols have been implemented in order to improve the collection and use of ethnicity data across the health sector. Recent evidence suggests that for the period 2001–2004 differences in ethnicity counts between the census and mortality datasets are minimal but hospitalisation and cancer registration datasets continue to undercount the Māori ethnic group (Harris et al., 2007). The accuracy and completeness of ethnicity data in primary care is poor and the differential misclassification of ethnicity in these databases results in under-enumeration, particularly of Māori and Pacific people (Bramley & Latimer, 2007; Health Utilisation Research, 2006; Marshall, Zhang, Broad, & Wells, 2007).

Although progress has been made in identifying and addressing ethnicity data issues over the last twenty years, the concept of ethnicity and the collection and use of ethnicity data continues to be contentious and/or confused within the bureaucratic, academic and public environments. Examples of areas of contention are: what ethnic group categories should be

used; who should be 'in' the Māori ethnic group (see for example Allan, 2001; Chapple, 2000) and how should ethnicity data from people who identify more than one ethnic group be managed (see for example Allan, 2001; Callister, Didham, Potter, & Blakely, 2007).

Statistics New Zealand (SNZ) is responsible for undertaking the five-yearly Census of Populations and Dwellings and other large national surveys. The SNZ prioritisation process was introduced in an attempt to standardise the way that data from people with multiple ethnic groups was outputted in the Census and other national surveys undertaken by government agencies (Allan, 2001; Statistics New Zealand, 1993). This process assigns every person who identifies Māori as an ethnicity to the 'Māori' ethnic group. Any person who nominates Pacific ethnicity and does not nominate Māori is classified as 'Pacific' ethnic group. All other participants, that is those who did not identify Māori or Pacific ethnicity, are assigned to the NZE/Other ethnic group.

The use of the prioritisation process has been contentious, with arguments against prioritisation focusing around the appropriateness of asking people to self-identify their ethnic groups and then automatically classifying people who nominate more than one ethnic group without asking if they agree to this process and whether they have a preference themselves.

From a study design point of view, the key question is whether different methods of classifying ethnic groups introduce systematic biases into studies. If bias is introduced the impact will be differentially applied, as the group most affected by changing methods of classification is the Māori ethnic group.

At the current time assessing the likely effect of bias is difficult. The critical issue is whether the health outcomes of people who are prioritised into the Māori group but prefer to be assigned to the NZE category, are the same as those of the NZE group or are the same as the (remaining) Māori ethnic group.

If Māori who prefer to be assigned to the NZE group have the same outcomes as NZE, assignment to the NZE group will not introduce bias, while assignment to the (prioritised) Māori ethnic group will result in an underestimation of Māori health inequalities.

If Māori who prefer to be assigned to the NZE group have the same outcomes as other Māori the use of prioritisation will not introduce bias, while assignment to the NZE group will result in an underestimation of health disparities.

Underlying the discussion in the preceding two paragraphs is the assumption that the outcomes are similar for all Māori who prefer to be categorised as NZE. This is unlikely to be true, particularly when the outcomes are influenced by institutions or agencies whose responsiveness may be influenced by the (perceived) ethnicity of the person in receipt of the goods or services. That is, when institutionalised racism results in different responses for different members of a group depending on how the person is perceived. The responses of agencies and institutions are likely to vary across the 'prefer NZE Māori' group as this group will contain people who are perceived and treated as Māori and those who are perceived and treated as NZE. To the author's knowledge there is no NZ research that addresses this issue and provides quantitative information that would allow an accurate assessment of the nature and size of any bias attributable to the various misclassifications described above.

1.5 Socio-economic position and health outcomes

In many countries, indicators of socio-economic position (SEP) such as education, income and small area measures of deprivation, are strongly associated with health outcomes in an inverse manner. Increasingly adverse health outcomes are observed with decreasing SEP (see for example Marmot, 1999; Ministry of Health & University of Otago, 2005). Furthermore, the relationship is observed in a wide variety of population health indicators including life expectancy, mortality, morbidity, and health status outcomes for many health issues including asthma (see for example Basagana et al., 2004; Mielck, Reitmeir, & Wjst, 1996).

In NZ socio-economic position varies markedly between ethnic groups. Across all indicators of SEP Māori and Pacific people are over-represented in lower socio-economic positions (Robson, Cormack, & Cram, 2007; Tobias & Yeh, 2006). However, SEP does not account for all the differences in health outcomes between Māori and non-Māori. Research has shown that ethnic differences in outcomes are observed within SEP strata, suggesting that other factors also contribute to these disparities. These differences are seen across a range of health outcomes including life expectancy, mortality, and hospitalisations (see for example Harris et al., 2006a; Ministry of Health & University of Otago, 2006; Reid, Robson, & Jones, 2000;

Riddell, 2005). SEP is, therefore, an important confounder in the investigation of ethnic disparities in health.

1.6 The investigation of ethnicity and quality of health care

The Institute of Medicine (IOM) published a critical review of the literature about ethnic differences in healthcare across a range of health issues, entitled *Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare* (Institute of Medicine, 2003). The report noted there are a number of factors that can confound the relationship between ethnicity and quality of care and that, in order to ascertain whether ethnicity is independently associated with quality of care, these factors should be considered and, where relevant, included in the design of a study investigating ethnicity and quality of care (Institute of Medicine, 2003). These factors are:

- access to care
- socio-economic position
- analysis of clinical characteristics such as
    - severity or stage of illness for the condition under investigation
    - differences in patient co-morbidities that may influence management of the condition under investigation
    - patient's appropriateness for procedures
- ethnic differences in rates of refusal or patient preferences for treatments.

1.7 Aims and objectives of the study

The aim of the study was to investigate the effect of ethnicity on asthma management and health service utilisation in a random, community-based sample of Auckland children from Māori, Pacific, and Other ethnic groups.

The primary objectives of the study were to:

- describe the use of medications, medication delivery systems, asthma education, and self-management plans in primary care for the three ethnic groups
- ascertain whether there were any ethnic disparities in the use of medications, medication delivery systems, asthma education, and self-management plans in primary care after controlling for differences in socio-economic position and other potential confounders.

Secondary objectives were to:

- describe the asthma-related utilisation of GP, after hours medical care, emergency departments, and hospital admissions among children with asthma
- ascertain whether differences in medication use, the provision of asthma education, and the provision of self-management plans explained ethnic differences in health service utilisation.

This chapter has provided information about key contexts that are essential to the study described in this thesis, namely: the primary care landscape at the time the study was undertaken; Kaupapa Māori Research in relation to this study; the definition, classification, and use of ethnicity data; the role of SEP in health services research; and essential features of studies that investigate ethnicity and quality of health care. The next chapter contains information about asthma including the prevalence, impact, and outcomes associated with asthma; the pathophysiology; symptoms, signs, and clinical presentations of asthma; and an overview of asthma management that includes any information available about asthma management prior to the commencement of data collection for this study.

Chapter 2 Asthma

This chapter presents an overview of the prevalence, impact, and outcomes associated with asthma. It contains a description of asthma including the pathophysiology, symptoms, signs, and clinical presentations; and an overview of asthma management. Literature about asthma management in NZ prior to the implementation of this study is included in the asthma management section.

2.1 Asthma prevalence

Asthma is a common respiratory problem in children. The prevalence of asthma varies around the world; the lowest prevalence estimates are observed in developing countries and the highest in English speaking countries (Anonymous, 1998; Beasley, Ellwood, & Asher, 2003). Phase one of the International Study of Asthma and Allergies in Childhood (ISAAC) reported that among children aged 13–14 years the prevalence of asthma ranged from 1.6% in Indonesia to 36.8% in the United Kingdom. New Zealand was ranked second of 56 participating countries. (Anonymous, 1998)

A summary table of NZ asthma prevalence estimates published between 1989 and 2004 is contained in Appendix 1. The reported prevalence of asthma increased in all ethnic groups over this time period. The largest study reporting estimates of asthma prevalence in NZ children was Phase One of the ISAAC study (Asher et al., 2001). Children in six centres[6] participated in the study. The 1992–1993 twelve month prevalence of asthma symptoms was found to be 25% in 6–7 year old children and 30% in 13–14 year old adolescents. There was little variation in the prevalence of asthma symptoms across the six centres (Asher et al., 2001).

Pattemore et al. reported prevalence estimates for Māori, Pacific, and New Zealand European (NZE) children from 1992–1993 ISAAC data. For children aged 6–7 years the 12 month

[6]Auckland, Bay of Plenty, Hawke's Bay, Wellington, Nelson, and Christchurch.

prevalence of wheeze was highest in Māori children (27.6%), followed by NZE (24.2%), and Pacific ethnic group (22.0%). The differences in prevalence between the Māori and NZE, and the Māori and Pacific groups were statistically significant, but that between the Pacific and NZE ethnic groups was not (Pattemore et al., 2004).

For children aged 13–14 years the 12 month prevalence of wheeze was highest in NZE children (31.7%), followed by Māori (30.8%), and Pacific (21.1%) ethnic groups. The differences in prevalence between the Māori and Pacific groups, and the NZE and Pacific ethnic groups were statistically significant but the difference between the Māori and NZE children was not (Pattemore et al., 2004) (see Appendix 1).

Pattemore et al. (2004) also examined indicators of asthma morbidity and found these were more frequent among Māori and Pacific children, particularly in the 6–7 year age group. Compared to NZE 6–7 year olds, a significantly higher proportion of Māori and Pacific children reported sleep disturbance at least one night per week over the previous 12 months (Māori 5.8%, Pacific 5.7%, NZE 2.6%). Similarly, Māori and Pacific children were significantly more likely to report speech limitation due to wheeze in the previous 12 months (Māori 6.9%, Pacific 6.9%, NZE 4.4%). There were no ethnic differences in the proportions of children reporting more than 12 attacks of wheeze in the previous 12 months. To summarise, Māori children had the highest and Pacific children the lowest prevalence of asthma, and both groups were significantly more likely to report sleep disturbance and sleep limitation than NZE children.

Among 13–14 year olds sleep disturbance was reported by 4.9% of Māori, 3.8% of Pacific, and 2.7% of NZE children. The difference between Māori and NZE children was significant but the other ethnic group differences were not. Speech limitation was reported by about 8% of children in all three ethnic groups. More than 12 attacks in the previous year were reported by 4.1% of NZE, 3.0% of Māori, and 1.3% of Pacific children, and all the ethnic group differences were statistically significant (Pattemore et al., 2004). To summarise, ethnic differences in prevalence and morbidity were less marked in this age group than in the 6–7 year olds. However, Pacific children had a significantly lower prevalence of asthma and were significantly less likely to report more than 12 attacks in the previous 12 months than Māori and NZE children. Sleep disturbance was significantly higher among Māori than NZE children but other ethnic group differences in sleep and speech disturbance were not significant.

The authors compared the 1992–1993 findings with those of an Auckland study undertaken in 1985. Although the prevalence of asthma had increased between 1985 and 1992–1993, the differences in prevalence between ethnic groups in 1992–1993 were similar to those found in 1985. The authors postulated that the factors responsible for the ethnic differences had remained relatively stable over time, and were independent from the factors that had caused the general increase in prevalence observed between the two studies (Pattemore et al., 2004).

More recently published data suggests that the observed increases in asthma prevalence over the last thirty years may be reversing. Asher et al. (2004) reported changes in the prevalence of asthma between ISAAC data collection phases in 1992–1993 and 2001–2003 with a 1.4% reduction in the 6–7 year age group and 3.0% in the 13–14 year age group over the time period .

These findings lend support to other people's work that suggests that, although asthma prevalence estimates are similar across ethnic groups, Māori and Pacific children are more likely to experience greater morbidity (Ellison-Loschmann & Pearce, 2000; Holt & Beasley, 2002). Discussion of population-based asthma outcomes is contained in Section 2.3.

2.2 The impact of asthma

Asthma-related mortality and morbidity are associated with significant costs to affected children, to their families, and to society.

The impacts of asthma on children and families include (Barnes, Jonsson, & Klim, 1996; Gergen, 2001; Juniper, 1997; Lenney, 1997; McNaughton et al., 1993; Milton, Whitehead, Holland, & Hamilton, 2004; Moonie, Sterling, Figgs, & Castro, 2006; Poulos, Toelle, & Marks, 2005; Schmier, Chan, & Leidy, 1998; Schmier et al., 2007; Taras & Potts-Datema, 2005; von Mutius, 2000):

- financial costs associated with medical care;
- financial costs associated with absences from work due to the child's illness;
- costs associated with trigger avoidance including financial costs associated with purchasing mattress and pillow covers, the replacement of floor coverings and other furnishings, and increased time spent on housework and other trigger avoidance activities;

- limitations on the child's participation in social interactions and activities such as play, sports, and pet ownership;
- limitation or cancellation of family activities and/or the parent's social life;
- impacts on the child's and/or the parent's relationships with siblings and other peers due to the time required to focus on asthma management, and the effects of illness and tiredness on interpersonal relationships;
- absences from school and reduced school performance and academic achievement for the child and their siblings due to asthma and sleep disturbance;
- reduction in the parent's work performance and achievement due to absences from work and sleep disturbance; and
- the impact of grief, fear, pain, unhappiness, and stress on the quality of life experienced by children and their families.

Societal costs include those associated with providing medical and allied health care, admissions, pharmaceuticals, and costs associated with caregiver's loss of productivity (Barnes, Jonsson, & Klim, 1996; Gergen, 2001; Juniper, 1997; Lenney, 1997; McNaughton et al., 1993; von Mutius, 2000).

Asthma results in significant costs for NZ. Holt & Beasley (2002) summarised the economic burden of asthma. Direct medical costs include the costs of pharmaceuticals, primary care, specialist services, emergency department services, hospitalisations, and healthcare costs paid by consumers. These were estimated to be $125.2 million dollars annually in the late 1990s. Indirect non-medical costs relate to the economic losses associated with days off school, days off work and lost productivity, premature mortality, and disability. These were estimated to be $699 million annually in the late 1990s.

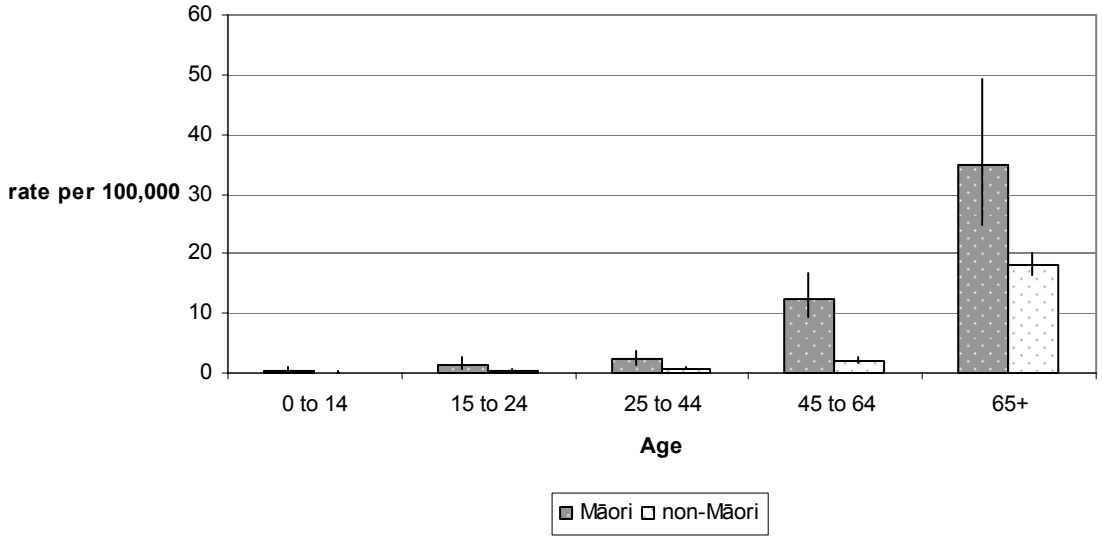
2.3 Asthma outcomes in New Zealand

Asthma outcome measures may be observed at both population and individual levels. Mortality and hospitalisation rates are population level measures, whereas outcomes such as asthma symptoms, impact on school attendance, and restriction of activities reflect the impact of asthma on affected children and their families. This section presents population level outcome information.

2.3.1 Asthma mortality

Over the age of 15 years, Māori mortality rates for the years 1998–2002 exceeded those of non-Māori (Figure 1). Deaths from asthma are relatively rare and this is reflected in the relatively wide confidence intervals around the point estimates.

Figure 1 Age specific asthma mortality rates by ethnicity, 1998–2002



Source Crengle, Pink, & Pitama (2007) Hauora: Māori Standards of Health IV. A study of the years 2000–2005

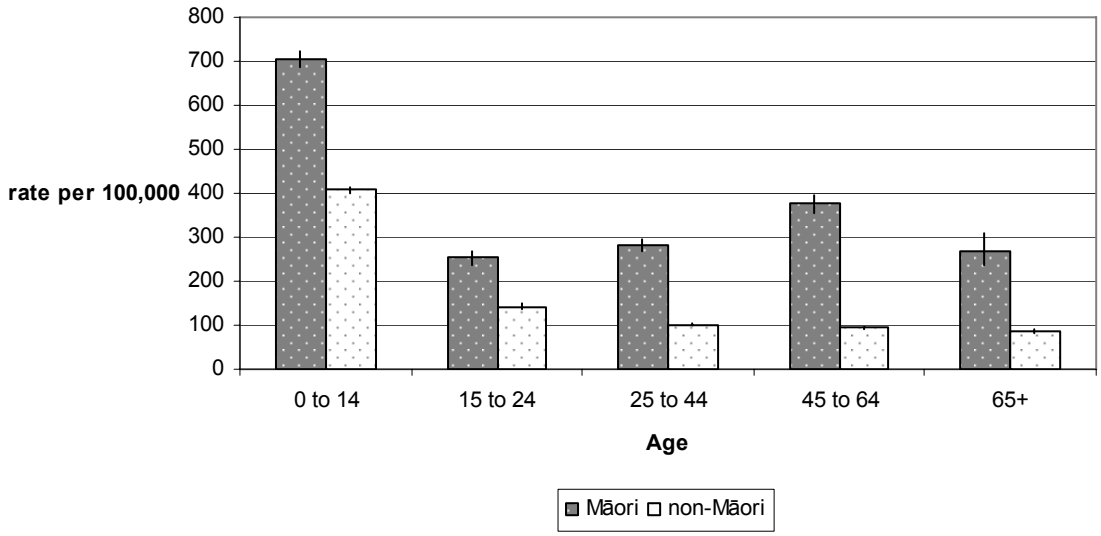
2.3.2 Asthma hospitalisations

Adults with asthma are more likely to be admitted to hospital than adults without asthma (Ministry of Health, 1999). There are ethnic disparities in asthma hospitalisation rates. Disparities in hospitalisation rates have been documented for many years (Mitchell, 1991; Mitchell & Borman, 1986; Mitchell & Cutler, 1984; Pōmare et al., 1995). For example, Mitchell (1991) calculated the average annual admission rates for children aged 5–14 years over the time period 1979–1986 and found the average Māori rate was 1.8 times that of NZE. Similarly, in 1992 asthma was the leading cause of hospital discharge for 1–4 year old Māori, the third leading cause for non-Māori, and the ratio of Māori to non-Māori (M:nM) public hospital discharges in this group of children was 3.1. In the 5–14 year age group asthma was the third leading cause of hospital discharge (fifth for non-Māori) and the rate ratio was 1.9 (Pōmare et al., 1995).

Figure 2 presents ethnicity and age-specific hospital discharge rates for the years 2000–2003, where the principal cause of admission was asthma. Māori asthma hospitalisation rates exceeded those of non-Māori across all age groups.

Disparities in hospitalisation rates have been documented for many years (Mitchell, 1991; Mitchell & Borman, 1986; Mitchell & Cutler, 1984; Pōmare et al., 1995). For example, Mitchell (1991) calculated the average annual admission rates for children aged 5–14 years over the time period 1979–1986 and found the average Māori rate was 1.8 times that of NZE. Similarly, in 1992 asthma was the leading cause of hospital discharge for 1–4 year old Māori, the third leading cause for non-Māori, and the ratio of Māori to non-Māori (M:nM) public hospital discharges in this group of children was 3.1. In the 5–14 year age group asthma was the third leading cause of hospital discharge (fifth for non-Māori) and the rate ratio was 1.9 (Pōmare et al., 1995).

Figure 2 Age specific asthma hospital discharge rates, by ethnicity, 2000–2003



Source Crengle, Pink, & Pitama (2007) Hauora: Māori Standards of Health IV. A study of the years 2000–2005

Pacific children experience a similar excess burden of disease. The average annual admission rate for Pacific children aged 5–14 years over the time period 1979–1986 was 2.4 times that of NZE children (Mitchell, 1991). Holt & Beasley (2002) observed that age-standardised asthma hospitalisation rates were highest among Pacific children and the *'Pacific Health Chart Book'* notes that for the years 1998-2002 Pacific children's asthma hospitalisation rates were about 50% higher than that of the 'total population' and suggests that this is most likely to represent "lesser access to care or poorer quality of community care for Pacific compared

to other children, or both" (Ministry of Health and Ministry of Pacific Island Affairs, 2004 p. 38). Age-standardised asthma hospitalisation rates for children over the years 1998-2002 are presented in Table 1. Note that the 'total NZ population' group includes the Pacific population as well as other ethnic groups and therefore the figures presented are likely to underestimate the true difference between Pacific and non-Pacific ethnic groups.

Table 1 Age-standardised asthma hospitalisation rate (95% confidence interval) per 100 000 children aged 0 to 14 years 1998–2002

	Male	Female	Total
Pacific ethnic group	815 (773, 858)	679 (640, 719)	748 (719, 777)
Total NZ population	572 (562, 582)	406 (397, 415)	491 (485, 498)

Source Ministry of Health and Ministry of Pacific Island Affairs, 2004 p. xiv

2.3.3 Asthma outcomes in primary care

Although asthma is a common cause of hospitalisation, most children with asthma are not admitted to hospital and the majority of asthma management is delivered in the primary care setting (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994; Kljakovic, 1994; Kljakovic & Salmond, 1996).

Ambulatory care sensitive conditions are conditions or diseases for which hospitalisations can be avoided by high quality, effective, and timely primary care. Hospitalisations for these conditions may also be referred to as 'avoidable hospitalisations', 'preventable hospitalisations', and 'potentially avoidable hospitalisations' (Flores, Abreu, Chaisson, & Sun, 2003; Graham, Leversha, & Vogel, 2001; Jackson & Tobias, 2001). Although a specific condition may be thought of as ambulatory care sensitive, it is worth noting that not all hospitalisations for a condition may be preventable. That is, 'ideal' primary care will reduce, but not prevent all, hospitalisations for a specific condition. Asthma is an ambulatory care sensitive condition (Flores, Abreu, Chaisson, & Sun, 2003; Graham, Leversha, & Vogel, 2001; Jackson & Tobias, 2001).

Published data identifies asthma as a leading cause of potentially avoidable hospitalisations[7] in NZ. Jackson & Tobias (2001) reported national data about potentially avoidable hospitalisations (PAH) in 1997–1998. Age-standardised PAH rates were higher in the Māori and Pacific ethnic groups than in the NZE ethnic group (respectively 40.0, 44.1, and 25.3 per 1000 population). Asthma was one of the top five causes of PAH in all ethnic groups, but was ranked higher in the Māori (second) and Pacific (third) ethnic groups than in the NZE (fifth) ethnic group. Asthma was the commonest cause of PAH among children aged 1 to 14 years, and accounted for 8% of all hospital admissions in this age group (Jackson & Tobias, 2001).

Data presented in *The Top 10 Report* on the health and wellbeing of children and young people aged 0 to 24 years in the Auckland and Waikato regions are consistent with Jackson & Tobias' findings. The report found that regional rates of potentially avoidable hospitalisations in 1999 were higher for the Māori and Pacific ethnic groups. Asthma was one of the most common causes of PAH in all ethnic groups, but Māori and Pacific asthma hospitalisation rates were higher than those of the Other ethnic group (Graham, Leversha, & Vogel, 2001).

In addition to PAH data, the relatively high asthma hospitalisation rates suggest that asthma management in NZ is not as effective as it could be. Other evidence supporting this conclusion was published by Kljakovic & McLeod (1997), who collected data from the records of asthma patients who had attended an after hours GP clinic and asked the GPs who worked there how often they undertook a range of asthma assessment and management activities when seeing a person with asthma. They then compared the GP opinions with the recorded action obtained from the medical records. There were significant differences between opinion and recorded action for most clinical, investigation, and management[8]

---

[7]Potentially avoidable hospitalisations included hospitalisations due to (a) ambulatory sensitive conditions (conditions for which hospitalisations can be avoided by primary care management), (b) preventable hospitalisations (hospitalisations that can be avoided by population strategies such as tobacco excise tax and smoke-free environments), and (c) hospitalisations avoidable through injury prevention).

[8] Management measures included the prescription of medication.

measures. The GPs' opinions of how often they undertook the action was significantly higher than that recorded in the notes. The NZ adult asthma guideline also identified gaps between current practice and guideline identified best practice for the management of asthma (New Zealand Guidelines Group, 2002).

2.3.4 Previous recommendations for improving asthma outcomes for Māori and Pacific peoples

A comprehensive inquiry about asthma among Māori people was commissioned by the then Minister of Māori Affairs, Hon. Koro Wetere, because of rising concerns about the number of Māori who died or were admitted to hospital for asthma. The review team's report, *He Mate Huango: Māori Asthma Review*, published in 1991, contained recommendations covering many facets of 'Māori asthma'. The recommendations included (Pōmare et al., 1991, 1992):

- improved access to care (both 'mainstream' services and marae-based or similar services);
- increased education about all aspects of asthma and its management, with information provided in ways that were appropriate, acceptable, and effective for Māori;
- development of the Māori asthma workforce;
- improved cultural safety among the non-Māori workforce involved in asthma education and/or management;
- on-going research into Māori asthma, including the development and evaluation of new service delivery programmes; and
- the availability of user-friendly asthma action plans for the Māori community.

Ellison-Loschmann & Pearce (2000) reviewed the findings of the Māori Asthma Review and the developments in research and policy following the release of the Review's report. The authors concluded that studies of asthma in children continued to indicate that the overall prevalence was similar among Māori and non-Māori, that Māori children experience more severe symptoms and excess hospitalisations compared to NZE/Other children, and that further work was required on strategies to improve access to care and the management of asthma.

Moala & Pearce (2001) published a review of asthma in Pacific peoples. They found that the prevalence of asthma in Pacific children was similar to, or lower than, that of non-Pacific children. They also concluded that morbidity (hospitalisations) was higher in Pacific peoples

and that access to care and differences in the management of asthma were important issues for Pacific children and adults (Moala & Pearce, 2001).

2.4 What is asthma?

This section describes the pathophysiology, symptoms, and clinical presentations of asthma.

2.4.1 Asthma pathophysiology

Asthma is characterised by reversible constriction of the airways. Three mechanisms underlie the airway constriction: bronchial smooth muscle constriction, swelling of the mucosal lining of the airways as a result of inflammation, and excess production of mucous within the airways. In persistent asthma there may be other changes that narrow the airways, including subepithelial fibrosis and bronchial smooth muscle hypertrophy and hyperplasia. (Global Initiative for Asthma, 2005)

2.4.2 Asthma symptoms, clinical presentations, and severity

The airway obstruction and excess mucous production cause a number of symptoms including (Global Initiative for Asthma, 2005):

- Wheeze – a whistling sound heard on expiration. This may be heard at rest or with exertion.
- Cough – this is usually dry and may have a wheezy quality. Nocturnal cough is common, particularly in younger children.
- Shortness of breath (dyspnoea).

Symptoms may also be accompanied by the following signs:

- Over-inflation of the chest. Airways constriction reduces the outflow of air from the lungs resulting in a higher lung volume.
- Respiratory distress as breathing becomes progressively more restricted. Signs of respiratory distress include increased respiratory rate, indrawing of muscles in the chest wall and subcostal area, use of accessory muscles to assist with respiration, flaring of the nostrils, and limitations on the person's ability to talk.
- Reduced maximal expiratory flow rates.

Broadly speaking, two clinical presentations may be seen:

- Acute episodes ('asthma attacks') – sudden episodes of exacerbation of asthma symptoms. These episodes may be precipitated by specific factors such as an upper respiratory tract infection or allergen exposure, but can also occur without specific precipitating causes. Although the acute exacerbations are episodic, the pathogenic airways inflammation is present chronically (Global Initiative for Asthma, 2005).
- Chronic asthma. Asthma symptoms occurring outside an acute episode are referred to as chronic symptoms. These symptoms may occur intermittently or be present all or most of the time (Global Initiative for Asthma, 2005). Chronic symptoms are sometimes referred to as interval symptoms or persistent asthma.

In both types of clinical presentation a spectrum of symptom severity, ranging from mild to severe, may be observed. Severity varies between individuals; however, the distribution of severity is skewed towards less severe forms and most people who have asthma have mild asthma. This is particularly true in children, and with the chronic asthma presentation. Acute asthma episodes may be life-threatening.

The severity of symptoms experienced by an individual may vary over time and may not be related to the frequency or persistence of symptoms. For example, one person may have mild intermittent chronic symptoms over summer months, moderate intermittent chronic symptoms over winter months, and occasional moderate to severe acute episodes at all times of the year. Another person may experience mild intermittent chronic symptoms over summer months and moderate-to-severe persistent chronic symptoms over winter months without experiencing acute episodes, and some may experience asthma episodes for a period of time, followed by an absence of symptoms for months or years (Global Initiative for Asthma, 2005).

2.5 Overview of asthma management

Effective asthma management can be expected to have the following outcomes for affected individuals (Paediatric Society of New Zealand, 2005):

- having minimal symptoms during the day and night
- having minimal need for reliever medication
- acute episodes of asthma are eliminated
- there are no asthma-related limitations of physical activity, and
- lung function is normal.

Achievement of these outcomes requires asthma management that is based on recommendations from explicit evidence-based guidelines. If explicit evidence-based guidelines are not available for particular aspects of management, recommendations from national or international expert opinion consensus statements should inform management decisions. Health professionals are responsible for providing high quality asthma care. This includes on-going:

- pharmacological management that is consistent with up-to-date explicit evidence-based guidelines
- provision of asthma education for children and their families to ensure that they are able to self-manage asthma safely and effectively
- provision of an asthma action plan (a self-management plan) to assist with self-management, and
- appropriate access to and utilisation of asthma care (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

Care by health professionals must be accompanied by the active involvement of children and caregivers in managing asthma (self-management) (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

2.5.1 Guidelines for asthma management

Best practice evidence-based guidelines provide recommendations about the management of a condition in specific circumstances, and can be used by health professionals and patients to inform decisions about health care. Explicit evidence-based guidelines are developed by multidisciplinary groups of people representing different interests. This group then:

- identifies the available evidence (information) through systematic review of the literature
- critically appraises the evidence and ranks the quality of each piece of evidence
- considers the body of evidence as a whole and summarises the main points
- makes recommendations that are explicitly linked to the supporting evidence. Each recommendation is graded, according to the strength of the evidence underlying the recommendation (Lethaby, 2005; Scottish Intercollegiate Guideline Network, 2001).

Until 2005, recommendations for the management of children's asthma in NZ were based on consensus statements developed by experts in the area. Recommendations regarding assessment, management, and discharge criteria for children with acute asthma were published in 1992 (Mitchell & Ad Hoc Paediatric Group, 1992). The consensus statement on preventive management of asthma in children included advice about information needs, medication, self-management, and the use of asthma action plans (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994). These two publications have been superseded by the NZ evidence-based guideline for the management of asthma in children (Paediatric Society of New Zealand, 2005). The outline of asthma management that follows this section is primarily based on this guideline. Instances where other sources of information have been used are clearly identified. As the guideline was produced after data collection for this study was completed, some of the recommendations may be different from 'best practice' at the time of data collection. The recommendations in the guideline have been discussed with Professor Innes Asher, an internationally recognised paediatric asthma expert based at the Starship Children's Hospital and the University of Auckland. Any instances where the guideline recommendations were inconsistent with best practice at the time of data collection have been clearly identified and referenced to guidelines that were current at the time of data collection.

In NZ two studies have reported on primary care management[9] of asthma and asthma guidelines. One compared the pharmacological management of children's asthma in NZ with guideline recommendations but did not address issues relating to treatment, ethnicity, and guideline adherence (Thompson et al., 1993). The second study compared GP's opinions about how they managed asthma with recorded action in medical records (Kljakovic & McLeod, 1997). The study did not examine whether the actions recorded in the medical records varied by the patient's ethnicity.

Thompson et al. (1993) compared prescribing for childhood asthma in the Wellington region with the pharmacological therapeutic algorithm recommended in an international consensus

[9]The phrase 'primary care management' refers to care delivered in a primary care setting, particularly general practices. Several types of management are covered by this phrase, including pharmacological management, asthma education, and the provision of self-management plans.

statement published in the Archives of Disease in Childhood in 1992 (Warner, 1992). The authors reviewed prescriptions that had been dispensed in 1991 from thirty randomly selected pharmacies in the region. The authors concluded that the therapeutic guideline had not been widely adopted by GPs in the region as:

- about half of children prescribed β_2 agonists were instructed to use them regularly rather than as needed for symptom control
- inhaled corticosteroid prescriptions among these children were relatively low, and some children, particularly those in the under 5 years group, probably required inhaled corticosteroid treatment but did not receive it
- children aged 5–15 years were inappropriately prescribed β_2 agonists in oral rather than inhaled forms
- there was very little use of inhaled forms of β_2 agonists in children under 5 years of age, despite the availability of spacers for use with MDIs, and breath activated inhaler devices.

It should be noted that the use of dispensed prescriptions as a method for assessing GPs prescribing behaviour is a potential source of bias in this study as it is not possible to ascertain whether prescriptions had been provided to the children but not dispensed.

Kljakovic & McLeod (1997) reported the findings of a study that compared GPs' opinions about asthma management with their recorded management of asthma in an after hours medical centre. Over a two month period in 1994 data from the records of all patients who had attended the clinic for asthma were systematically abstracted from records the day after attendance. Data collected included information on who treated the patient, history and clinical findings, prescribed medications, diagnoses, and referrals made. One year later GP's opinions about the diagnosis and management of asthma were collected using a posted questionnaire. There were significant differences between opinion and recorded action for most clinical and investigation measures. For both adults and children the recording of respiratory rate, pulse rate, pulsus paradoxus, and peak expiratory flow rate was significantly lower than GPs' opinions of how often they recorded these measures. For adults, auscultation of the chest was recorded less frequently than GPs' opinions of how often they undertook auscultation. Similar discrepancies were noted for management. Recording of action in children and adult records was significantly lower than opinion about the frequency of specific management actions for the use of nebulised bronchodilator, oral prednisone,

increased preventive medications, increased inhaled bronchodilators, and use of oxygen. Conversely, for both adults and children, recorded prescribing of antibiotics was higher than opinion about frequency of use (although the finding was not statistically significant for adults) (Kljakovic & McLeod, 1997). Assuming that the medical records contain complete information about the actions and practices undertaken within the consultation, this study provides evidence that doctors' beliefs about the standard of their asthma management overestimates their actual practice.

Both these studies suggest that asthma management practices in primary care were not consistent with guideline recommendations at the time the studies were undertaken.

2.5.2 Access to and utilisation of care

Paediatric asthma guidelines make a number of recommendations regarding the management of children's asthma. Active management of both acute and chronic asthma is required. This is most easily achieved by patients having an appropriately trained regular source of primary care who is familiar with the patient and their history and clinical presentation(s) of asthma (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

Other recommendations of relevance to the use of primary care and management of acute asthma episodes include:

- repeated assessments to monitor response to treatment during acute asthma episodes
- review of the management of chronic asthma symptoms shortly after the resolution of the acute asthma episode (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

Regular review of children with chronic asthma is recommended to ensure good control of asthma is achieved and maintained. The frequency of these reviews will vary according to the level of control of asthma, with less frequent review necessary when control is good. Review at times of good control provides opportunities for stepping down pharmacological management where this is appropriate (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005). The NZ adult asthma guideline notes that regular review of all adults with asthma improves symptom control, reduces the number of acute episodes, and reduces absenteeism (New Zealand Guidelines Group, 2002). These reviews can be undertaken by

appropriately trained GPs, nurses, or asthma educators (New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005).

2.5.2.1 Access to, and utilisation of, primary care in New Zealand

Māori utilisation of primary care in general has been examined using a number of different designs, sampling frames, and methods of collecting data, with varying results. Broadly speaking, some publications have reported lower rates of primary care utilisation by Māori (for example Malcolm, 1996) – an absolute underutilisation relative to the non-Māori population. Other authors reported similar rates of utilisation by Māori and non-Māori (for example Davis, Lay-Yee, Sinclair, & Gribben, 1997; Gribben, 1992). When the higher health needs experienced by the Māori population are taken into account, similar rates of utilisation by Māori and non-Māori represent a relative underutilisation in the Māori population.

The 1996/97 New Zealand Health Survey collected data from participants across the country during face-to-face interviews. Similar proportions of Māori, Pacific, and NZE adults[10] in the survey reported visiting a GP at least once in the previous 12 months. However, statistically significant ethnic differences in the proportions of people who reported high use of GP services[11] were reported. A higher proportion of Māori adults reported high use of GP services (18.9%; 95% CI 16.0, 21.8) compared with NZE (15.0%; 95% CI 13.6, 16.4; $p < 0.0001$). The proportion of Pacific people who reported high use of GP services was intermediate between Māori and NZE (16.3%; 95% CI 12.6, 20.0). There were no ethnic differences in use of GP services by children under 15 years of age (Ministry of Health, 1999).

[10]People aged 15 years of age and over.

[11]High use was defined as six or more visits in the previous 12 months.

The same survey found significant ethnic differences among adults reporting unmet need[12] for GP care in the previous 12 months. Māori (18.6%; 95% CI 15.5, 21.7) and Pacific (17.5%; 95% CI 12.8, 22.2) adults were more likely to report unmet need than NZE (11.6%; 95% CI 10.4, 12.8; $p < 0.01$). Six percent of caregivers reported that their child(ren) had experienced unmet need for GP care in the 12 months prior to the survey (Ministry of Health, 1999).

In summary, prior to the commencement of this study, data about Māori and Pacific utilisation of primary care indicated that utilisation of primary care by Māori and Pacific people was low in absolute and/or relative terms. It should be noted that more recent data about the utilisation of primary care in NZ is available (for example in the 2006/07 New Zealand Health Survey) but has not been included here as this study was conducted prior to the survey being undertaken.

2.5.2.1.1 Asthma-related access to and utilisation of primary care

The 1996–1997 New Zealand Health Survey found that people aged 15–44 years with probable asthma were twice as likely as people without asthma to have seen their GP six or more times in the previous 12 months. This data was not reported by ethnicity. Data for children under 15 years was not reported.

Kljakovic (1994) analysed the respiratory care given to children with and without asthma from a single suburban 'predominately NZE middle class'[13] general practice in 1990. Analyses were not undertaken by ethnic group. The mean number of consultations was significantly higher for asthmatic children.

Garrett, Mulder, & Wong-Toi (1989), in a study of patients aged 5–50 years who attended Accident and Emergency (A&E) departments and urgent medical services for asthma, found that Māori and Pacific participants were less likely to have a regular GP than NZE

[12]Unmet need is defined as the participant reporting that they thought the needed to see a GP but had not seen one.

[13]Kljakovic (1994) p. 240.

participants. Despite this, there were no ethnic differences in the number of GP visits in the previous year, or in the proportion of people who had seen a GP during the asthma episode for which they sought A&E care. Māori and Pacific patients had a higher number of visits to after hours GP services than NZE. Māori and Pacific rates of after hours GP service use were the same as their rates of A&E use, whereas the NZE rate of after hours GP service use was higher than the rate of A&E use. Age-specific subgroup analyses were not undertaken.

In summary, people with asthma have greater use of GP services than those without asthma. Analyses by ethnic group suggested that Māori and Pacific people were less likely to have a regular source of GP care, had similar numbers of visits to the GP, and had higher rates of use of A&E and after hours GP services than non-Māori people.

2.6 Components of asthma management

Comprehensive management of children's asthma can be subdivided into three components: pharmacological management; action (self-management) plans; and asthma education. This section provides an outline of management for each of these components. This framework is used throughout the thesis to structure the presentation of the contextual literature in this chapter, the critical appraisal of literature (Chapter 3), methods (Chapter 4), the results of data analysis (Chapter 5), and the discussion of the findings of the project (Chapter 6).

2.6.1 Pharmacological management

Pharmacological management of asthma includes decisions regarding the devices used to deliver medications and the prescription of medications. The provision of information about medication and medication delivery devices is covered in asthma education.

2.6.1.1 Methods of drug delivery in asthma management

The most common form of delivery is via an inhaler device. Inhaler devices deliver drugs to the lungs during inspiration. All types of inhaler devices must be appropriately placed within the mouth to ensure that medication is delivered to the lungs rather than deposited in the mouth or upper airway. Metered dose inhalers (MDIs) deliver a specific dose when the device is triggered by hand, and very good coordination of triggering and inspiration is needed. Breath activated inhaler devices are triggered automatically during inspiration. Lung

function must be sufficiently developed to trigger the device and ensure that medication is deposited in the lung rather than the mouth or upper airway. As a result of these factors, recommendations about the type of inhaler device vary with age (see Table 2).

Table 2 Type of inhaler delivery device recommended for use in different age groups

Inhaler device	<2 years	2–4 years	5–7 years	8–15 years
MDI*, small volume spacer, and mask	Yes	Yes		
MDI and small volume spacer without mask		Possible	Yes	Yes
Dry powder inhaler (breath activated)			Possible	Yes
Auto-haler (breath activated)			Possible	Yes
MDI alone				Possible but not ideal

Source Paediatric Society of New Zealand (2005) p. 27

* MDI Metered dose inhaler

Spacers are devices that have a chamber with one end able to be attached to the mouthpiece of MDIs. At the other end is a mouthpiece through which the child inhales the contents of the chamber. The medication is released into the chamber and the child breathes through the mouthpiece. This removes the need to carefully coordinate triggering of the MDI and inspiration. Spacers can also be used when the child does not have sufficiently developed lung function to trigger breath activated inhalers. A face mask can be attached to the spacer mouthpiece and placed over the child's mouth and nose if the child is too young to use the mouthpiece effectively.

Other forms of delivery include nebulised inhaled delivery, oral medication, and intravenous injection.

Nebuliser devices drive a gas flow (either air or oxygen enriched) through a chamber containing a liquid form of the medication. This results in the suspension of the medication in the gas, which is then inhaled. Nebulisers were routinely used in the treatment of acute asthma in the past. By 1992 the use of spacer devices in acute asthma was recommended as an alternative to nebulisation (Mitchell & Ad Hoc Paediatric Group, 1992), and by the time of data collection for this study spacer devices were considered the delivery system of choice,

with nebulisers only used in very severe acute asthma (British Guidelines on Asthma Management, 1997; Chou, Cunningham, & Crain, 1995; Dewar, Stewart, Cogswell, & Connett, 1999; Leversha, Campanella, Aickin, & Asher, 2000).

Oral medication may be used to administer corticosteroids in acute asthma management. In rare situations oral corticosteroids may also be required to control severe chronic asthma. The use of oral β-adrenoreceptor agonists is outdated (Paediatric Society of New Zealand, 2005) and was not recommended at the time of data collection (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994).

Intravenous medication is reserved for critically unwell children with severe acute asthma. Both salbutamol (a β-adrenoreceptor agonist; β_2 agonist) and corticosteroid medications can be administered intravenously.

One NZ study has provided information about medication delivery devices. Mitchell (1991) examined the prescription of nebulisers to use at home at the time of discharge from hospital. The study sample consisted of Māori, Pacific, and NZE/Other children aged 0–14 years, who were stratified into first and subsequent admission groups. The prescription of nebulisers for home use was uncommon (NZE/Other 7%, Māori 2%, and Pacific 3%; differences not significant). Among children who had been admitted two or more times home nebulisation was prescribed to 35% of NZE/Other, 27% of Māori, and 12% of Pacific children. The NZE vs Māori and NZE vs Pacific differences were statistically significant but the Māori vs Pacific difference was not. It should be noted that the data was collected some time before 1991 and at that time home nebulisation was an appropriate practice for severe asthma.

2.6.1.2 Drugs used in asthma management

Broadly speaking there are two main types of asthma drug treatments: drugs to control asthma symptoms and drugs used to prevent asthma symptoms developing. Drugs used to control asthma symptoms may be referred to as ‘reliever’ medications and those used to prevent symptoms developing are sometimes called ‘preventive’ medications.

Children with mild intermittent asthma require treatment to relieve symptoms when they occur. Preventive medication is not indicated.

The use of asthma preventives is recommended for children who have moderate to severe intermittent asthma, and children with persistent asthma. The criteria for considering preventive therapy are: an acute asthma episode in the previous two years, or using inhaled β_2 agonists three or more times per week, or asthma symptoms present three or more times per week, or waking one or more nights per week with asthma symptoms (Paediatric Society of New Zealand, 2005). The current criteria for implementing asthma preventives were also used at the time of this study (Anonymous, 1997; Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994; British Guidelines on Asthma Management, 1997).

2.6.1.2.1 Ethnicity and asthma medication in general in New Zealand

A number of previous publications have documented the use of asthma medications by ethnicity. The use of asthma drugs was found to be lower in Māori and/or Pacific people compared with the NZE/Other ethnic group (Garrett, Mulder, & Wong-Toi, 1989; Ministry of Health, 1999; Mitchell & Quested, 1988).

The 1996–1997 NZ Health Survey found that, among participants over 15 years of age, fewer Pacific people (7.5%; 95% CI 5.0, 10.0) were on asthma medication than Māori (10.0%; 95% CI 7.6, 12.4) and NZE (10.8%; 95% CI 9.0, 12.6) (p value for difference across the ethnic groups <0.05). Data for children under 15 years was not reported (Ministry of Health, 1999).

However, children's data was included in earlier studies. In a study that included both adults and children, Garrett, Mulder, & Wong-Toi (1989) found that Pacific people were on fewer asthma medications than NZE and Māori participants.

Mitchell & Quested (1988) reported that in a study of children who had been admitted to hospital, 'Polynesian'[14] children were on significantly fewer asthma medications in the 24 hours prior to admission than their NZE peers (Polynesian mean 1.4 vs 1.8 NZE; $p<0.05$). In addition, at the time of admission a significantly greater proportion of 'Polynesian' children

[14]Māori and Pacific.

had not received any asthma medications in the previous 24 hours (relative risk (RR) 1.94; 95% CI 1.25, 3.00). Six months post-discharge the mean number of asthma medications remained lower for Polynesian children (2.0 vs 2.4 NZE; p=0.055). However, there were no significant ethnic differences in the proportion of children who were not on any asthma medications six months after discharge from hospital.

Analysis of data from a community-based sample of children produced similar results. Pacific children were significantly less likely to have had 'any medication for asthma at some time' than Māori or NZE[15] children. Although Māori children were also less likely to have had asthma medication than NZE children the difference was not statistically significant (Mitchell, 1991).

Shaw et al. (1994) recruited a community-based sample of children with diagnosed asthma and did not find statistically significant differences between Māori and NZE in 'current asthma medication'.

2.6.1.2.2 Drugs used to control asthma symptoms

Two types of drugs are used to treat asthma symptoms: β-adrenoreceptor agonists (β_2 agonists) and anticholinergic medications. Both types of drugs relieve asthma symptoms by reversing the constriction of the smooth muscle in bronchial walls.

2.6.1.2.2.1 β-adrenoreceptor agonists

Short acting β_2 agonists are the mainstay of immediate symptom management in both acute and chronic asthma. The most common route of administration is using an inhaler device. However, the route of administration and the dose used varies with the severity of the asthma. Nebulisers and intravenous short-acting β_2 agonists may be necessary in severe acute asthma.

[15]NZE defined as non-Māori, non-Pacific in footnote to Table 1 p. 832 (Mitchell, 1991).

Long acting β_2 agonists (LABA) may be used in the management of chronic asthma symptoms and are recommended when regular preventive therapy does not control asthma and regular β_2 agonist medication is required in addition to preventive treatment. LABA should not be used to treat acute symptoms or asthma attacks. At the time this study was collecting data the initiation of LABA treatment required a Special Authority application from a GP or relevant specialist. Two types of LABA were available at that time.

2.6.1.2.2.2 Anticholinergic medication

The use of anticholinergic medication was recommended for moderate acute asthma episodes in 1992 (Mitchell & Ad Hoc Paediatric Group, 1992), and is currently recommended for use in conjunction with short acting β_2 agonists in severe acute asthma (Paediatric Society of New Zealand, 2005). They are usually administered using an inhaler device, but can be administered using a nebuliser. Although not currently recommended for use in the management of chronic asthma (Paediatric Society of New Zealand, 2005), anticholinergics were recommended for use in chronic management where control of asthma was difficult to achieve in 1994 (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994). At the time of data collection anticholinergics were not recommended for use in chronic asthma management as their effectiveness had not been demonstrated, the effectiveness of LABA in chronic symptom management had been demonstrated, and LABA were recommended by guidelines published in 1997 (Anonymous, 1997).

2.6.1.2.2.3 Ethnicity and the use of reliever medications in NZ

Several authors have reported on ethnicity and the use of reliever medications in New Zealand. Results of these studies vary, with some authors finding no differences in the prescription or use of this type of medications and others finding significant differences.

Mitchell & Quested's work found that, in a sample of hospitalised children, 'Polynesian' children were significantly less likely than NZE children to have received a β_2 agonist in the 24 hours prior to admission. Six months after the index admission the proportion of children who were taking a β_2 agonist had increased in both ethnic groups (77% Polynesian vs 88% NZE), however, the ethnic differences persisted (RR 0.88; 95% CI 0.77–1.00; $p<0.05$) (Mitchell & Quested, 1988).

Garrett, Mulder, & Wong-Toi (1989) studied children and adults attending A&E and found no ethnic differences in the proportion of people who had β_2 agonist medications. Reducing courses of oral steroids are usually used to manage acute asthma episodes. The authors did not find ethnic differences in the use of reducing oral steroids. However, Pacific participants were less likely to be on continuous oral steroids than Māori and NZE participants (Garrett, Mulder, & Wong-Toi, 1989). It is likely that continuous oral steroids were for the management of severe chronic asthma (i.e. preventive treatment) rather than severe acute asthma but the authors did not specify this.

Mitchell reported on the use of medications in a community-based sample of children. The highest proportion of children currently taking a bronchodilator[16] was observed in the NZE ethnic group (55%); Māori were intermediate (43%), and the lowest proportion was observed in the Pacific ethnic group (21%). The Pacific vs Māori and Pacific vs NZE differences were both statistically significant; however, the Māori vs NZE difference was not (Mitchell, 1991).

In the same paper, Mitchell presented data on the prescription of β_2 agonists to children aged 0–14 years at the time of discharge from hospital. The sample was stratified into first and subsequent admission groups. In the first admission group 79% of NZE/Other, 71% of Māori, and 67% of Pacific children received a prescription. The difference between NZE/Other and Pacific groups was statistically significant but the other ethnic group differences were not. In the group who had at least one previous admission the proportions receiving a prescription for β_2 agonists were similar (83% Māori, 89% NZE/Other, and 90% Pacific) and the ethnic group differences were not statistically significant. There were no significant ethnic differences in the use of 'as required' (for acute asthma management) courses of oral steroids.

2.6.1.2.3 Drugs used to prevent asthma

The primary mechanism of action of drugs used to prevent asthma is inhibition of the inflammatory process that causes the swelling of the bronchial mucosa and mucous

[16] β_2 agonists and other bronchodilator medication

production. Reduction of the inflammation in the airways reduces swelling and mucous production and also reduces the sensitivity of the bronchial smooth muscle which means it is less likely to constrict. Three types of drugs may be used to prevent asthma symptoms: corticosteroids, cromoglycates, and leukotriene receptor antagonists.

2.6.1.2.3.1 Corticosteroids

Corticosteroids are most commonly used in the management of chronic asthma and exert a general anti-inflammatory effect on the bronchi and bronchioles. They are usually delivered using inhaler devices. Rarely, where chronic symptoms are severe and persistent, corticosteroids may be taken orally. Corticosteroids are also used in the management of moderate and severe acute asthma episodes; in these situations they are usually administered orally but may be administered intravenously with very severe asthma.

2.6.1.2.3.2 Cromoglycates

Mast cells produce leukotriene, histamine, and other autacoids that are involved in inflammatory and allergic responses in the lung. These autacoids, particularly leukotrienes, promote inflammatory responses and increase the sensitivity of the bronchial smooth muscle resulting in increased bronchoconstriction. Cromoglycates act to stabilise mast cells, thereby preventing the release of these chemicals. Cromoglycates do not have any effect in acute asthma. They are delivered by inhaler devices. In the past they were recommended as first line preventive therapy (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994). At the time of data collection guidelines suggested that children with mild persistent asthma should be given a trial of cromoglycates or commenced on low dose inhaled corticosteroids (Anonymous, 1997; British Guidelines on Asthma Management, 1997). Inhaled corticosteroids were recommended for children with moderate and severe persistent asthma, although the British Guidelines on Asthma Management (1997) noted that cromoglycates could also be used in conjunction with inhaled corticosteroids in these groups. At the current time cromoglycates are recommended for use in mild persistent asthma if inhaled corticosteroids cannot be used (Paediatric Society of New Zealand, 2005).

2.6.1.2.3.3 Leukotriene receptor antagonists

Leukotriene receptor antagonists (LTRA) interfere with leukotriene activity by preventing them from attaching to their receptors. This inhibits their ability to exert their usual effects. LTRAs were not available in NZ at the time data was collected for this project.

2.6.1.2.3.4 Ethnicity and the use of preventive drugs in New Zealand

Several studies have described ethnicity and the use of preventive drugs in NZ. It is difficult to draw clear conclusions from this information.

Mitchell & Quested (1988) found that, among children admitted to hospital, relatively few Polynesian (8%) or NZE (4%) were on inhaled corticosteroids in the 24 hours prior to admission, and there were no ethnic differences (RR 0.71; 95% CI 0.37, 1.39; p=ns). The proportion of children taking inhaled corticosteroids 6 months after discharge increased in both ethnic groups (26% Polynesian and 29% NZE) and there were no significant ethnic differences (RR 0.96; 95% CI 0.59, 1.55; p=ns).

Similar findings were observed among a community-based sample of children. A minority of children in all three ethnic groups were taking preventive drugs at the time of the study. The proportion taking these drugs was highest in the NZE ethnic group (25%), intermediate among Māori (13%), and lowest in the Pacific ethnic group (4%). The Māori vs NZE, Māori vs Pacific, and Pacific vs NZE differences were all statistically significant (Mitchell, 1991).

In the same paper, Mitchell also reported that NZE/Other children were more likely to receive a prescription for preventive medication on discharge from hospital. The author analysed the medications prescribed for a sample of children aged 0–14 years that was stratified into first and subsequent admission groups. In the first admission group 26% of NZE/Other, 17% of Māori and 5% of Pacific children received preventive medication prescriptions at the time of discharge. The NZE/Other vs Pacific and Māori vs Pacific group differences were statistically significant, although the NZE/Other vs Māori difference was not. Among children who had at least one previous admission preventive medications were prescribed for 59% of NZE/Other, 41% of Māori and 38% of Pacific children. The NZE/Other vs Māori and NZE/Other vs Pacific group differences were statistically significant although the Māori vs Pacific difference was not (Mitchell, 1991).

Among a sample of people attending A&E for asthma, Pacific children and adults were less likely to be on preventive medication, and were less likely to be on continuous oral steroids than Māori and NZE participants. Although not stated, it is assumed that the use of continuous oral steroids was for the management of severe chronic asthma (preventive treatment) rather than severe acute asthma (Garrett, Mulder, & Wong-Toi, 1989).

Shaw et al. (1994) recruited children with diagnosed asthma from the community. No statistically significant differences in 'regular ICS' and 'any regular prophylactic medication' between Māori and NZE children were observed.

2.6.1.2.4 Drugs used in the past but no longer recommended

Several drugs have been used in the past but are no longer recommended for use in children's asthma management.

2.6.1.2.4.1 Methylxanthines: aminophylline and theophylline

Methylxanthines cause relaxation of bronchial smooth muscle. Theophylline had previously been recommended for the management of severe acute asthma (Mitchell & Ad Hoc Paediatric Group, 1992) and chronic asthma (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994), but at the time of data collection theophylline was no longer a preferred treatment in children from six years of age and was not recommended for children younger than six years of age (Anonymous, 1997; British Guidelines on Asthma Management, 1997). Similarly, aminophylline is no longer recommended unless the child is in an intensive care unit with very severe bronchospasm that has not responded to maximal doses of β_2 agonists, anticholinergics, and intravenous corticosteroids.

2.6.1.2.4.2 Ketotifen

Ketotifen is an orally administered antihistamine drug that has been used to prevent asthma. However, it was not recommended in the acute and chronic asthma management consensus statements that preceded data collection, and it is not recommended in the current best practice evidence-based guideline (Asher, Toop, Mitchell, & Ad Hoc Paediatric Group, 1994; Mitchell & Ad Hoc Paediatric Group, 1992; Paediatric Society of New Zealand, 2005).

2.6.1.3 Pharmacological management pathways for acute asthma episodes and chronic asthma

The pharmacological management of acute asthma episodes and chronic symptoms differ. Careful assessments of the occurrence, frequency, and severity of asthma symptoms and clinical signs are required on presentation and during on-going treatment in both acute attack and chronic situations (Anonymous, 2002; Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

Criteria for establishing the severity of asthma and for assessing asthma control are provided in the National Asthma Education and Prevention Program (NAEPP) guideline for the management of asthma (Anonymous, 1997), the *Pocket Guide for Asthma Management and Prevention in Children* (Global Initiative for Asthma, 2005) and in the *Management of Asthma in Children aged 1-15 years: Best Practice Evidence Based Guideline* (Paediatric Society of New Zealand, 2005).

As previously mentioned, some drug treatments are used in both acute and chronic presentations, although the method of delivery and doses used may vary. Similarly, some drugs are used at all levels of severity, although the method of delivery and doses may vary, while other drugs are only used with more severe asthma.

2.6.1.3.1 Pharmacological management pathway for acute asthma episodes

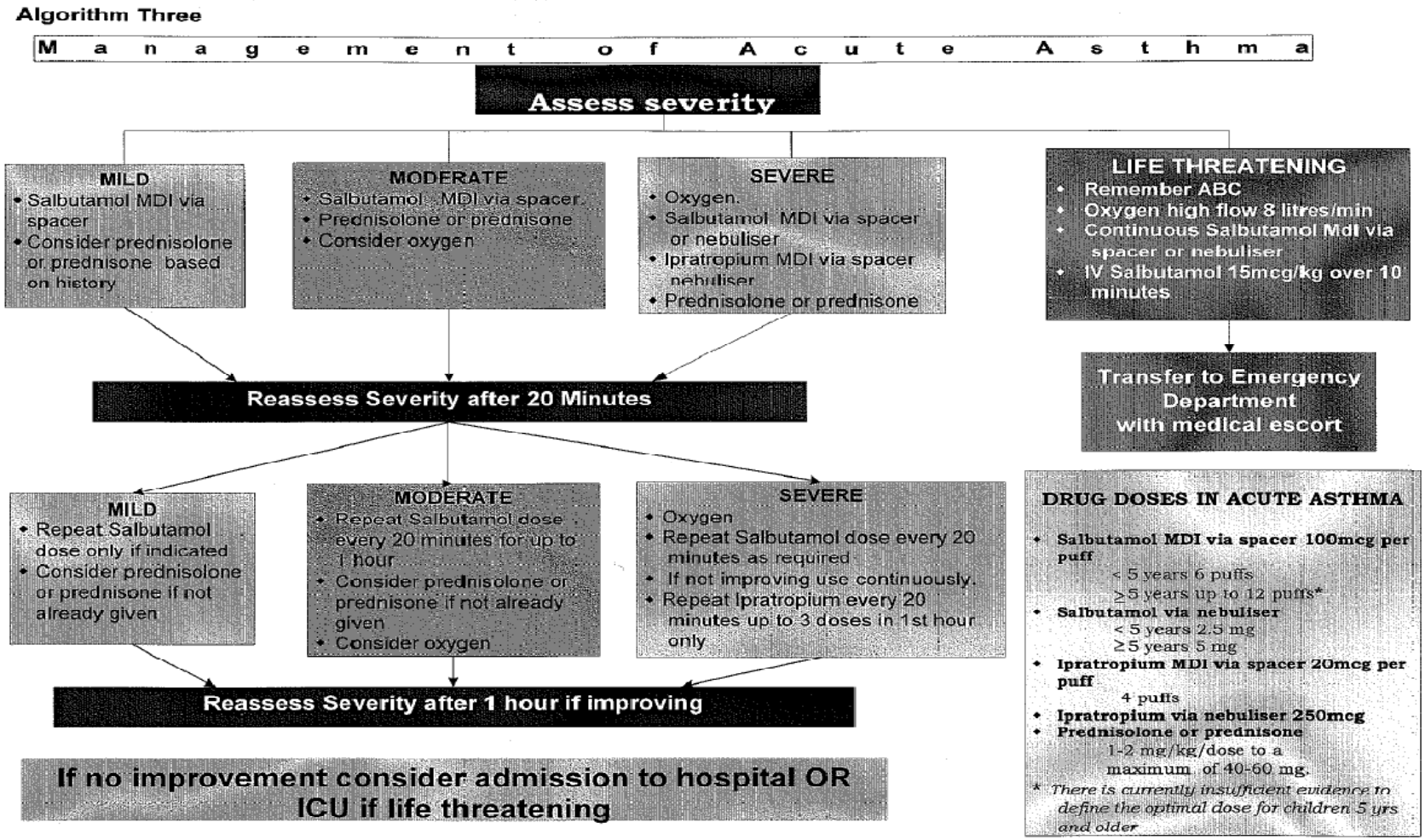
The goal of drug treatment in acute episodes is to control asthma, using the lowest possible doses of medication. A stepwise approach is adopted. Treatment commences at a step determined by the initial asthma severity, with the immediate aim of achieving rapid symptom control. Symptom control is then maintained by stepping treatment up or down according to severity, and treatment continues until the attack subsides. Follow-up is necessary for assessment of the control of the acute episode and, in the longer term, to identify and treat chronic (interval) asthma symptoms (Anonymous, 1997; Global Initiative for Asthma, 2005; New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005). The acute asthma management algorithm from the Paediatric Society of New Zealand (2005) is presented in Figure 3.

2.6.1.3.2 Pharmacological management pathway for chronic asthma

A stepwise approach is also recommended for treatment of chronic (interval) symptoms. Initial drug treatment is implemented at a step that is appropriate for the severity of chronic symptoms, with the aim of achieving early symptom control. Symptom control is then maintained by stepping treatment up or down according to the degree of asthma control (Anonymous, 1997; Global Initiative for Asthma, 2005; New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005).

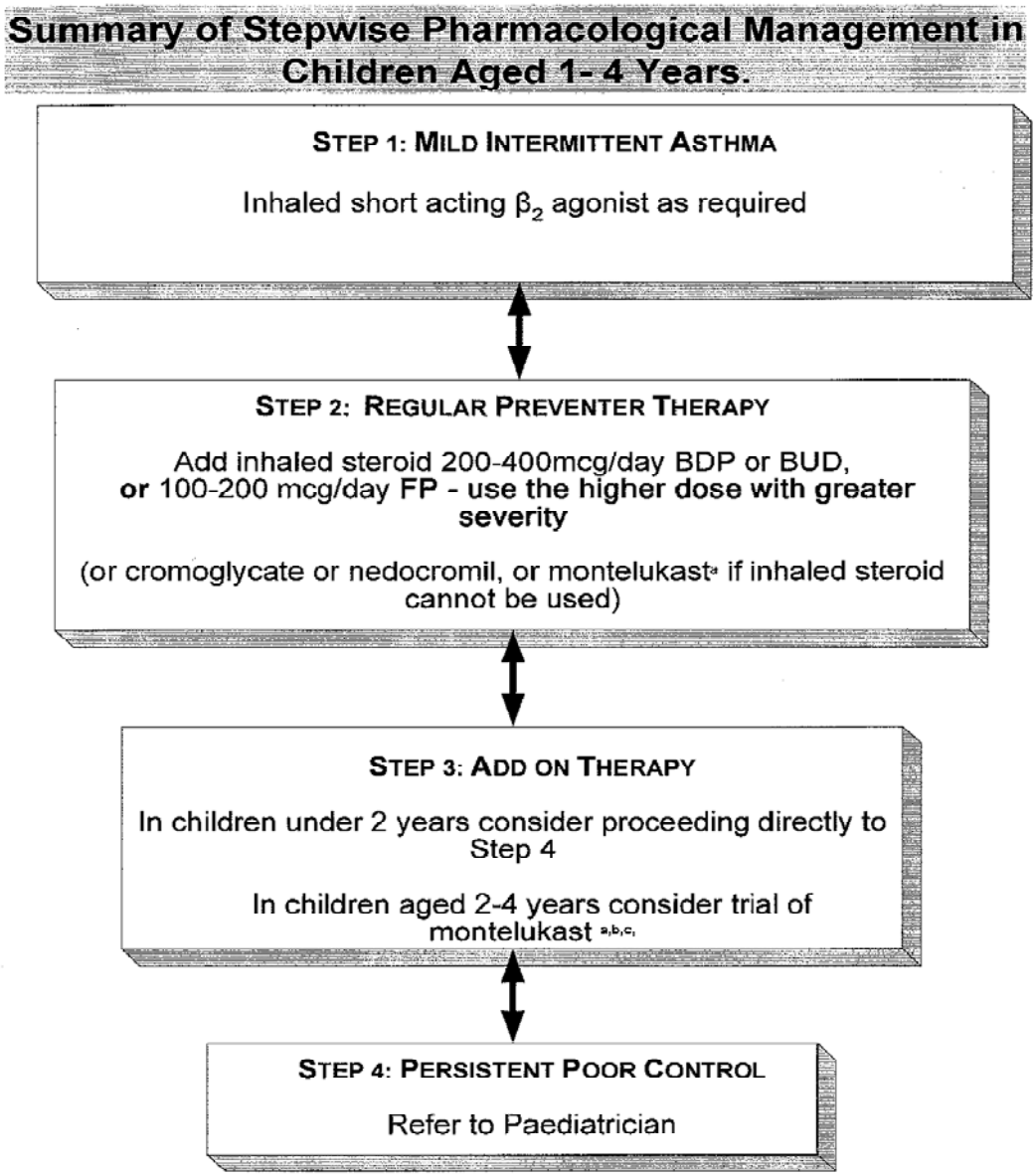
The NZ children's asthma guideline algorithms for pharmacological management in children 1–4 years and aged 5–15 years, and the algorithm for review of chronic asthma from the Paediatric Society of New Zealand (2005) can be found in Figure 4, Figure 5, and Figure 6.

Figure 3 Algorithm for acute asthma management in children



Source Paediatric Society of New Zealand (2005).

Figure 4 Algorithm for management of chronic asthma in children aged 1–4 years



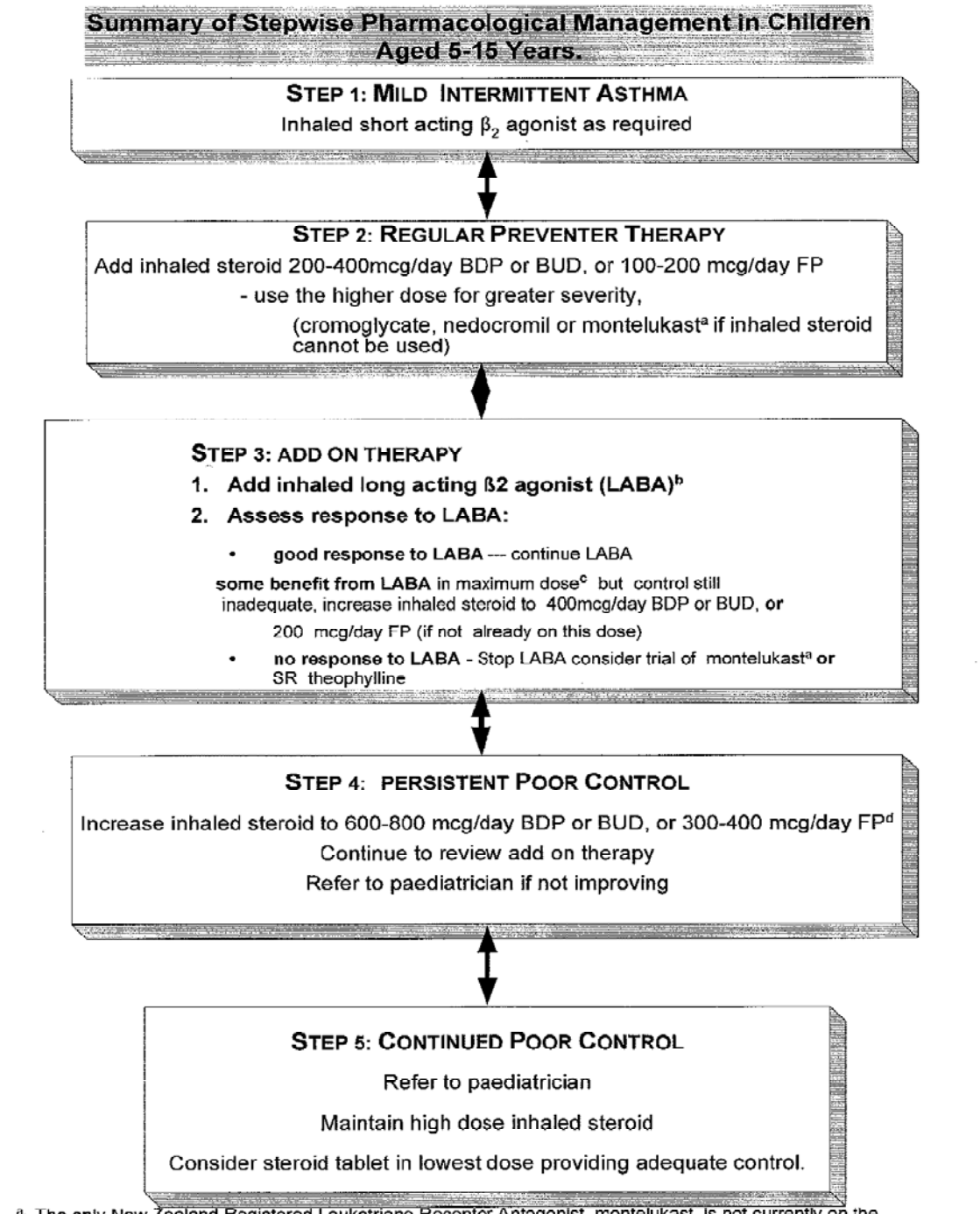
a. The only New Zealand Registered Leukotriene Receptor Antagonist, montelukast, is not currently on the Pharmaceutical Schedule

b Montelukast as add on therapy is recommended before increasing the dose of BDP or BUD over 400mcg/day, or FP200 mcg/day.

c LABA's are not licensed for use <4years (Salmeterol) and <6 years (eformoterol), but are an alternative for families who can't afford to pay for montelukast.
- The use of licensed medicines for unlicensed indications is often necessary in paediatric practice when there is no suitable alternative.
- This should be in consultation with a paediatrician.
- For Medicine Data Sheets and further information on the use of Unapproved Medicines consult Medsafe: http://www.medsafe.govt.nz.
- Always need to take corticosteroid with LABA.

Source Paediatric Society of New Zealand (2005).

Figure 5 Algorithm for management of chronic asthma in children aged 5–15 years



a. The only New Zealand Registered Leukotriene Receptor Antagonist, montelukast, is not currently on the Pharmaceutical Schedule

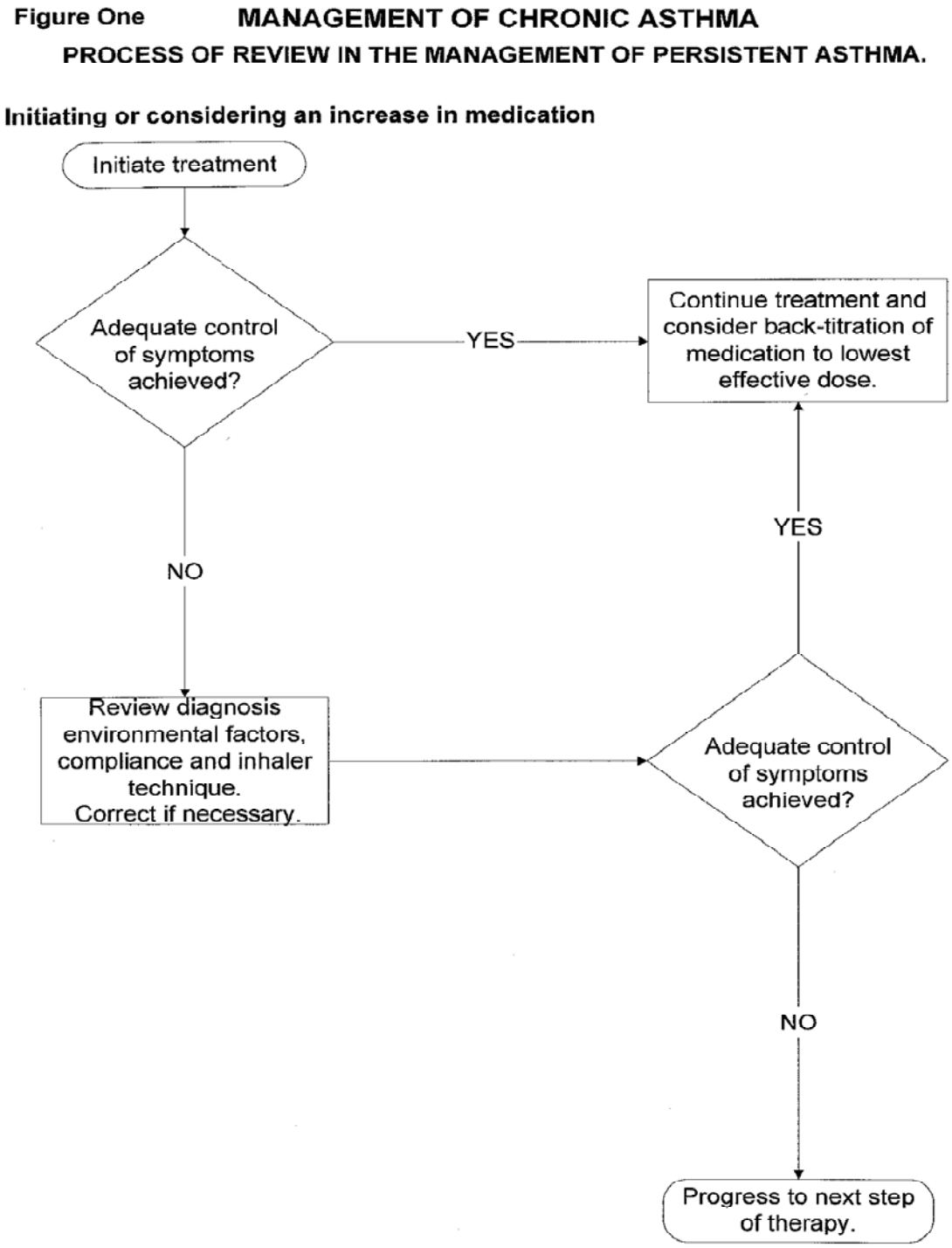
b. The current Special Authority criteria of the Pharmaceutical schedule allows LABA to be introduced at the higher threshold of 400mcg/day BDP or BUD, or 200mcg/day

c. Maximum recommended dose of eformoterol is 12mcg bd, and salmeterol 50mcg bd

d. These levels of ICS are greater than usually required to achieve optimal control (See Dose Response Curve pg 21) and do not hesitate to seek advice from a paediatrician.

Source Paediatric Society of New Zealand (2005).

Figure 6 Algorithm for process of review in chronic asthma



Source Paediatric Society of New Zealand (2005).

2.6.2 Asthma self-management

Self-management skills are a critical component of effective asthma control (Global Initiative for Asthma, 2005; New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005). Comprehensive asthma education and the provision of individualised written asthma action plans are prerequisites for self-management (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005).

The Cochrane systematic review of self-management education for adults with asthma reported that self-management education interventions were associated with clinically important improvements in asthma outcomes. Intensive interventions involving a written action plan, self-monitoring, and regular medical review were most effective and resulted in reductions in the use of health services and some improvements in nocturnal symptoms and absences from work (Gibson et al., 2006a).

In adults the provision of asthma education without an action plan does not result in any clinically important changes in lung function or health service utilisation (Gibson et al., 2006a; Gibson et al., 2006b; New Zealand Guidelines Group, 2002). In adults and children the use of asthma action plans results in improved health outcomes (New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005).

Self-management skills and expertise are best developed through a structured programme that teaches the person with asthma and/or their caregiver to recognise and manage asthma symptoms and exacerbations, recognise and manage triggers, make optimum use of medications, and access health services appropriately for acute and chronic asthma care (New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005).

The components of a self-management programme are (Global Initiative for Asthma, 2005; New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005):

- written information about asthma
- asthma education
- an individualised action plan
- self-monitoring of asthma symptoms, with or without peak flow monitoring
- regular review of medications and current asthma severity by a doctor or nurse

- opportunities for discussion of the person/caregiver's understanding and experiences of asthma, confidence managing asthma, and their fears, anxieties, and concerns about asthma and its management.

The programme should focus on the person's and/or their caregiver's needs, and identified goals for treatment.

2.6.2.1 Asthma education

Asthma education provides people with the knowledge they need to participate in management. In theory, asthma education increases self-management knowledge and skills, leading to improved self-management behaviour and subsequent reductions in asthma morbidity and mortality (Blessing-Moore, 1996; Karnick et al., 2007; Kolbe, 1999). However, as noted above, asthma education may increase asthma knowledge but on its own does not necessarily lead to improved asthma outcomes (Bernard-Bonnin, Stachenko, Bonin, Charette, & Rousseau, 1995; Blessing-Moore, 1996; Cote et al., 1997; Garrett et al., 1994; Kolbe, 1999).

The following topics should be covered in asthma education (Global Initiative for Asthma, 2005; Kolbe, 1999; New Zealand Guidelines Group, 2002; Paediatric Society of New Zealand, 2005):

- asthma pathophysiology
- signs and symptoms of asthma, self-monitoring of symptoms, and chronic management of asthma
- exacerbating factors ('triggers') and avoidance of triggers
- asthma medication types, the use of different types of medicines, asthma medication delivery devices and how to use them
- peak flow meters and asthma action plans, what they are and how to use them
- how to recognise that asthma is getting worse and what to do in this event.

Asthma education should not be a 'one-off' activity. Reinforcement and updating of previous asthma education is essential.

2.6.2.1.1 Ethnicity and asthma education in New Zealand

Two studies have reported on aspects of asthma education. The findings of both suggest that Māori and/or Pacific people receive less asthma education and/or the asthma education they have received has been less effective than that provided to their NZE peers.

Garrett, Mulder, & Wong-Toi (1989), in their study of children and adults attending A&E found that Pacific people were significantly less likely to have written information about asthma than NZE participants. The Pacific participants were significantly less likely to recall their asthma medicines than Māori and NZE people. In addition, fewer Pacific people were able to correctly identify their preventive medicine than NZE and Māori participants; the difference was statistically significant for Pacific vs NZE but not for Pacific vs Māori participants. Māori vs NZE differences were not reported.

A trial of a community-based asthma education clinic reported greater improvements in asthma knowledge among NZE than Māori or Pacific participants (Garrett et al., 1994).

2.6.2.2 Asthma action plans

Individualised written action plans provide children and their families with clear information about recognising when asthma is getting worse, steps to take to re-establish control of asthma, and when to seek medical advice.

Peak flow meters are simple devices that measure the peak flow rate a person is able to achieve during expiration (peak expiratory flow rate, PEFR). The PEFR falls when asthma control is deteriorating. In the past PEFR measurement was an integral part of self-management, and action plans were based on this measurement as well as the level of symptoms the person was experiencing. However, more recent evidence has shown that action plans are equally effective with or without peak flow measurements or recorded diaries of symptoms (New Zealand Guidelines Group, 2002). Historically it was recommended that daily PEFR monitoring was undertaken regardless of the level of control of asthma. However, a body of literature suggested this regime was not well accepted by people with asthma (see for example Kamps & Brand, 2001; Kamps, Roorda, & Brand, 2001; McMullen, Yoos, & Kitzman, 2002; Sly & Flack, 2001) and more recent recommendations suggest that PEFR monitoring could be used intensively when introducing and teaching self-management plans, and during times when asthma is unstable. More frequent PEFR monitoring should be

recommended for people with severe asthma morbidity, high mortality risk, and those people who have difficulty perceiving the severity of their asthma without the use of PEFR meters (D'Souza et al., 1998).

The Cochrane systematic review of written action plans for children was not able to draw conclusions about the benefits of providing (versus not providing) a written action plan as the review team were unable to identify any trials that answered this specific question. When considering whether there was any difference by type of action plan the authors concluded that symptom-based action plans were more effective at reducing acute care visits than PEFR-based action plans. The review also found that parents had no preference for symptom-based or PEFR-based plans, while children preferred symptom-based plans. (Bhogal, Zemek, & Ducharme, 2006)

The NZ paediatric asthma guideline recommends that all children with asthma, regardless of severity, should be offered a written action plan. It further recommends that any child on step 2 or greater (see Figure 4 and Figure 5) should have an action plan (Paediatric Society of New Zealand, 2005).

Children's lung function, including peak expiratory flow rate, increases with age until adulthood. Furthermore, the clinical presentation and course of an individual's asthma can vary over time. Action plans, therefore, should be reviewed regularly to ensure they remain applicable to the child concerned.

2.6.2.2.1 Ethnicity and the provision of action plans in New Zealand

Ethnic disparities in the provision of action plans have been documented. Garrett, Mulder, & Wong-Toi (1989) reported that Māori and Pacific participants in their study were significantly less likely to have a PEFR meter, and Pacific participants were less likely to have an action plan than NZE participants. Significantly lower proportions of Pacific and Māori participants had a PEFR meter when they were enrolled into a randomised controlled trial (RCT) of a

community-based asthma education clinic (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994; Garrett et al., 1994).

Although the effectiveness of using action plans for adult and childhood asthma had previously been documented in NZ[17] they were not used comprehensively by medical practitioners (Garrett, Williams, Wong, & Holdaway, 1997b). About 76% of participating paediatricians and paediatric registrars and 91.2% of GPs reported that they used action plans. Nearly 98% reported they found action plans useful in the management of children's asthma. Furthermore, about 89% of doctors believed the use of action plans improved the patient's understanding of asthma, and about 76% thought that action plans increased patient's compliance with asthma management. However, only 25 % of these doctors provided action plans to more than 75% of their patients with asthma. A further 28% of doctors gave action plans to less than 25% of their patients with asthma. GPs were just as likely to use action plans as paediatric doctors but gave action plans to a smaller proportion of their patients. Information on action plan use for people of different ethnic groups was not collected (Garrett, Williams, Wong, & Holdaway, 1997b).

2.6.2.3 Interventions to improve asthma self-management in New Zealand

Three sets of authors have reported on interventions to improve self-management in NZ. One study was an RCT of a community-based asthma education clinic for people who had presented to the local hospital's A&E department (Garrett et al., 1994). The two other studies examined the impact of implementing action plans in the community (D'Souza et al., 1994; D'Souza et al., 1998; D'Souza et al., 2000; Gillies et al., 1996; Wairarapa Maori Executive & The Wellington Asthma Research Group, 1992).

Garrett and colleagues conducted a RCT of a community-based asthma education clinic. The clinic was run by an asthma nurse specialist and three community health workers of Māori or Pacific ethnicity. The community health workers were trained to deliver the education

[17]See, for example, D'Souza et al. (1994, 2000); Gillies et al. (1996); Wairarapa Māori Executive & The Wellington Asthma Research Group (1992).

programme. Participants, aged 2–55 years, were recruited after presenting to the hospital's A&E department and were randomised into a control group (usual care) or intervention group (usual care plus education at the community clinic). Medical assessment and treatment continued to be managed by the doctor who usually cared for the participant. Baseline data was collected within five days of A&E presentation and follow-up data collection occurred nine months after randomisation. Unsatisfactory completion of the education programme was significantly associated with age >15 years, and Māori and Pacific ethnicity. An intention to treat analysis was undertaken. Between group effects (intervention vs control) after controlling for age, SEP, ethnicity, sex, and length of time since asthma diagnosis were reported separately for adults and children. No differences between intervention and control groups for socio-demographic, clinical or psychosocial measures were observed at baseline. Analyses demonstrated that the education group was significantly more likely to have acquired preventive medicines, PEFR meters, and action plans. The education group was also more likely to report a reduction in some, but not all, measures of asthma morbidity and demonstrated better knowledge of appropriate actions when asthma was worsening. Ethnic group differences were reported for some outcomes. Significantly lower proportions of Māori and Pacific participants had a PEFR meter on entry to the trial (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994). NZE children were more likely to visit a GP for regular (non-acute) care than Māori and Pacific children (Garrett et al., 1994). Māori participants were more likely to report nocturnal awakenings, had more A&E re-attendances, and more courses of oral prednisone than Pacific and NZE participants (Garrett et al., 1994). Over the course of the intervention Māori and Pacific people had more days off work, and improvements in knowledge among NZE children's caregivers were greater than those of Māori and Pacific caregivers (Garrett et al., 1994).

The Wairarapa Māori community and D'Souza et al. (1994) conducted a six month trial of a 'credit card'-type asthma self-management plan. The trial consisted of data collection at baseline (an eight week period before the introduction of the self-management plan), the introduction and explanation of the self-management plan, and data collection eight and 16 weeks after the introduction of the plan. At 16 weeks the trial ceased and the research team members had no on-going involvement with the participants or community until further

follow-up data was collected one, two and six years after the end of the trial. Even though the participants, who were all Māori, had 'considerable morbidity'[18] only 13% had a written self-management plan and 54% had a PEFR meter when they were enrolled into the trial. Almost all (63/69) participants completed the trial. Significant improvements in morbidity, health service use, and use of preventive and reliever medications were reported. The acceptability of the plan was also evaluated at the end of the trial and was found to be very high (D'Souza et al., 1994; Wairarapa Maori Executive & The Wellington Asthma Research Group, 1992).

Reductions in morbidity and acute health service utilisation persisted one and two years after the completion of the trial. Self-management activities such as PEFR monitoring, increases in ICS, and initiation of oral steroids were also favourably reported (D'Souza et al., 1998).

Improvement in some of the measures of health service use and self-management strategies persisted six years after the completion of the trial. Some other measures (nocturnal awakenings, days 'out of action') had fallen to baseline levels, while other measures (e.g. inhaled steroid use, mean daily does of inhaled steroids) were better at 6 years than at baseline but had deteriorated relative to the findings at one and two years follow-up (D'Souza et al., 2000).

The impact of possible sources of bias was assessed at enrolment, the end of the trial, and at the three follow-up points. No evidence of bias was found (D'Souza et al., 1994; D'Souza et al., 1998; D'Souza et al., 2000). The study is also important because it is an example of a successful research project partnership between researchers and a Māori community. The asthma-specific positive outcomes were accompanied by other benefits including: cultural affirmation; improved access to other health services; a greater sense of control for participants; and positive impacts on the extended family (Ratima et al., 1999).

Gillies et al. (1996) studied the effect of providing an action plan to the caregivers of children with mild to moderate asthma. Children aged 3–11 years who had not previously had an action plan were recruited through general practices. Following an eight week pre-

[18]D'Souza et al. (1994) p. 1261.

intervention data collection period participants were given an action plan, educated about its use and followed up for 16 weeks. Post-intervention follow-up showed significant decreases in asthma morbidity and in GP visits, reduction in asthma reliever medications (oral steroids, inhaled β_2 agonists, nebuliser use), and a non-significant increase in inhaled preventive medicine use. Participants were very supportive of the use of action plans, and indicated high levels of acceptability, benefit from use, and increased confidence managing the child's asthma. The GPs also supported the use of action plans; thought the plan had assisted them with understanding the participants' asthma; and thought it had made it easier to manage the asthma.

2.6.2.4 The use of asthma management strategies by people with asthma and/or their caregivers

Adherence may be defined as "the extent to which a patient's behaviour coincides with medical advice" (Kolbe, 1999 p. 278) and is determined by a complex array of factors. Adherence to medical advice and the implementation of self-management strategies are important factors influencing the effectiveness of asthma management and asthma outcomes. However, the focus of this thesis is the management of children's asthma by health professionals, and whether there are ethnic differences in the care provided by these professionals. Adherence is, therefore, beyond the scope of this thesis and is not reviewed further in this section or the literature review.

2.6.2.5 Discussion of previous New Zealand literature

Information from previously published literature about asthma management in NZ has been presented in the preceding sections of this chapter. The articles from which this information was derived were published between 1988 and 1999 – prior to the collection of data for the study reported in this thesis.

A variety of study designs were used and all the studies have design and method flaws that limit the internal validity and generalisability of the findings and make it difficult to directly compare the findings of the studies. The following paragraphs outline the study designs and limitations. Table 3 and Table 4 summarise the findings about pharmacological and asthma self-management that were published in those papers that reported on ethnic differences. Detailed critical appraisal tables for these studies are appended in Appendix 2.

Some studies did not address ethnicity. These studies described asthma management in general; compared asthma management with guideline recommendations; compared management from records with GP's beliefs about how they managed asthma; or reported on the provision of action plans by medical practitioners without making comparisons by ethnicity (Garrett, Williams, Wong, & Holdaway, 1997b; Kljakovic, 1994; Kljakovic & McLeod, 1997; Thompson et al., 1993). Furthermore, these studies described pharmacological management (Kljakovic, 1994; Thompson et al., 1993), clinical assessment and prescribing (Kljakovic & McLeod, 1997), or the provision of action plans (Garrett, Williams, Wong, & Holdaway, 1997b) in isolation without investigating other aspects of asthma management.

Among the studies that did provide information about ethnicity, none were designed to specifically address the question of ethnic differences in the management of children's asthma. Mitchell (1991) examined whether differences in prevalence, admission criteria or medical care accounted for ethnic differences in mortality and hospitalisation rates. In order to answer this question, Mitchell combined data from two earlier studies that differed in design and method, with 'new' data obtained from hospital records, hospitalisation, and mortality databases. This approach limits the reliability and validity of the findings. Nevertheless the study found there was no evidence of differences in prevalence or admission criteria, but there were significant differences in management. Other information about ethnic differences in medications and/or asthma knowledge and/or self-management behaviour was obtained from studies of asthma-related risk factors for symptoms or health service utilisation, or from trials of asthma-related interventions (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994; Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Garrett, Mulder, & Wong-Toi, 1988; Gillies et al., 1996; Ministry of Health, 1999; Mitchell, 1991; Mitchell & Quested, 1988; Shaw et al., 1994).

Sampling frames for the studies that did report information about ethnicity differed. The sampling frames included children with asthma identified from hospital admissions or general practices (Gillies et al., 1996; Mitchell & Quested, 1988); children in community-based samples (Mitchell, 1991; Shaw et al., 1994); adults and children with asthma attending A&E (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994; Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Garrett, Mulder, & Wong-Toi, 1988); and children and adults in the community (Ministry of Health, 1999).

Among the articles that did report ethnicity findings several issues relating to ethnicity data can be identified. A number of studies do not describe how ethnicity was classified (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994; Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Garrett, Mulder, & Wong-Toi, 1988; Gillies et al., 1996; Mitchell, 1991). Other articles used differing methods for collecting and classifying ethnicity data. This is understandable as the studies were published over the period 1988–1998[19] and significant developments in methods for classifying, collecting, and analysing ethnicity data occurred over this time.

Measures of explanatory and/or outcome variables for asthma morbidity, medications, and asthma knowledge also differ across studies. These measures include:

- Occurrence and frequency of symptoms:
    - Number and length of attacks in the last year (Mitchell & Quested, 1988; Shaw et al., 1994)
    - Daytime symptoms (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Shaw et al., 1994)
    - Nocturnal symptoms or asthma (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Mitchell & Quested, 1988; Shaw et al., 1994)
    - Nocturnal awakenings (Garrett et al., 1994)
    - Days off school/work (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Mitchell & Quested, 1988)
    - Clinical indices of severity on admission and/or at A&E (Garrett, Mulder, & Wong-Toi, 1989; Mitchell, 1991).
- Health service utilisation:
    - Utilisation of GP and after hours services (Garrett et al., 1994)
    - A&E (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989)
    - Hospital admissions (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989; Mitchell & Quested, 1988; Shaw et al., 1994).

[19]The six year follow-up of the 'credit card' self-management plan in a Māori community was published in 2000. However, the initial findings and those at one and two years follow-up were published in 1992, 1994 and 1998.

- Current and/or previous medications:
    - 'Asthma medications' not otherwise specified, mean number of medications (Mitchell, 1991; Mitchell & Quested, 1988; Shaw et al., 1994)
    - 'Any preventive medication'(Mitchell, 1991; Shaw et al., 1994)
    - Cromoglycate (Mitchell, 1991; Mitchell & Quested, 1988)
    - ICS (Mitchell, 1991; Mitchell & Quested, 1988; Shaw et al., 1994)
    - ICS and/or cromoglycate (Garrett, Mulder, & Wong-Toi, 1989)
    - Theophylline (Garrett, Mulder, & Wong-Toi, 1989; Mitchell, 1991; Mitchell & Quested, 1988)
    - Systemic steroids (Mitchell, 1991)
    - Continuous oral steroids (Garrett, Mulder, & Wong-Toi, 1989)
    - 'Reliever medications', 'inhaled β-agonists' (Garrett, Mulder, & Wong-Toi, 1989; Mitchell, 1991)
    - 'Bronchodilators' (Mitchell, 1991)
    - 'Sympatheticomimetics' (Mitchell, 1991; Mitchell & Quested, 1988)
    - Reducing oral steroids (Garrett, Mulder, & Wong-Toi, 1989).
- Knowledge and self-management:
    - Has PEFR meter (Garrett, Fenwick, Taylor, Mitchell, & Rea, 1994; Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989)
    - Has an action plan (Garrett, Mulder, & Wong-Toi, 1989)
    - Knows which medication is preventive (Garrett, Mulder, & Wong-Toi, 1989)
    - Asthma scenario performance (Garrett et al., 1994)
    - Has written information on asthma (Garrett, Mulder, & Wong-Toi, 1989).

Mitchell & Quested (1988) and Garrett et al. (1994) adjusted estimates for differences in socio-economic position, using parental occupation as the measure of socio-economic position. Other studies do not appear to have taken differences in socio-economic position into account in their analyses. With the exception of Garrett et al. (1994) other potential confounders were not considered.

The above discussion illustrates some of the design features and limitations of the previously published literature. Although these issues cause some problems with the internal and external validity of the studies, and limit the capacity to directly compare the findings of the studies, some general conclusions can be drawn.

Research published between 1988 and 1998 found that Māori and Pacific people were on fewer asthma medications than NZE people. For Pacific people these differences were always statistically significant. In relation to inhaled β_2 agonists the proportion of Māori and Pacific children who had these drugs was lower than the proportion of NZE children and the differences, particularly in NZE/Other vs Pacific ethnic group comparisons, were statistically significant. The three studies with samples that were limited to children found that higher proportions of NZE children had received ICS. These differences were significant in Mitchell (1991). However, the differences observed in Mitchell & Quested (1988) and Shaw et al. (1994) were not statistically significant, most likely because of small sample sizes and/or the low frequency of ICS in all ethnic groups. Ethnic differences in preventive medication use were also observed in a study that included both adults and children. The use of inhaled and oral preventive medicines was significantly lower among Pacific people than among Māori and NZE people (Garrett, Mulder, & Wong-Toi, 1989).

Data about asthma education, action plans and asthma knowledge is more limited than that addressing pharmacological management. Nevertheless the findings suggest that Māori and Pacific people may have received less education, had poorer asthma knowledge, and were less likely to have tools such as PEFR meters and action plans to assist in asthma self-management. Asthma education interventions demonstrated that improvements in asthma knowledge and self-management were possible but the improvements were greater in NZE than Pacific and Māori participants. On the other hand, the intervention in the Wairarapa community provided strong evidence that a community-based intervention that involved collaboration with the community and the use of appropriate delivery strategies could produce long-standing improvement in asthma self-management and indicators of morbidity.

The reviewed studies strongly suggest that asthma management falls short of guideline recommendations and that there are ethnic differences in asthma management.

Table 3 Summary of findings about ethnic differences in primary care pharmacological management from New Zealand publications 1989–1999

	Mitchell & Quested (1988) Children On admission to hospital	Garrett, Mulder, & Wong-Toi (1989) Children and adults attending A&E	Mitchell (1991) Children Community sample	Shaw et al., (1994) Children with diagnosed asthma Community sample
Were on medication or mean number of current drugs	At time of admission Polynesian* <E p<0.05 6 months post-discharge Polynesian <E p<0.055 RR (Polynesian:European) for not having medication in 24 hours before admission RR 1.94; 95% CI 1.25, 3.00		Any medication for asthma ever P<M<E M vs E p=ns ‡ P vs E p<0.001 M vs P p<0.05	On any medication at time of study M:E OR 1.1 95% CI 0.6, 2.1 p=0.75
Reliever medication *Bronchodilators currently used*			P <M <E P vs E p<0.001 M vs E p=ns M vs P p<0.01	
Inhaled β_2 agonist	At time of admission RR 0.81; 95%CI 0.70, 0.94 6 months post-discharge RR 0.88; 95%CI 0.77, 1.00	P<M<E p=ns†		
Reducing oral steroids		P<E<M p=ns†		
Preventive medication *Preventive medications prescribed*			P <M <E†† P vs E p<0.001 M vs E p<0.05 M vs P p<0.05	M:E** OR 0.6 95% CI 0.3, 1.4 p=0.22
Inhaled corticosteroids	At time of admission RR 0.71; 95%CI 0.37, 1.39. 6 months post-discharge			M: E OR 0.6 95% CI 0.3, 1.4 p=0.22

	RR 0.96; 95%CI 0.59, 1.55.	
Inhaled cromoglycates	At time of admission RR 0.52; 95%CI 0.32, 0.84 6 months post-discharge RR 0.76; 95%CI 0.53, 1.10	
Inhaled corticosteroids or cromoglycates		P<M<E p<0.005†
Oral theophylline	At time of admission RR 1.12; 95%CI 0.81, 1.54 6 months post-discharge RR 1.00; 95%CI 0.75, 1.35	P<E<M p<0.05†
Continuous oral steroids		P<E<M p<0.05 †

* Polynesian consists of Māori and Pacific ethnic groups.
† For some variables tests of significance for M vs E, M vs P and P vs E. are reported. For variables marked † it is not clear which ethnic group comparison the p value refers to.
†† Cromoglycate or inhaled steroid or regular oral steroids or ketotifen, or any combination.
** Includes inhaled steroids, cromoglycate, theophylline, Ketotifen, slow release salbutamol.
‡ 'ns' – p value not reported but noted to be non-significant in publication.

Table 4 Summary of findings about ethnic differences in self-management and knowledge from New Zealand publications 1988-1998

	Garrett, Mulder & Wong-Toi (1989) Children and adults A&E attendees	Garrett et al. (1994) Adults and children. Community-based asthma education clinic RCT[†]	Garrett, Fenwick et al. (1994) Adults and children who had presented to ED
Had a PEFR meter	M<E p=0.06 P<E p<0.0001 M vs P not reported	Had PEFR meter on entry P least likely p<0.0001	P<M<E p<0.0001
Has a self-management plan	P<E, M p<0.005[*] M % slightly <E		
Possessed books, pamphlets on asthma	P<E, M p<0.0005[*] M % slightly <E		
Name asthma medications	P<M, E p<0.005[*] M % slightly <E		
Know which medication is preventive	P<M<E P vs E p<0.01 P vs M p=ns[††] M vs E not reported		
Knowledge of action to take when asthma slowly worsening		Improved E>M, P p=0.001	
Knowledge of action to take when sudden severe worsening of asthma		Improved >M, P p=0.001	
Did not use PEFR meter appropriately	No ethnic differences		(Among those who had a PEFR meter) P<M<E p=ns
Oral theophylline levels low	P 58% M 60.5% E 63% p=ns		

[*] For some variables tests of significance for M vs E, M vs P and P vs E. are reported. For variables marked [*] it is not clear which ethnic group comparison the p value refers to.
[†]A limited number of the results were reported by ethnic group.
[††] 'ns' – p value not reported but noted to be non-significant in publication.

Chapter 3 Critical appraisal of literature

This chapter presents a systematic review of studies that specifically addressed the question of ethnic differences in asthma management. Each study addressed at least one of the following outcomes: pharmacological management, asthma education or asthma action plans.

3.1 Rationale for a systematic review of the literature focusing on ethnic disparities in asthma management

A vast body of literature about asthma is available. Much of the literature addresses the prevalence of asthma symptoms or diagnosed asthma, and risk factors for adverse outcomes such as Emergency Department (ED) visits, hospital admissions, or poorly controlled asthma. Studies that specifically address ethnic disparities in asthma management are less common. Only two studies addressing ethnic disparities in asthma care were included in the IOM's report on ethnicity and quality of health care (Institute of Medicine, 2003). The studies, published by Krishnan et al. (2001) and Zoratti et al. (1998), are both included in the systematic review undertaken for this thesis.

Since the publication of the IOM's report two other systematic reviews of asthma care have been published (Elster, Jarosik, VanGeest, & Fleming, 2003; Netuveli et al., 2005). Elster and colleagues (2003) undertook a systematic review of health service utilisation by adolescents and concluded that there were too few studies about asthma health service utilisation to draw reliable conclusions. Netuveli et al. (2005) published a systematic review and meta-analysis of ethnic variations in asthma frequency, morbidity, and health-service use in the United Kingdom. One article about asthma management was included in this work; the other articles focused on ethnic differences in asthma prevalence and health service utilisation. Where appropriate, some of the studies included in Elster et al. (2003) and Netuveli et al. (2005) have been included in this systematic review.

3.2 Identification of relevant literature: methods and results

The primary aim of the systematic reviews was to appraise the internal and external validity of published studies into ethnic differences in asthma management and to summarise the

effect estimates and findings of studies included in the reviews. Two reviews were undertaken. The first review was about pharmacological management, and the second focused on two aspects of asthma self-management: action plans and asthma education.

Studies published in peer reviewed journals between 1995 and July 2008 were included in the reviews. Studies published before 1995 were not included because recommended practices had changed and reviewing studies about out-dated management would not be useful for the current study, and research into ethnic differences in quality of care was uncommon prior to the late 1990s.

Non-peer reviewed publications and grey literature were not included, as ascertaining the completeness of coverage of this literature would have been extremely difficult. No language restrictions were applied. The search strategies did not identify any non-English language articles that met the inclusion criteria for the review.

At the commencement of the review process an exclusion criterion relating to the age of study participants was also in place. However after an initial search the age restriction was removed as very few studies were identified if the age limit was imposed.

Retrospective and prospective cohort studies and cross-sectional surveys were considered. Studies that used financial claims, other administrative databases, and clinical databases as data sources were included in the review if they satisfied the inclusion and exclusion criteria. Randomised controlled trials were not specifically excluded; however, as the scope of the review is essentially descriptive rather than focused on interventions, randomised controlled and other types of intervention trials were not specifically included as review criteria.

3.2.1 Inclusion criteria

Studies were included in the reviews if they met the following criteria:

- the research question(s) specifically addressed whether there were ethnic differences in pharmacological management, asthma education or the provision of asthma action plans
- comparisons were made between an indigenous and/or minority group(s) and the dominant population group
- the data related to management in the primary care setting

- potential confounding by socio-economic position was addressed in the study design and/or during data analysis
- the level of asthma control or morbidity was considered in the study design
- the studies were published between 1995 and July 2008.

3.2.2 Exclusion criteria

Published studies that drew samples from specialist outpatient clinics, the ED or during a hospital admission were excluded from the systematic reviews because of the major differences between these sampling frames and the community-based sampling frame that was used in this thesis.

3.2.3 Literature searching

Information specialists from the Philson Library[20] provided expert advice about the choice of search terms and search strategies. However, the author developed and ran the searches, drawing on published evidence and the advice of the information specialists.

The databases used for the pharmacological review were:

- Medline(R) (1950 to July 2008)
- Medline(R) In-process and other non-indexed citations
- Excerpta Medica database EMBASE (1980 to July 2008) and
- Cumulative Index to Nursing & Allied Health Literature (1982 to July 2008).

For the self-management review the following databases were utilised:

- Medline(R) (1950 to July 2008)
- Medline(R) In-process and other non-indexed citations
- Cumulative Index to Nursing & Allied Health Literature (1982 to July 2008)
- PsychINFO (1806 to July 2008)
- ERIC (1966 to July 2008).

[20]Philson Library – University of Auckland Medicine and Health Sciences library based at the Grafton campus.

The search terms that were used varied according to the database being interrogated. Medical subject heading and keyword searches covering asthma, ethnicity and either asthma medications or self-management were undertaken. The specific search terms employed for each of the databases are contained in Appendix 3.

In general, the terms employed were designed to be as inclusive as possible. The exception to this was when the medical subject heading 'asthma' was used for pharmacological searches in the Medline, Medline In-process, and Cumulative Index to Nursing & Allied Health Literature databases. In these cases 'asthma' was limited to prevention and control, drug therapy, rehabilitation, and therapy. The fields interrogated during keyword searches were title, abstract, and subject heading word. Some databases also included 'name of substance word', and 'instrumentation' fields.

The reference lists of appraised studies were reviewed to ascertain if they included articles that had not been identified in the database searches. In addition, searches for citations of appraised articles were undertaken using Ovid and Web of Science citation searches.

3.2.4 Studies identified

The pharmacological management database searches identified 742 articles. The majority of these (573) were excluded after reading the titles and/or abstracts. The remaining 169 articles were appraised. Eight studies fulfilled inclusion criteria and have been included in the pharmacological management critical review (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Ortega et al., 2002; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998).

The asthma education and action plans database searches identified 364 articles. The majority of these (349) were excluded after reading the titles and/or abstracts. The remaining 15 articles were appraised. Four studies fulfilled inclusion criteria and have been included in this component of the critical review (Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998).

3.3 Critical appraisal of studies that met criteria for inclusion in the systematic reviews

Studies that fulfilled inclusion criteria for the reviews were summarised in tabular form with explicit consideration of the study type, sources of data, explanatory and outcome variables, sources of selection bias, information bias and potential confounding, and generalisability. The overall quality of each study was assessed on the basis of these criteria.

Meta-analysis involves the statistical analysis of a collection of studies in order to contrast and combine the results of different studies (Greenland, 1998; Hennekens & Buring, 1987). Although more commonly undertaken using data from randomised trials, the data from observational studies such as cross-sectional surveys can also be used but the results of the meta-analysis are more vulnerable to issues associated with uncontrolled confounding (Greenland, 1998; Hennekens & Buring, 1987). Seven of the studies included in this critical appraisal were cross-sectional surveys. Furthermore, the studies were heterogeneous in relation to the sample composition, the outcome variables that were used, and the degree to which potential confounders were managed. After consideration of these factors, a meta-analysis was deemed inappropriate for the studies considered in this critical appraisal.

Detailed tables containing the critical appraisal of each paper are contained in Appendix 4.

3.3.1 Study design

Six studies were classified by the authors as cross-sectional surveys (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Zoratti et al., 1998). The type of study was not made explicit in Ortega, Gergen et al. (2002) but should also be considered a cross-sectional survey as it reported data about exposure(s) and outcome(s) that were collected simultaneously at the time of recruitment into the study. One study was a retrospective cohort study (Shields, Comstock, & Weiss, 2004).

Cross-sectional surveys gather data about exposures and outcomes at a single point in time. Associations between exposures and outcomes can be identified and quantified using cross-sectional surveys but this design is not able to establish causation between exposures and outcomes (Beaglehole, Bonita, & Kjellstrom, 1993).

Shields, Comstock, & Weiss' retrospective cohort study could, in theory, establish causation between the explanatory variable (ethnicity) and the outcome variables. In this study the outcome variables were quality of care indicators that had been developed a priori from an evidence-based guideline. The two medication outcomes were assessed in a subset of the sample. One outcome assessed underuse of anti-inflammatory medications among children who had received at least three months supply of β_2 agonist medication, and the other outcome assessed overuse of β_2 agonists. While providing useful information about these specific processes of care, they do not provide information about the use of medications across the whole sample. Asthma education and self-management outcomes were not included in the study (Shields, Comstock, & Weiss, 2004).

3.3.2 Sources of data, dates and location of data collection

In two studies data were collected electronically from clinical and administrative databases (Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998). The remaining six studies collected data using questionnaires that were administered to the participant. The questionnaires were administered by an interviewer over the telephone in two studies (Inkelas, Garro, McQuaid, & Ortega, 2008; Lieu et al., 2002) and during a face-to-face interview in two studies (Moudgil & Honeybourne, 1998; Ortega et al., 2002). In two studies the questionnaire was self-administered by the participant (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Krishnan et al., 2001). In addition to parent-reported data Lieu, Lozano et al. (2002) also collected computerised data from electronic medical records and claims for asthma-related health service utilisation and medication.

Data was collected in the following time periods:

- 1990–1991 (Duran-Tauleria, Rona, Chinn, & Burney, 1996)
- 1993 (Krishnan et al., 2001) and (Zoratti et al., 1998)
- 1993–1994 (Shields, Comstock, & Weiss, 2004)
- 1995–1996 (Moudgil & Honeybourne, 1998)
- 1996–1998 (Ortega et al., 2002)
- 1999 (Lieu et al., 2002)
- 2003–2004 (Inkelas, Garro, McQuaid, & Ortega, 2008).

Six studies were located in the USA (Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Ortega et al., 2002; Shields, Comstock, & Weiss, 2004; Zoratti et

al., 1998), one in England (Moudgil & Honeybourne, 1998), and the other in England and Scotland (Duran-Tauleria, Rona, Chinn, & Burney, 1996).

3.3.3 Explanatory variable: determination of ethnicity

The methods used to collect and classify ethnicity data were clearly described in two papers (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Lieu et al., 2002). Duran-Tauleria et al. (1996) used a combination of field worker assessment of the child's ethnic group and language spoken at home to assign the child's ethnicity. Lieu et al. (2002) adapted USA census questions on race/ethnicity to allow for parental reporting of the child's ethnicity. Parents were asked the child's race/ethnic group and, if more than one ethnic group was identified, the parent was asked to choose one of the ethnic groups.

Three papers included some information about the collection of ethnicity data and assignment of ethnic group in the study but did not report full details. Ortega et al. (2002) and Shields et al. (2004) reported that ethnicity data had been provided by the child's parent but they did not describe the question used in their study. Furthermore, they reported that ethnicity was classified as Black, Hispanic, or White but did not describe the process used to make this classification. Similarly, Zoratti et al. (1998) used self-reported ethnicity data collected from a managed care organisation's electronic database. However, they did not describe the question used to collect this data; nor did they describe the process used to assign 'Caucasian' and 'African American' ethnicity.

One paper provided information about which ethnic groups were excluded from the analysis, but did not report specific detail on the method of collecting ethnicity data (Inkelas, Garro, McQuaid, & Ortega, 2008).

Two papers did not describe the method of collecting and classifying ethnicity data (Krishnan et al., 2001; Moudgil & Honeybourne, 1998).

3.3.4 Outcome measures

This section describes the pharmacological and asthma self-management outcome measures that were used in the appraised studies.

3.3.4.1 Pharmacological outcome measures

The pharmacological outcome measures used in the studies have been classified according to whether the drugs are used to treat or prevent asthma. The outcomes presented here were those used for multivariable analyses. Five papers used binary (yes/no) outcomes relating to the use of medication (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Ortega et al., 2002). One paper compared rates of prescription filling for each medication type (Zoratti et al., 1998) and two used process of care outcome measures that were derived a priori from asthma guideline recommendations (Krishnan et al., 2001; Shields, Comstock, & Weiss, 2004).

Medications used to treat asthma:[21]

- inhaled β_2 agonists in the past year (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Ortega et al., 2002) or previous three months (Inkelas, Garro, McQuaid, & Ortega, 2008)
- any 'quick relief medications' (relievers) in previous three months (Inkelas, Garro, McQuaid, & Ortega, 2008)
- inhaled β_2 agonists average number of prescriptions filled in the year[22] (Zoratti et al., 1998)
- inhaled anticholinergic medication average number of prescriptions filled in the year (Zoratti et al., 1998)
- oral corticosteroid average number of prescriptions filled in the year (Zoratti et al., 1998)
- systemic steroid use in the last year (Ortega et al., 2002)
- over-reliance on β_2 agonists – receiving more than six months β_2 agonists in a six month period (Shields, Comstock, & Weiss, 2004)

[21]Oral corticosteroids and systemic steroids have been included with medications used to treat asthma as these medications are usually used for this purpose.

[22]One prescription fill equals one month's supply.

Medications used to prevent asthma:

- currently has an ICS (Krishnan et al., 2001)
- has used ICS on a daily basis over the previous four weeks (Krishnan et al., 2001)
- ICS use in the previous three months (Inkelas, Garro, McQuaid, & Ortega, 2008)
- ICS used in the last year (Ortega et al., 2002)
- ICS average number of prescriptions filled in the last year (Zoratti et al., 1998)
- cromolyn use in the last year (Ortega et al., 2002)
- anti-inflammatory (ICS, cromoglycates) drugs in the past year (Duran-Tauleria, Rona, Chinn, & Burney, 1996)
- current anti-inflammatory (not otherwise specified) medication (Moudgil & Honeybourne, 1998)
- daily anti-inflammatory (not otherwise specified) medication use (Lieu et al., 2002)
- any controller medication in the previous three months (Inkelas, Garro, McQuaid, & Ortega, 2008)
- Received at least three prescription for β_2 agonists[23] over a six month period and received an anti-inflammatory prescription over that same time period (Shields, Comstock, & Weiss, 2004)

3.3.4.2 Asthma management and action plans

Each of the four studies included in the self-management review used different outcome measures in their multivariable analyses.

The outcome measures used by Krishnan et al. (2001) documented whether participants had reported care that was consistent with the recommendations in the NAEPP guideline. The measures documented whether doctors or nurses had provided sufficient information about asthma triggers, action plan use, and adjusting medications.

[23] This outcome is about prescribing of anti-inflammatory medication in a situation where the use of β2 agonists strongly suggests the child should also receive preventive medication.

The other three studies reported on specific aspects of asthma self-management. Lieu et al. (2002) and Inkelas et al. (2008) examined whether participants reported having a written action plan. Mougdil & Honeybourne (1998) used the following outcome measures: previous asthma education, previous advice on trigger factors, had the symptoms/mechanisms explained, had role of medications explained, had drug delivery technique assessed, and carries out self-management. Inkelas et al. (2008) also reported whether participants had been: taught to recognise early signs of asthma; taught what to do during an attack; taught how to use a PEFR meter; advised to change things in the child's environment; or had taken a class about managing asthma.

3.3.5 Bias

Systematic error (or bias) in studies causes the observed results to differ from the 'true' results in a systematic rather than a random manner. There are two major types of bias: selection bias and information bias (Beaglehole, Bonita, & Kjellstrom, 1993; Hennekens & Buring, 1987).

3.3.5.1 Selection biases

Two types of sampling frames were used in these studies: community-based and patient databases.

Community-based sampling frames were used in three studies. Duran-Tauleria et al. (1996) identified particular geographic areas in England and Scotland and invited children aged five to eleven years attending schools in those areas to participate in the study. Although the authors argue that the sample is representative of Scotland and England, the use of purposefully identified geographic areas rather than a random sample must be borne in mind. The sampling frame used by Ortega, Gergen et al. (2002) was women who had delivered a baby in hospital and had an older child less than 13 years of age with asthma. In both these studies data about asthma management may not reflect the experience of all children with asthma, as children aged over 12 (Duran-Tauleria, Rona, Chinn, & Burney, 1996) and over 13 years (Ortega et al., 2002) were not included in the study. Inkelas et al. recruited participants from the community using random digit dialling and a screening question to identify children with asthma (Inkelas, Garro, McQuaid, & Ortega, 2008).

Patient databases were used to identify eligible participants in the other five studies (Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998).

In six studies a diagnosis of asthma recorded during an episode of care was an eligibility criterion (Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Ortega et al., 2002; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998). Inkelas et al. (2008) used a screening question to identify individuals who had been diagnosed with asthma. The use of diagnosis of asthma to determine eligibility for the study excluded people who had wheeze without a formal diagnosis of asthma having been recorded. Two studies also included criterion relating to the dispensing of asthma medication (Lieu et al., 2002; Shields, Comstock, & Weiss, 2004). This approach excluded participants who did not meet the criteria because they had mild illness, well-controlled asthma, or had not accessed care when needed.

Five studies focused specifically on children. Two used age ranges that covered the childhood period and excluded the first two years of life – a period where non-asthma wheezy illnesses can be misdiagnosed as asthma (Lieu et al., 2002; Shields, Comstock, & Weiss, 2004). The age ranges used in Duran-Tauleria, Rona et al. (1996) and Ortega, Gergen et al. (2002) (five to eleven years and under 13 years respectively) were narrower; therefore the findings may not be representative of the experience of all children in the community. Furthermore, Ortega, Gergen et al. (2002) do not specify whether a lower age limit was used to exclude infants. One study included children aged 0–18 years and therefore included infants for whom the diagnosis of asthma may not be correct (Inkelas, Garro, McQuaid, & Ortega, 2008). Mougdil and Honeybourne (1998) collected data from children aged 11 years or over and adults up to 59 years of age.

Three studies collected data from adults. Krishnan, Diette et al. (2001) used an age range 18 years of age and over. The inclusion of older adults may have introduced bias in that adults who had chronic obstructive airways disease may have been identified as eligible for the study if their diagnosis had been recorded as asthma rather than chronic obstructive airways disease. This potential bias was addressed in the other studies by excluding the ages where this is most likely to occur (Moudgil & Honeybourne, 1998; Zoratti et al., 1998). The age range used by Mougdil and Honeybourne (1998) may still be vulnerable to this bias as the upper age limit was 59 years, whereas Zoratti, Havstad et al.(1998) excluded people over 45

years. Mougdil and Honeybourne (1998) reported that the results of descriptive demographic and morbidity data were similar among the total sample and the subsample aged less than 45 years. However, the results of these analyses were not provided. Moreover, sensitivity analyses were not undertaken for any of the primary outcome variables.

3.3.5.2 Response rates

Response rates varied and some studies had significant issues with response rates.

The study reported by Duran-Tauleria et al. had high overall response rates for both the 'representative' (England and Scotland; 92.3%[24]) and the 'inner city' (largely ethnic minorities; 85.3%) samples. Nevertheless, the response rate from the 'representative' sample was higher than that of the 'inner city' sample. The authors did not discuss the likely impact of differential response rates on their findings. Furthermore, there were marked ethnic differences in the proportion of missing values for questionnaire items. This is discussed in the section on information biases (Duran-Tauleria, Rona, Chinn, & Burney, 1996).

Response rates in the study reported by Mougdil and Honeybourne (1998) varied significantly by ethnicity and gender. The response rates varied from 43% to 71% and were higher for the Indian subcontinent ethnic group (compared with the White/European group). Within each ethnic group the response rates were higher among females than males. The authors sent a questionnaire to the non-responders and comment that the level of self-reported asthma morbidity among the two ethnic groups was similar. However, objective measures of morbidity were collected in the study proper and self-report data, if collected, was not reported. Therefore, it is difficult to assess the impact of non-response on the study findings as it appears that the sources of morbidity information differ for the responders and non-responders.

[24]No information about the ethnic composition of the representative sample is given. Ethnic stratification is only undertaken for the 'inner city' sample.

Krishnan et al. (2001) reported that overall 77% of eligible participants returned questionnaires. They do not provide information about ethnic specific response rates; nor do they provide any information about the characteristics of responders and non-responders.

Lieu et al. (2002) assessed overall response rate (63%) in a rigorous manner but did not provide information about the response rates by ethnic group. They did comment on the likely impact of the response rate, suggesting this was likely to underestimate results, as non-respondents and those who became ineligible because of loss of Medicaid cover over the course of the study may experience more problems with care than those who completed the study.

Ortega et al. (2002) reported that 1 002 families with a newborn and sibling(s) under 12 years with physician diagnosed asthma had been recruited into their study but provided no information about the total number of eligible families. The response rate is unable to be determined and the possible effect of response bias cannot be estimated.

Shields et al. (2004) and Zoratti et al. (1998) identified eligible participants and collected data from electronic databases. Neither study reported total sample, nor ethnic specific information, about missing values for variables.

Inkelas et al. (2008) report an overall response rate of 52.2% but do not report ethnic specific response rates.

The possible impacts of these sources of bias range from no effect to under or overestimation of the point estimates for ethnic differences in management. The impact of the bias will also vary according to whether the effect is differentially or non-differentially distributed across the ethnic groups. If the source of bias is non-differentially distributed across ethnic groups, the point estimates of odds and rate ratios will be shifted towards 1.0, which may result in a type 2 error (accepting there are no differences when there are). However, if differentially distributed the effect will be over or underestimation of the ratios.

3.3.5.3 Information biases

The effect of four possible types of information biases are discussed in this section: recall bias, missing data, misclassification bias, and publication bias.

3.3.5.3.1 Recall bias

Recall bias is a potential source of bias in studies that collect self-reported data about outcomes and exposures from the participants. Recall bias arises where the participant's recollection of events may not accurately reflect the events as they occurred. This is particularly the case when participants are asked to recall events that occurred some time ago. Recall bias can be non-differentially distributed – that is, applies to all participants in the study. Differential recall bias may occur where a subset of participants may recall the information more (or less) completely than another subgroup. For example, participants with very severe asthma may recall details about medication use more completely than those with very mild asthma.

Six of the studies are prone to recall bias as they used self-reported data (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Ortega et al., 2002).

The data used by Krishnan et al. (2001) had been collected in the Managed Health Care Association Outcomes Management System Asthma Study (MCHA Study). In their paper the authors stated that the concordance between patient's and physician's reporting of physician speciality in the MCHA study was 93.7% but did not provide a supporting reference for this statement. Krishnan, Diette et al. (2001) also reported that an earlier feasibility study found reasonably high concordance between patient's and physician's reporting of medication use (80.1% for β_2 agonists and 81.7% for ICS). However, the figures they quoted were not presented in the paper that they cited (Steinwachs, Wu, & Skinner, 1994). Information about ethnic differences in concordance for medication use or physician specialty was not provided.

The possibility of differentially distributed recall bias accounting for some or all of the observed ethnic differences was explicitly discussed, with reference to other literature, by Krishnan et al. (2001). Duran-Tauleria et al. (1996) also discussed the potential impact of ethnic differences in recall contributing to the observed ethnic differences in asthma

management. Lieu et al. (2002) noted there was 'good concordance between parent-reported medication use and computerised records of recent medication dispensing'[25] but do not present the data and make no mention of analysis of concordance by ethnic group. Mougdil and Honeybourne (1998) reported that they sought 'objective confirmation' of patient-reported data but do not specify how that was obtained. Nor do they report the level of concordance between patient-reported and 'objective' data, and the potential impact of recall bias is not discussed. Ortega, Gergen et al. (2002) categorised medication data into time periods to 'limit the potential for misclassification as a result of recall bias'[26]. The authors did not discuss potential sources of recall bias further; nor did they discuss possible ethnic differences in recall bias, and/or the likely impact of these biases if they existed. The authors of the two studies that explicitly considered the possibility of ethnicity-based differential recall bias concluded that ethnic differences in recall bias did not account for the observed differences in asthma management (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Krishnan et al., 2001).

Recall bias is not discussed by Inkelas et al.(2008).

3.3.5.3.2 Missing data

Missing data is another source of information bias and, if present, may be differentially or non-differentially distributed. If the distribution of missing data is similar across all participants the effect of the bias is also distributed equally across all participants. If missing data is more common among a subgroup(s) of participants the effect estimates will be over or underestimated.

Duran-Tauleria et al. (1996) reported ethnic group differences in the proportions of missing values for respiratory symptom questions. The proportion of missing values was lower among the 'representative' sample (3–10%) compared with 20–23% in the 'inner city' sample. Among the 'inner city' sample the proportion of missing values for respiratory questions was highest among the Afro-Caribbean ethnic group (31–33%). Children who did

[25]Lieu et al. (2002) p. 863

[26]Ortega et al. (2002) page 6 of 6.

not have complete data were excluded from data analysis. As a result, a higher proportion of children from the 'inner city' sample were excluded and this may have biased the estimates for the ethnic subgroups in the 'inner city' sample and for the total 'inner city' sample. Ideally, the effect of excluding participants with incomplete data should be assessed from a theoretical perspective or, where possible, by undertaking data analyses that provide some estimate of the effect of exclusion. Neither of these approaches were utilised by Duran-Tauleria et al. (1996).

Ortega et al. (2002) noted that sample sizes for analyses varied due to missing data but did not provide information about ethnic differences in missing data or the possible effects of missing data on the results.

Missing data was not discussed in Mougdil and Honeybourne (1998); Zoratti et al. (1998); Krishnan et al. (2001); Lieu et al. (2002); Shields et al. (2004) or Inkelas et al. (2008).

3.3.5.3.3 Misclassification bias

The gold standard for the collection of ethnicity data is self-reported ethnicity collected through the administration of a standardised ethnicity question. Ideally, the question should be the same as that used to collect denominator information, most commonly the national census question. Similarly, the classification of ethnicity data should be standardised and consistent between different sites that collect ethnicity data. As ethnicity is the primary explanatory variable in these studies it needs to be collected and assigned rigorously, and the methods and processes used for the collection and classification of the data should be explicitly discussed in the papers.

Krishnan et al. (2001) do not report the method of collecting ethnicity data. Self-reported ethnicity data was not obtained by Duran-Tauleria et al. (1996), who assigned ethnicity on the basis of language spoken in the home and the opinion of the researcher who interviewed the participant.

Mougdil and Honeybourne (1998) used ethnicity data from GPs' records during the selection of participants. They do not discuss the reliability and validity of the data including the method and process used by GPs to collect ethnicity data, whether this is standardised and used by all GPs, whether multiple ethnicities are allowed, and how ethnicity data is classified.

Ortega et al. (2002) used parent-reported ethnicity data that was classified into Black, Hispanic, and White. There is no discussion of multiple ethnic groups and methods of prioritisation in this situation. Shields et al. (2004) state that parent-reported ethnicity data were used. As the data used in that study was extracted from Medicaid databases the parent reporting must have occurred at the time of enrolment on the Medicaid programme rather than directly to the researchers. The authors of the paper do not describe the methods and process used to collect the data, or the reliability and validity of ethnicity data on the Medicaid databases. Similarly, Zoratti et al. (1998) used electronic databases to collect data. They describe the ethnicity data as 'self-described as Caucasian or African American', but do not provide any further information.

Lieu et al. (2002) collected self-reported data using two questions from the USA census and clearly describe the method used to classify the data. However, there was no assessment or discussion of the congruency between parent-reported ethnicity data and that recorded on the medical records files.

The paper by Inkelas et al. classified ethnicity as White, African American, Latino (English speaking), or Latino (Spanish speaking). They note they excluded children with multiple ethnic groups, with an ethnic group other than those described, or with missing ethnicity data. (Inkelas, Garro, McQuaid, & Ortega, 2008)

3.3.5.3.4 Publication bias

Publication bias refers to the tendency of journals to preferentially accept papers that report associations rather than those that report no associations (Greenland, 1998). The possible impact of this form of bias on this critical appraisal would be that the search strategies may not have identified all studies that fit the inclusion criteria. If studies that found no associations between ethnicity and outcomes were unpublished, and therefore not identified in the literature searches, the conclusions drawn in this appraisal would overestimate the associations between ethnicity and outcomes. Funnel displays can be used to indicate if publication bias may be operating but require a large number of studies to 'distinguish actual from imagined patterns' (Greenland, 1998 pp. 659-60). There were insufficient studies in the current appraisal to make use of funnel plots (Begg & Mazumdar, 1994).

3.3.6 Confounding

The relationship between ethnicity and asthma management outcomes can be confounded by a number of factors. The strategies used by the appraised studies to manage confounding are described in this section.

Asthma morbidity has not been considered a confounder in this review, as the level of asthma morbidity a person experiences is primarily a function of asthma management. Previous research suggests that there are ethnic differences in management; therefore, ethnicity, asthma management and asthma morbidity can be considered to all lie on the causal pathway.

3.3.6.1 Age and gender

Six studies included age and sex in multivariable models (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Krishnan et al., 2001; Lieu et al., 2002; Ortega et al., 2002; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998). Age, but not sex, was included in multivariable modelling by Inkelas et al. (2008).

Mougdil and Honeybourne (1998) reported that effect modification by age and gender was identified in their study. These effects were managed by presenting outcome data using Mantel-Haenszel weighted (by age strata) summary chi-square analyses that were reported separately for females and males.

3.3.6.2 Socio-economic position

In order to be included in this appraisal the study had to have addressed confounding by socio-economic position. A variety of methods were used to address this issue.

Three studies managed confounding by restricting the sample to low socio-economic position populations (Lieu et al., 2002; Moudgil & Honeybourne, 1998; Shields, Comstock, & Weiss, 2004). Participants in studies by Lieu et al. (2002) and Shields et al. (2004) were drawn from

people enrolled in Medicaid[27] programmes. Participants in Mougdil and Honeybourne (1998) lived in high deprivation districts in 'inner city' Birmingham.

Management of possible confounding by socio-economic position during analysis was undertaken in five studies by including measures of socio-economic position in multivariable analysis. Two measures were used in Duran-Tauleria et al. (1996), Krishnan et al. (2001), and Ortega et al. (2002). A single measure was used in Zoratti et al. (1998) and Inkelas (2008). A variety of measures of socio-economic position were used in the studies. The measures were:

- individual level measures:
    - paternal social class (Duran-Tauleria, Rona, Chinn, & Burney, 1996)
    - single parent family (Duran-Tauleria, Rona, Chinn, & Burney, 1996)
    - level of education (Krishnan et al., 2001; Ortega et al., 2002)
    - employment status (Krishnan et al., 2001)
    - family income (Inkelas, Garro, McQuaid, & Ortega, 2008; Ortega et al., 2002).
- small (geographic) area measures:
    - income based (Zoratti et al., 1998).

Zoratti et al. (1998) conducted income adjusted multivariable analyses for the total sample. They also conducted an analysis of the major outcome variables that was limited to the 'low income' subgroup. The rationale for the subgroup analyses was not explicit in the paper and there was no reporting of tests of effect modification or interaction. Furthermore, the presented results are for the total sample and the low income sample. This suggests that there was no interaction or effect modification, as the outcomes would have been presented for low and high income groups separately had effect modification been identified.

3.3.6.3 Access to care

Access to care may also confound the relationship between ethnicity and management outcomes. In this context access to care does not include health service utilisation, as health

[27]Medicaid programmes are United States Federal and State Government funded health insurance programmes. Eligibility is determined by income level.

service utilisation is largely a function of morbidity and, therefore, management (i.e. on the causal pathway). Components of access to care that could be considered potential confounders are: whether the participant had a routine source of primary care, and (in the USA) insurance status and type of health care organisation (for example, managed care).

Studies by Duran-Tauleria et al. (1996) and Mougdil and Honeybourne (1998) did not consider access to care in design or analysis. Ortega et al. (2002) note they had very limited information on access to care; however, they did adjust for the number of visits to the routine source of care in their multivariable analysis.

Zoratti et al. (1998), Krishnan et al. (2001) and Lieu et al. (2002) addressed insurance status and access to care in the design of their studies by restricting participation to members of managed care programmes. Participants in Shields et al. (2004) were restricted to those enrolled in the State Medicaid 'primary care case manager' or fee-for-service plans (~76% of the non-elderly Medicaid population). Ortega et al. (2002) adjusted for insurance status (private and Medicaid). People without insurance were not included in their study. A binary 'currently has health insurance' variable was used in the study by Inkelas et al. (2008).

Ortega et al. (2002) also examined the impact of site of care on medication use. The three different sites were ambulatory care centre, private practice, and hospital-based clinic. Subgroup analyses limited to those children who had been seen in private practice were undertaken for inhaled β_2 agonist and ICS use in the previous months. Preliminary bivariable analysis of medication use data had shown that medication use was highest in private practices and the authors wished to assess, using multivariable analysis, whether ethnic disparities were apparent in the private practice setting.

3.3.6.4 Other potential confounders

Previous experience of asthma may also confound associations for some outcomes. For example, if a child has a parent or sibling with asthma then the caregiver's knowledge of asthma and their self-management approaches may be influenced by their prior knowledge. None of the studies considered this form of confounding.

3.3.7 Effect estimates

This section outlines the reported effects estimates for various medications and aspects of asthma self-management (asthma education and action plans).

Although the pharmacological outcome variables used in each paper addressed the same broad medication types (i.e. treatment and prevention medications), the specific outcome variables differed between studies. Two studies used markers of quality of care such as 'over-reliance on β_2 agonist' as outcome measures. The remaining studies included one (or more) medication type(s) as outcome measures; however, among these studies the specific outcome varied. For example, in relation to β_2 agonist medication the following outcome measures were employed: used in previous 3 months, used in previous year, carries a β_2 agonist, prescribed a β_2 agonist, and average number of prescriptions in a calendar year. Mougdil and Honeybourne (1998) used a minority group as the reference group. Duran-Tauleria, Rona et al.(1996), Ortega, Gergen et al.(2002), Shields, Comstock et al.(2004), and Inkelas (2008) used White/English as the reference.

3.3.7.1 Effect estimates: β_2 agonist medications

Table 5 summarises the point estimates and measures of precision for outcomes measures relating to inhaled β_2 agonist medications.

Shields et al. (2004) used medical claims administration data to determine whether there was over-reliance[28] on β_2 agonist medication. The authors stated there were no Black–White ethnic differences but did not report the odds ratio. The Hispanic–White odds ratio was 0.73 and the 95% confidence intervals (95% CI) were 0.54 and 0.99 indicating that Hispanic children were less likely to have received 'levels of β_2 agonist prescriptions indicating overuse' (p. 500).

Similarly, Zoratti et al. (1998) reported there was no difference in the average number of β_2 agonist prescriptions between Caucasian and African Americans. However, measures of

[28]Over-reliance was defined as a child receiving more than six months supply of β_2 agonist medication in a six month period.

central tendency such as an average may be misleading where variables are likely to be skewed. The large standard deviations observed in this study lend support to the possibility that there may be problems with the method used to analyse this variable.

Four studies reported odds ratios for the use, possession, or having been prescribed β_2 agonist medication (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Moudgil & Honeybourne, 1998; Ortega et al., 2002). Inkelas et al. (2008) did not observe any differences in the likelihood of having used a β_2 agonist in the previous three months. The other three studies found that β_2 agonist medication was less common among minority ethnic groups than 'White' (ORs ranged from 0.25 to 0.80), or more common among White/Europeans than minority groups (ORs 1.69 to 2.18). The confidence intervals did not include 1.0 for eight of the ten reported odds ratios. (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Moudgil & Honeybourne, 1998; Ortega et al., 2002)

Ortega et al. (2002) undertook a subgroup analysis of β_2 agonist use in the previous year among children who were seen in private practices. The effect estimates were essentially unchanged, although the precision was reduced slightly with confidence intervals for both the Black and Hispanic odds ratios including 1.0.

3.3.7.2 Effect estimates: inhaled corticosteroids or anti-inflammatory medications

A summary of point estimates and measures of precision for inhaled corticosteroid and anti-inflammatory medications is presented in Table 6.

Shields et al. (2004) included a measure of anti-inflammatory use based on asthma management guidelines. This measure stated that participants who had been prescribed more than three months supply of β_2 agonist in the previous six months should also have been prescribed an anti-inflammatory medication. The authors state that no ethnic differences were observed but do not report odds ratios or confidence intervals.

Zoratti et al. (1998) reported a statistically significant difference in the average number of filled prescriptions for inhaled corticosteroid medications between Caucasian (1.74) and African Americans (1.44; $p=0.038$). As with β_2 agonist medication, the standard deviations were relatively large (3.26 for Caucasians and 2.87 for African Americans).

Point estimates obtained in Duran-Tauleria et al. (1996), Lieu et al. (2002), Ortega et al. (2002), and Inkelas et al. (2008) indicated that corticosteroid or anti-inflammatory medications were less likely among minority groups (ORs 0.26 to 0.74), while those obtained by Mougdil and Honeybourne (1998) and Krishnan et al. (2001) indicate that these medications were more common among the White/European population (ORs 1.12 to 2.16). The confidence intervals for eight of the fourteen reported odds ratios did not include 1.0, and the upper confidence limit was 1.0 for two of the remaining ratios.

Inkelas et al. (2008) reported on any 'controller' medication use in the previous three months. Odds ratios using White as the reference group were 0.2 for Latino Spanish speaking participants, 0.4 for Latino English speaking and 0.4 for African American participants. The upper limit of the confidence interval was below 1.0 for all three odds ratios.

Ortega et al. (2002) undertook a subgroup analysis of inhaled steroid use in the previous year among children who were seen in private practices. The effect estimates were essentially unchanged for both the Black and Hispanic odds ratios. Both sets of confidence intervals widened in the subgroup analysis. The Black confidence interval extended to include 1.0; however, the confidence intervals associated with the Hispanic odds ratio remained under 1.0.

As the distribution of sex varied between ethnic groups, Mougdil and Honeybourne (1998) reported the ethnic differences in medications stratified by sex. This effectively reduced the study's sample size and power for these outcomes. The inclusion of 1.0 in the confidence intervals for both males and females may be due to the resultant reduction in power and precision. The third set of confidence intervals that included 1.0 was for the OR associated with Afro-Caribbean ethnicity in the study by Duran-Tauleria et al. (1996). The small sample size (n=55) for this group may have limited the precision of the findings.

3.3.7.3 Effect estimates: systemic/oral steroids and cromoglycate medications

Only two of the studies examined cromoglycate and systemic/oral steroid use (Ortega et al., 2002; Zoratti et al., 1998). Table 7 summarises the effect estimates for these outcomes.

Although neither study found significant ethnic differences in the number of prescriptions or use of cromoglycates, the point estimates and measures of precision suggested lower use among minority groups with the upper confidence interval for odds ratios being 1.0 (Black) and 1.1 (Hispanic).

The findings of the two studies in relation to systemic/oral steroid use are contradictory. Zoratti et al. (1998) found the average number of prescriptions was higher for African American than Caucasian participants. However, odds ratio point estimates for use of these drugs for Black and Hispanic people were not indicative of ethnic differences in use (Ortega et al., 2002).

3.3.7.4 Effect estimates: asthma education and action plans

Four papers included outcomes related to eight different aspects of asthma self-management: previous asthma education, explanation of symptoms and mechanisms of asthma, asthma triggers, action plans, information and education about medication, self-management practices, advice about managing the home environment, and whether the caregiver had taken a class about managing asthma (Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998).

Thirty-five effect estimates were reported in the four papers. Table 8 summarises the effect estimates from these papers.

The three point estimates reported in Krishnan et al. (2001) indicated that White/European participants were more likely to report or have received the elements of asthma education and action plans, with odds ratios ranging from 1.60 to 1.94. The two point estimates reported in Lieu et al. (2002) found that Black and Latino participants were more likely to report having a written action plan than White participants, with odds ratios of 1.80 and 1.50 respectively. The confidence intervals associated with the five point estimates reported in Krishnan et al. (2001) and Lieu et al. (2002) did not include 1.0.

Moudgil & Honeybourne (1998) included six outcomes comparing Indian subcontinent and White/European participants. Each estimate is reported separately for males and females because the response rates varied by gender (i.e. 12 point estimates). Although this post-hoc stratification is likely to have reduced the precision of the estimates, White/Europeans were

more likely to have reported or received all six measures of asthma education/self-management. However, the confidence intervals for seven of the 12 estimates included 1.0.

Inkelas et al. (2008) included six measures associated with asthma self-management and reported odds ratios for African American, Latino (English speaking), and Latino (Spanish speaking) participants, using White as the reference group. For three outcomes the Latino (Spanish speakers) odds ratios were below 1.0 (0.4 to 0.6). The upper confidence limit was under 1.0 for two of these estimates and was 1.0 for the third. A further six point estimates were below 1.0 although the confidence intervals included 1.0. The remaining nine point estimates ranged from 1.0 to 1.7 and the confidence intervals all included 1.0.

3.3.8 Summary of effects estimates and assessment of internal validity

Factors limiting the internal validity, particularly in relation to sampling criteria, response, and information biases were present in all the reviewed studies. On the basis of the information discussed in the previous sections all the studies had similar, moderate, internal validity.

In addition to the issues relating to study design, the use of different outcome variables also made comparison of the reported effect estimates challenging.

For the two major asthma treatment types (inhaled β_2 agonists and inhaled corticosteroid/anti-inflammatory medications) the results were strongly, but not universally, indicative of ethnic differences in asthma medication, with minority children less likely to possess, use, or experience guideline-consistent β_2 agonists and corticosteroid/anti-inflammatory medications. This finding is arguably stronger for corticosteroid/anti-inflammatory medications than for β_2 agonists.

In relation to oral/systemic steroids and cromoglycate use the reported findings do not provide clear evidence for or against the presence of ethnic disparities in the use of these medications.

Across a diverse range of outcomes relating to asthma education and action plans the effects estimates suggested that minority participants are less likely to have received these aspects of asthma management, although a number of estimates found no ethnic differences and the

study by Lieu et al. (2002) found Black and Latino children were more likely to have action plans.

Overall, the effects estimates provide evidence for the presence of ethnic differences in the management of asthma that favour the White/European population.

Table 5 Summary of effect estimates for β_2 agonists related outcomes by ethnicity

	Effect estimate	Precision 95% CI or SD	Comment
Quality indicator or the number of β_2 agonist prescriptions			
(Shields, Comstock, & Weiss, 2004)			
Black, non-Hispanic	OR not reported		Over-reliance on β_2 agonist – child received more than 6 months supply during a six month period. Reference=White, non-Hispanic No Black-White differences in reporting of overuse of β_2 agonist
Hispanic	OR 0.73	0.54, 0.99	
(Zoratti et al., 1998)			
Caucasian	4.02	SD=5.55	Average number of prescriptions in calendar year. Not statistically significant
African American	4.54	SD=6.30	
Possession or use of β_2 agonist			
(Ortega et al., 2002)			
Black	OR 0.6	0.4, 0.9	β_2 agonist use in previous year. Reference=White
Hispanic	OR 0.8	0.5, 1.2	
(Moudgil & Honeybourne, 1998)			
White/European males	OR 1.69	1.03, 2.87	Carries β_2 agonist. Reference=Indian subcontinent
White/European females	OR 2.18	1.22, 3.97	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.7	0.8, 3.8	Used β_2 agonist in previous 3 months. Reference=White
Latino (English speaking)	OR 0.9	0.4, 1.8	
Latino (Spanish speaking)	OR 0.7	0.2, 2.3	
(Duran-Tauleria, Rona, Chinn, & Burney, 1996)			
Afro-Caribbean	OR 0.63	0.30, 1.19	Taken a β_2 agonist in previous year. All children with asthma symptoms.
Indian subcontinent	OR 0.25	0.15, 0.40	

Other	OR 0.40	0.19, 0.94	Reference=English
Afro-Caribbean	OR 0.43	0.22, 0.81	Taken a β_2 agonist in previous year. Children with reported asthma attacks. Reference group=English
Indian subcontinent	OR 0.35	0.22, 0.57	
Other	OR 0.41	0.21, 0.82	

Table 6 Summary of effect estimates for inhaled corticosteroid or anti-inflammatory related outcomes by ethnicity

	Effect estimate	Precision 95% CI or SD	Comment
Quality indicator or the number of inhaled corticosteroid prescriptions			
(Shields, Comstock, & Weiss, 2004)			
Black, non-Hispanic	Not reported		Multivariable modelling – no ethnic differences in those who were prescribed more than 3 months supply β_2 agonist in 6 month period and also received anti-inflammatory. Reference=White, non-Hispanic
Hispanic	Not reported		
(Zoratti et al., 1998)			
Caucasian	1.74	SD=3.26	Average number of prescriptions in calendar year.
African American	1.44	SD=2.87	
Possession or use of inhaled corticosteroid or anti-inflammatory			
(Krishnan et al., 2001)			
White	OR 1.49	1.25, 1.77	Possesses ICS. Reference =Black
White	OR 2.16	1.78, 2.62	Daily use ICS. Reference =Black
(Lieu et al., 2002)			
Black	OR 0.64	0.45, 0.90	Daily use ICS. Reference=White
Latino	OR 0.52	0.33, 0.82	

(Moudgil & Honeybourne, 1998)			
White/European males	OR 1.31	0.77, 2.28	On anti-inflammatory. Reference=Indian subcontinent
White/European females	OR 1.12	0.62, 2.01	
(Ortega et al., 2002)			
Black	OR 0.4	0.2, 0.8	Use of ICS in previous year. Reference=White
Hispanic	OR 0.3	0.1, 0.5	
(Duran-Tauleria, Rona, Chinn, & Burney, 1996)			
Afro-Caribbean	OR 0.74	0.41, 1.35	Children with reported asthma attacks. Taken an inhaled anti-inflammatory in the last year. Reference group=English.
Indian subcontinent	OR 0.26	0.15, 0.45	
Other	OR 0.44	0.21, 0.92	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 0.5	0.2, 1.0	Children with persistent asthma. Used an ICS in previous 3 months. Reference=White
Latino (English speaking)	OR 0.5	0.2, 1.0	
Latino (Spanish speaking)	OR 0.4	0.1, 1.4	
Any controller in previous 3 months			
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 0.4	0.2, 0.8	Children with persistent asthma. Reference=White
Latino (English speaking)	OR 0.4	0.2, 0.8	
Latino (Spanish speaking)	OR 0.2	0.1, 0.8	

Table 7 Summary of effect estimates for other outcome variables by ethnicity

	Effect estimate	Precision 95% CI or SD	Comment
Number of prescriptions for or use of cromoglycate in previous year			
(Zoratti et al., 1998)			
Caucasian	0.36	SD=1.48	Average number of prescriptions in calendar year. Not statistically significant
African American	0.28	SD=1.26	
(Ortega et al., 2002)			
Black	OR 0.5	0.3, 1.0	Use in the previous year. Reference=White
Hispanic	OR 0.6	0.4, 1.1	
Number of prescriptions for or use of oral/systemic steroids in previous year			
(Zoratti et al., 1998)			
Caucasian	0.59	SD=1.57	Average number of oral steroid prescriptions in calendar year
African American	0.91	SD=2.08	
(Ortega et al., 2002)			
Black	OR 0.9	0.5, 1.6	Use in the previous year. Reference=White
Hispanic	OR 0.8	0.5, 1.4	

Table 8 Summary of effect estimates for asthma education and action plan outcomes by ethnicity

	Effect estimate	Precision 95% CI	Comment
Asthma education			
(Moudgil & Honeybourne, 1998)			
White/European males	1.31	0.80, 2.15	Proportion reporting having been given asthma education in the past.
White/European females	1.22	0.75, 2.01	Reference=Indian subcontinent
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 0.9	0.5, 1.7	Taught what to do in an attack. Reference=White
Latino (English speaking)	OR 0.8	0.4, 1.3	
Latino (Spanish speaking)	OR 0.4	0.2, 0.6	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.1	0.7, 1.7	Taught how to use PEFR meter (aged 5–17 years). Reference=White
Latino (English speaking)	OR 0.7	0.5, 1.1	
Latino (Spanish speaking)	OR 0.7	0.4, 1.2	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.1	0.7, 1.6	Advised to change home environment. Reference=White
Latino (English speaking)	OR 0.8	0.5, 1.1	
Latino (Spanish speaking)	OR 0.5	0.3, 0.8	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.7	1.0, 2.9	Caregiver has taken a class about asthma management. Reference=White
Latino (English speaking)	OR 1.0	0.6, 1.7	
Latino (Spanish speaking)	OR 1.5	0.8, 3.1	
Explanations of symptoms and mechanisms of asthma			

(Moudgil & Honeybourne, 1998)			
White/European males	2.46	1.58, 4.21	Proportion reporting having told about symptoms and pathophysiology in the past. Referenc =Indian subcontinent
White/European females	2.47	1.57, 4.03	
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.1	0.7, 2.0	Taught to recognise early signs
Latino (English speaking)	OR 0.8	0.5, 1.3	
Latino (Spanish speaking)	OR 0.6	0.4, 1.0	
Asthma triggers			
(Moudgil & Honeybourne, 1998)			
White/European males	1.69	1.05, 2.75	Proportion reporting having previous advice on trigger factors. Reference=Indian subcontinent
White/European females	1.99	1.27, 3.26	
(Krishnan et al., 2001)			
White	1.94	1.64, 2.29	Proportion judged to have guideline consistent education about avoiding asthma triggers. Reference=African American
Action plans			
(Lieu et al., 2002)			
Black	1.80	1.33, 2.43	Proportion that reported having a written action plan. Reference=White
Latino	1.50	1.04, 2.15	
(Krishnan et al., 2001)			
White	1.60	1.36, 1.88	Proportion judged to have guideline consistent information about action plan use. Reference=African American
(Inkelas, Garro, McQuaid, & Ortega, 2008)			
African American	OR 1.2	0.8, 1.8	Children who had ever given an action plan. Reference=White
Latino (English speaking)	OR 1.0	0.7, 1.4	
Latino (Spanish speaking)	OR 1.0	0.6, 1.6	

Information and education about medication			
(Moudgil & Honeybourne, 1998)			
White/European males	1.51	0.95, 2.43	Proportion that had role of medications explained. Reference=Indian subcontinent
White/European females	1.22	0.77, 1.93	
(Moudgil & Honeybourne, 1998)			
White/European males	1.15	0.71, 1.87	Proportion that had drug delivery technique assessed. Reference=Indian
White/European females	1.24	0.78, 1.99	
(Krishnan et al., 2001)			
White	1.60	1.36, 1.89	Proportion judged to have guideline consistent information about adjusting medications. Reference=African American
Self-management			
(Moudgil & Honeybourne, 1998)			
White/European males	1.41	0.70, 2.76	Proportion that report carrying out self-management. Reference=Indian subcontinent
White/European females	2.17	1.16, 4.09	

3.3.9 External validity/generalisability

The external validity of a study relates to the degree to which the findings of the study can be generalised (applied) to populations other than the population in the study. In order for a study to be generalisable to other populations the study itself should be internally valid. In addition, the study population should be representative of the population that one wishes to apply the findings to. As previously mentioned, all of the studies included in this critical appraisal had moderate internal validity.

Seven of the eight studies included in this review had significant limitations on representativeness and, therefore, the external validity (generalisability) of the outcomes to general populations both within the country of origin and to the population in NZ. These challenges to the external validity of the studies arose from differences between the samples and the general population in terms of geographic location, socio-economic position, type of health service/programme, and/or asthma symptoms.

The study by Duran-Tauleria et al. (1996) had the strongest external validity. The study randomly sampled children in schools across England and Scotland, with 'over-sampling' of children in 'inner city' areas. The distribution of 'social class' in the England and Scotland samples was similar to that of the general population. Ethnic minority children accounted for a substantial proportion of the children in the 'inner city' sample. All children with wheeze and/or diagnosed asthma were included in the study. Some results were only reported for specific subgroups such as 'known asthma attack'. Asthma can be of sufficient severity to require treatment without the presence of asthma attacks. It is not appropriate to generalise the findings regarding management among children who experience asthma attacks to all children who experience asthma symptoms.

Inkelas et al. (Inkelas, Garro, McQuaid, & Ortega, 2008) used a community-based sample and accounted for non-response from households without telephones or with multiple phones in their analyses. However, the sample was drawn from four States in the USA and may not be generalisable to the rest of the USA population. Furthermore, participants required a doctor's diagnosis to be eligible for the study, and children with asthma symptoms but without a formal diagnosis were not eligible for the study.

Although Ortega, Gergen et al. (2002) also used a community-based sampling frame the external validity was limited by the non-random sample and the exclusion of families who did not have a newborn child. Furthermore, families were excluded if they had not been told, or did not recall, that the older child had been diagnosed with asthma by a doctor.

The samples in the five remaining studies were drawn from patients enrolled in health services or health management organisation databases, that is the sampling frames were not community-based (Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998).

Three studies conducted in the USA were located in managed care organisations (Krishnan et al., 2001; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998). The study by Lieu et al. (2002) was located in two non-managed care State-run Medicaid health insurance plans.

In the UK, Mougdil & Honeybourne (1998) identified eligible people using primary care records. Population enrolment with primary care providers in the UK is very high, suggesting that the study should have strong external validity. However, the response rate was moderate overall and low in some ethnic groups. Furthermore, a recorded diagnosis of asthma in the primary care records was required in order to identify eligible people.

A physician diagnosis of asthma was also necessary in the studies conducted by Zoratti et al. (1998), Krishnan et al. (2001), Lieu et al. (2002) and Shields et al. (2004). The requirement for physician diagnosis of asthma reduces external validity as some people have asthma symptoms and treatment but a diagnosis of asthma is not recorded in their medical records or recalled by the patient.

Krishnan at al. (2001) investigated the consistency of management with asthma guidelines for people with ‘at least moderate’ asthma symptom severity, limiting the generalisability of their findings to the total population.

The sampling frame was limited to particular socio-economic related subgroups in three studies. The study sample was drawn from socio-economically deprived areas or low income groups in Moudgil et al. (1998), Lieu et al. (2002) and Shields et al. (2004). The findings from these groups should not be applied to the wider population as management may vary by socio-economic position.

With the exception of Duran-Tauleria et al. (1996) all the studies were located in specific geographic areas, thereby limiting the generalisability of the findings to the total population.

Differences in the structure of health systems and associated factors such as funding for health services and access to care, limit the generalisation of findings from the country of origin to the population in NZ.

The USA health system operates under a private model, with individuals covering the cost of health care through out-of-pocket payments and health insurance. Publicly funded health services are only available to the low income (Medicaid) and elderly or disabled (Medicare) populations. In contrast, the majority of health services in the UK are publicly funded. New Zealand occupies an intermediate position, with a mix of publicly and privately funded services. In particular, primary care funding is derived from both government subsidy and patient co-payments. Mechanisms for delivering care also differ between countries. In NZ and the UK primary medical care is delivered by GPs and the majority of care is delivered in this sector, with specialist care being sought following referral by the GP. In the USA primary medical care is delivered by GPs, general medicine physicians, paediatricians and obstetricians/gynaecologists. Direct access to and management by specialists is common.

Differences in access to care may impact on health outcomes and can confound the relationship between ethnicity and management or quality of care. There is also some evidence that management of conditions may vary between types of practice (see for example Finkelstein et al., 1995) and between primary and speciality care (see for example Joseph, Havstad, Ownby, Johnson, & Tilley, 1998). These cross-national differences in the organisation and delivery of health care influence the validity of generalising findings from one country to the population of another.

In summary, the external validity of all the studies presented here was limited by one or more factors. Overall, the study reported by Duran-Tauleria et al. (1996) had the strongest external validity. Differences in health systems also limit the generalisability of data from other countries to the population in NZ.

3.4 Critical appraisal – summary

This review reveals that there is a large body of research about asthma management but few studies have specifically addressed the question, 'Are there ethnic differences in asthma management?'. The eight papers included in this review have a variety of limitations to both their internal and external validity. Furthermore, while highly supportive of ethnic differences in asthma management that favour White/European populations, not all effect estimates were in this direction and for some estimates the confidence intervals included 1.0. Therefore, it may be argued that the question remains unresolved. The study presented in this thesis addresses a number of the issues relating to the internal and external validity of the studies in the review and, in particular, provides data specific to the population in NZ.

Chapter 4 Methods

This chapter documents the design of the study and the methods used for the collection, analysis, and interpretation of the data presented in this thesis. Information about the organisation of the study, including staffing, staff training, consultation with the community, and dissemination of the results is also included.

4.1 Study design

The study was a cross-sectional survey of the caregivers of children with asthma. Retrospective data was collected using a structured questionnaire.

4.2 Study participants

Participants were identified from a population based random sample of children resident in three areas of metropolitan Auckland as defined by the urban Auckland zone area census unit maps (Department of Statistics, 1990). The three areas included in the study were Central, Western, and Southern Auckland. Southern North Shore suburbs were also included in the study area. The Gulf Harbour Islands, Rodney County, and northern suburbs of the North Shore were excluded for logistical reasons, namely the low proportion of the population in that area who were of Māori or Pacific ethnicity, and distance to travel to those areas.

Children who were eligible to be enrolled in the study were identified using random residential address start points and cluster sampling of a fixed number of dwellings from each start point (section 4.3.2).

Children were eligible for the study if they:

- had been diagnosed with asthma or had 'wheeziness or whistling in the chest' at any time after one year of age
- had experienced asthma or wheeze in the 12 months prior to enrolment in the study
- were aged twenty four months to fourteen years.

As infants aged 12 months or less may experience wheeze associated with other (non-asthma) illnesses, and there are difficulties with making the diagnosis of asthma in this age group, children who had been diagnosed with asthma or had experienced wheeze or whistling in the chest in the first 12 months of life were excluded from the study.

Not all children with wheeze receive a diagnosis of asthma (Asher et al., 1995). The use of 'wheeziness or whistling in the chest' allowed identification of children who had wheeze but had not been given a formal diagnosis as well as those children who had received a formal diagnosis.

Children who had not experienced asthma symptoms in the previous 12 months were excluded on the basis of concerns about the validity of the diagnosis, and concerns about recall bias. The natural history of asthma is complex and several outcomes may be observed. Some children will experience a spontaneous resolution of asthma as they age ('growing out of asthma'). Consequently, some children who had not experienced symptoms in the previous year may no longer have asthma. The accuracy and completeness of recalled information diminishes as the time period between an event and the time of recall increases. Recall bias may be introduced into a study if one subgroup of participants recalls information more (or less) accurately than other subgroups. Information from caregivers of children who had been symptom free for over a year may be less complete and/or accurate than that from caregivers whose children had experienced symptoms in the past year.

4.3 Sampling characteristics

This section documents the method used to identify eligible children and to determine whether they would be enrolled into the study.

4.3.1 Sampling method

A random sample of the eligible population was identified using a cluster sampling technique based on a door knocking protocol. This methodology was developed and used in Auckland (Meningococcal Disease Case Control Study Project Group, 1996). The specific sampling method employed in this study is described in section 4.3.2.

Other methods of identifying a random sample were considered and rejected because they were more likely to be affected by sample bias. For example, the use of random phone number dialling to identify eligible children was considered and rejected because some families did not have telephone services. As Māori, Pacific, and low income households are less likely to possess telephones the use of random digit dialling would have introduced significant selection bias into the study.

The use of GPs' medical records and/or asthma registers to identify and approach eligible participants was also considered and rejected. This method would also have introduced selection bias because eligible children would not be identifiable and/or contactable if they: did not have a routine source of GP care, did not have a formal diagnosis of asthma on the clinical record, had out-of-date contact information on GP records and/or were not included on the GP's asthma register[29] . Furthermore, access to care may vary by ethnicity. If ethnic differences in access to care exist, any selection bias associated with these methods of identification and recruitment of eligible children would be differentially applied to Māori and Pacific groups.

4.3.2 Identification of eligible participants and enrolment into study

A list of random residential start points was obtained from the Department of Statistics[30]. The start points had been selected in proportion to the number of households in each census mesh block.

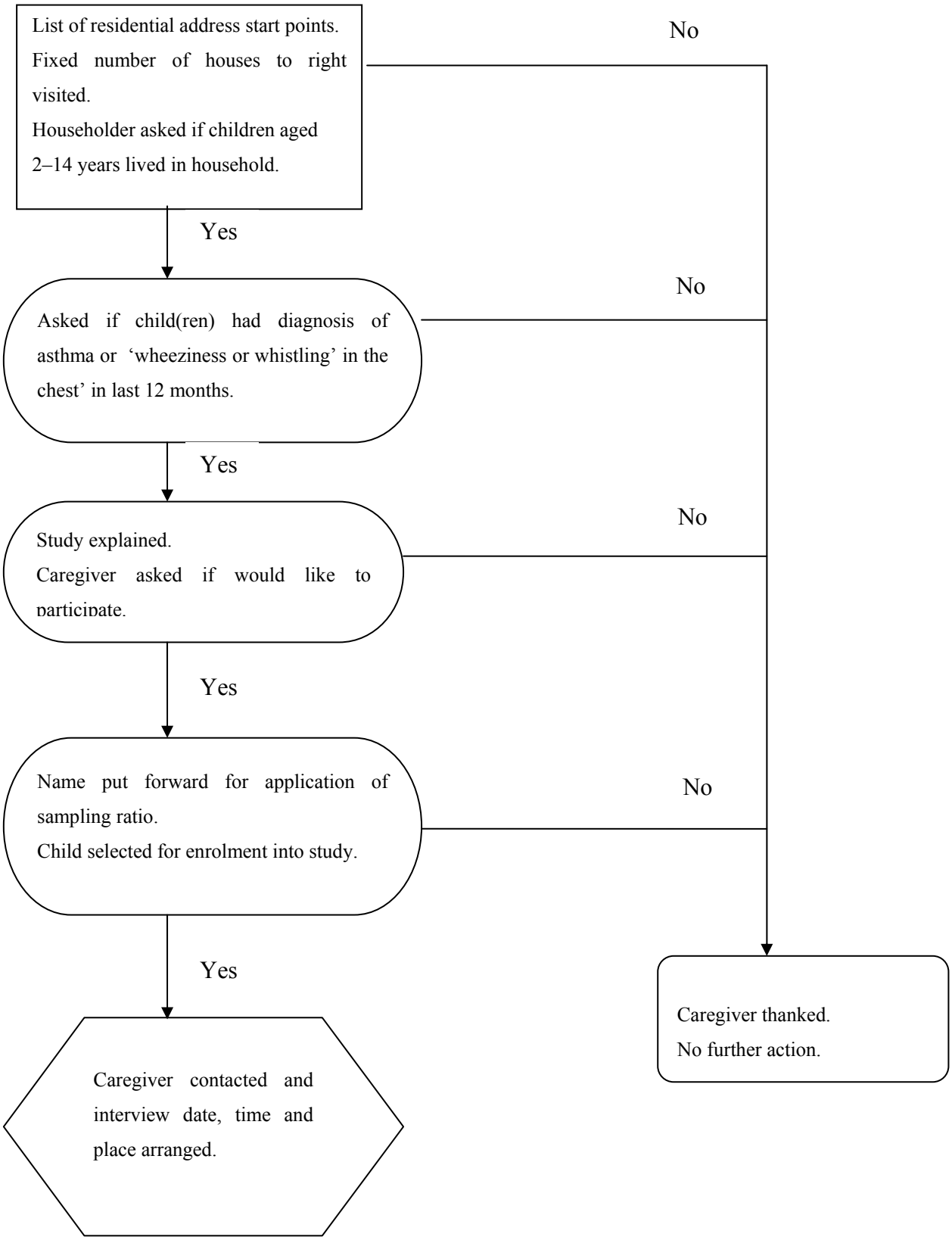
Figure 7 outlines the processes used in recruiting and enrolling participants in the study.

---

[29]A register is a list of patients with a particular condition (e.g. asthma), or requiring a particular service (such as immunisation, cervical screening). The register facilitates identification and proactive management of these subgroups.

[30]Now known as Statistics New Zealand.

Figure 7 Flow chart of recruitment and enrolment process



Recruiters approached a fixed number of dwellings from each start point and identified all eligible children. The procedures used by the recruiters are included in Appendix 5. For the first five months of recruitment ten houses per start point were visited. After the first five months the number of houses visited per start point was increased from ten to twenty[31]. The effect of this change was taken into account during data analysis.

If the recruiter was unable to talk with a member of the household on the first visit, a maximum of two further visits to the house were made in order to contact residents in all of the houses related to each start point. Return visits were made on different days and at different times of the day in order to maximise the likelihood of successful contact.

At all houses with eligible children, caregivers were provided with verbal information about the study, given the written participant information sheet, and were asked if they would like to participate. Caregivers were given one week to make a decision. Once caregivers agreed to participate, enrolment into the study was determined by the application of a sampling ratio.

A sampling ratio was utilised, as we wished to have equal numbers of Māori, Pacific, and Other ethnic group children enrolled into the study. SNZ prioritised ethnicity was used in developing the sampling ratios (see Section 4.6.1). The ratios were determined by census-derived estimates of: the number of eligible children in each ethnic group in the geographic area of the study; estimated family size; and the estimated asthma prevalence (see Section 4.4). The caregiver's of all eligible Pacific children were invited to participate. Caregivers of 60% of the eligible Māori children and 20% of the eligible Other children were enrolled into the study and offered an interview.

---

[31]Recruitment for this study was undertaken concurrently with another study that was recruiting children aged 6–23 months for a study about iron, vitamin A, and vitamin D. Recruitment for this study was slower than anticipated so there was a procedural change to increase the number of houses visited at each start point. As recruitment for both studies was occurring concurrently, the procedural change also applied to recruitment into the asthma study.

The sampling ratio was applied by the research coordinators using a table of random digits. Caregivers of children who were enrolled into the study through the application of the sampling ratio were contacted and arrangements made for the interview to be conducted (place, date and time). The caregivers of children who were not enrolled into the study were contacted, advised they had not been enrolled, and thanked for their participation to date.

If more than one child in a household was eligible for the study each eligible child was put forward and the sampling ratio was applied but only one child from each household was actually enrolled in the study (see section 4.4).

If houses contained more than one family, we planned to treat each family as an independent unit and allow up to one eligible child from each family to be enrolled into the study. However, none of the houses contained two or more families with eligible children.

The forms used during recruitment and enrolment are contained in Appendices 6 and 7.

4.3.3 Clustering and unequal probabilities of selection

This method of sampling resulted in a cluster effect associated with approaching houses around the residential address start point. The majority of start points (360) were associated with one enrolled participant. Of the remainder, 77 start points had two, 14 start points had three, three start points had four, and three start points had five enrolled participants.

Unequal probabilities of selection were associated with the number of eligible children in each household. Children from households that contained more than one eligible child had a lower probability of selection than children from households with a single eligible child. Most (550) children who completed the survey came from houses in which only one child was eligible for the study. One child came from a house where there were three eligible children and the remaining 32 children came from houses with two eligible children.

The effects of clustering and unequal probability of selection were taken into account during the data analysis.

4.4 Sample size calculations

In order to describe asthma management for children in the three ethnic groups, and to ascertain if there were ethnic disparities in asthma care, the sample had to contain a sufficient number of children within each ethnic group to allow reliable comparisons. In order to achieve this, we aimed to enrol an equal number of children in each ethnic group (equal explanatory power).

Based on the 1996 census it was estimated that there were about 158 440 children aged 2–14 years in the proposed study area, of whom 32 080 were Māori, 34 010 were of Pacific origin, and 92150 were of Other origin. At the time of undertaking the sample size calculations the ISAAC prevalence estimates of asthma symptoms were higher for Māori children (36% for 6–7 year olds and 28% in 13–14 year olds). Pacific children had the lowest rates for both 6–7 year olds (21%) and 13-14 year olds (19%)[32]. Because this study included children less than 6 years of age we adjusted the estimates of the prevalence of asthma symptoms to 25% in Māori, 20% in Other, and 15% in Pacific peoples.

As the management of asthma was likely to be similar for children in the same family, only one eligible child per family was to be enrolled. In the 1996 census the average number of children aged 0–14 years per family in the study area was 1.74 for Pacific families, 1.56 for Māori families, and 1.14 for Other families[33]. This figure excluded couple-only families (i.e. those without children).

The ranges of true differences between ethnic groups that could be detected with a sample size of 170 per group (510 children in total) with at least 80% power at the 0.05 significance level are presented in Table 9. The proportions were based on those found in Garrett et al. (1989) and Mitchell (1991). In order to achieve a final sample size of 510, and to allow for a

[32]Personal communication, A. Stewart, April 1998.

[33]Personal communication, P. O'Brien, Statistics New Zealand, 7 May 1998.

hypothesised non-completion rate of 20%, we aimed to enrol 204 Pacific, 204 Māori, and 204 Other children (612 children in total).

Table 9 Effect size and statistical power

	Pacific	Māori	Other	Power at 0.05 level of significance to detect a true difference of this size
Currently receiving preventive medicines *	4%	13%	25%	Pacific-Māori 85% Pacific-Other 81%
Have a crisis plan †	15%	40%	40%	Pacific-Māori 99%
Know which medicines are preventive ‡	30%	45%	70%	Pacific-Māori 82% Pacific-Other 99%

* percentages taken from Mitchell (1991)

† estimates presented here are based on but are more conservative than the measured effect in Garrett, Mulder & Wong-Toi (1989)

‡ Garrett, Mulder & Wong-Toi (1989)

These sample sizes assume a random sample. However the sampling frame involved both clustering (arising from the use of residential address start points) and weighting (based on the number of eligible children in each house). The effects of these design characteristics were taken into account during statistical analyses. The use of a different sampling ratio for each ethnic group resulted in children in different ethnic groups having unequal probabilities of selection. As the study was focused on ethnic differences in asthma management and did not aim to make prevalence or other estimates that were based on total population representativeness, adjustment for the unequal probability of selection associated with the use of different sampling ratios for each ethnic groups was not undertaken.

4.5 Data collection and quality control

This section describes the processes used to collect data, to code responses for entry into the study database, and to ensure quality control throughout the data collection and entry phase of the study.

4.5.1 Data collection

Data was collected through the administration of a structured questionnaire during a single face-to-face interview with the primary caregiver. The primary caregiver was defined as the one or two adults who were most responsible for the care[34] of the child.

A trained interviewer administered the questionnaire and recorded the participants' answers. The interviewers were matched to the ethnicity of the caregiver providing the information. For Pacific participants, efforts were made to match the interviewer with their specific Pacific ethnicity. However, this was not always possible. When this was not possible the interviewer was from another Pacific ethnic group. Bilingual interviewers were available for three[35] of the most numerous Pacific ethnic groups (Samoan, Tongan, and Niuean). Interpreters for Asian speaking participants were able to be arranged but were not required. The interview took 40–45 minutes to complete.

Participants nominated the site for the interview. All interviews were undertaken in the participant's home. At the completion of the interview participants were given a $20 food voucher in recognition of the time they had contributed to the study. Participants were not aware of the voucher prior to the completion of the interview.

When the interviewer arrived to conduct the interview they explained the study again, confirmed the caregiver's agreement to participate, and obtained written consent to participate prior to commencing the interview. The consent form is contained in Appendix 8.

---

[34]Care was defined as the provision and supervision of meals, clothing, sleeping arrangements, and other necessities.

[35]In the 1996 census the total Pacific ethnic group was 202 234 people. The four commonest Pacific ethnic groups were Samoan (101 755), Cook Island Māori (47 018), Tongan (31 390) and Niuean (18 475). General population.xls on Statistics New Zealand accessed 23rd October 2007.
http://www2.stats.govt.nz/domino/external/pasfull/pasfull.nsf/web/Standard+Tables+More+Census+96+counts+1996+Census+of+Population+and+Dwellings?open

We initially planned to undertake data collection between February 1999 and July 2000. Implementation of the study and staff recruitment took longer than anticipated, delaying the start of data collection. In addition, recruitment, particularly of Pacific participants, took longer than anticipated so the time period for data collection was extended. Data collection occurred over a two year period from June 1999.

4.5.2 Quality control

This section covers the quality control processes used during data collection, data coding, and data entry.

4.5.2.1 Standardisation of data collection

Several strategies were used to maximise the quality of the data collected and to reduce the risk of introducing interviewer bias. Standardisation of data collection was achieved by training the interviewers to ask each question as it was written in the questionnaire. The interviewers were trained to not make suggestions about answers to the questions. The interviewers were also trained in ways to respond to participant queries about the questions. At intermittent intervals completed questionnaires were reviewed by the author or research coordinator to assess the quality of the questionnaire completion and data recording.

4.5.2.2 Data coding

The questionnaires included coding information for each question. A separate coding manual contained each question and its responses, coding instructions, the field name of the variables associated with each question in the database, the area that each question addressed and, if the question had been sourced from a pre-existing instrument, the source of the question. The coding manual is contained in Appendix 9.

Data coding of completed questionnaires was undertaken by the research coordinators who then entered the data into two separate databases using EpiInfo software. Data coding and data entry were undertaken as each interview was completed. The two datasets were compared and discrepancies between the datasets were checked and corrected. The data were also checked for extreme or outlying values and the original completed questionnaire was

reviewed to confirm that the value was correct. Data cleaning was undertaken between June 2001 and February 2002.

4.6 The questionnaire

A structured questionnaire (Appendix 10) was developed by the author in conjunction with the co-investigators. Coding information for each question was included in the questionnaire and in a separate coding manual. Some questions had multiple response options. For these questions the participants were provided with a card containing the response options and were asked to tell the interviewer the response(s) that applied to them. The response cards are appended in Appendix 11.

Interviewers pre-tested the questionnaire on each other and on family members during their training. Training in the administration of the questionnaire and the pre-testing process ensured that the interviewers were familiar with the questionnaire, allowed interviewers to ask questions about the questionnaire and the interview process, and provided opportunities for the clarification of potential areas of misinterpretation.

Once interviews with the first twenty participants in each ethnic group were completed a meeting to discuss the questionnaire and the interview process was held to discuss any issues or problems that had arisen with use of the questionnaire in the field. No changes were made to the questionnaire or the interview process. As no changes were made to the questionnaire or interview process, data collected from these participants were included in data analysis.

One alteration was made to the response coding. Coding for the question that identified the main caregiver allowed only one person to be nominated. Interviewers reported that a small number of participants stated both parents were the main caregiver and equally divided the caregiving functions. Response coding and data entry were modified to allow two responses for this question. In total, 56 participants responded that both parents were the main caregiver. For the remaining participants only one person was nominated as the main caregiver. During data analysis the first nominated main caregiver was considered the 'main caregiver' and no further data analysis relating to the 'second' main caregiver was undertaken.

The use of medical record review to validate information obtained from the main caregiver was considered and rejected because:

- identifying all asthma-related medical records from the regular source of GP care, other GPs that had been consulted, after hours services, and emergency departments would be extremely difficult
- the cost of undertaking this exercise was prohibitive
- literature supported the use of parent reports (Hamman, Halil, & Holland, 1975; Mak, Johnston, Abbey, & Talamo, 1982; Pless & Pless, 1995; Speight, Lee, & Hey, 1983).

The questionnaire collected information about the following topics:

- ethnicity
- socio-demographic information about the child, main caregiver, other parent, and household
- asthma-related medication use and modes of delivery of medications
- asthma education
- asthma action plans[36]
- health service utilisation
- the caregiver's knowledge of asthma and its management.

Asthma morbidity, medication use, and asthma-related health service utilisation are influenced by the season of the year. Cross-sectional data is vulnerable to bias if data is collected from participants across different seasons. One strategy for managing this source of bias is to collect data relating to a 12 month period. In this thesis, data about health service utilisation and medications in the 12 months prior to the interview have been analysed and reported. In addition to minimising 'season of response' bias, the approach is consistent with the 12 month time period used for assessing asthma morbidity and the currency of asthma self-management plans. Twelve month recall of information about the number of visits for asthma has been shown to be accurate. In a Canadian study parents were asked how many asthma-related paediatrician visits had occurred in the previous 12 months (Pless & Pless,

[36]The terms 'self-management plan' and 'action plan' are synonymous.

1995). Validation using medical records demonstrated that parental reporting for asthma visits was in good agreement[37] in 91% of participants. Parental recall of the number of (all cause) hospitalisations in the child's life showed 84.6% good and 12.6% fair agreement[38] (Pless & Pless, 1995). Other studies (of adults) have reported high levels of agreement between self-report and medical records in relation to the diagnosis of asthma, particularly when patients were asked about physician diagnosed asthma (Harlow & Linet, 1989; Linet, Harlow, McLaughlin, & McCaffrey, 1989; Toren, Brisman, & Jarvholm, 1993).

Detailed information about questionnaire items relating to the determination of ethnicity, the outcome variables, and other variables is presented in Sections 4.6.1 to 4.6.4.

4.6.1 Ethnicity

Ethnicity is the major explanatory variable in this study. This section describes the determination of ethnicity at the time of recruitment and during the interview, and how ethnicity data was classified and used for analyses.

4.6.1.1 Determination of ethnicity at time of recruitment and enrolment

At the time of recruitment, the recruiting staff asked the householder the ethnicity of all the children living in the household. The recruiters carried the ethnicity question response card with them and asked householders the ethnicity question contained in the interview questionnaire. The recruiters recorded the caregivers' responses as Māori, Pacific, and/or Other ethnic groups. Multiple ethnic groups were documented where appropriate. Recruiting staff sent the completed recruitment forms to the research coordinators who then used random digits to apply the sampling ratio. If a child had more than one ethnic group the coordinators

[37]For asthma visits good agreement was defined as perfectly matching the information in medical records.

[38]For hospitalisations good agreement was defined as perfectly matching the information in medical records. Fair agreement was +/- 1 visit from that noted in medical records.

used the SNZ prioritisation process to assign each child to the Māori, Pacific, or NZE/Other ethnic groups. This classification was then used for the application of the sampling ratio.

Validation of ethnicity data obtained during recruitment has not been undertaken as the only possible method of validation was comparison of the recruitment and interview ethnicity data. However, interview ethnicity data is not available for children who were not enrolled into the study, meaning that validation of recruitment data for these children is not possible.

4.6.1.2 Determination of ethnicity during the interview

The project described in this thesis was designed in 1998. Three questions relating to ethnicity were included in the questionnaire. The 1991 census ethnicity question was used, but was modified slightly by adding 'your child' to the question. The answer options were also modified to include 'other' options as investigators wanted to have more detailed ethnicity information available.

The child's ethnic group(s) was identified by the caregiver. Identification of multiple ethnic groups was allowed. As the questionnaire was interviewer-administered the ethnicity question was read out to the participant. However, the caregiver was provided with a printed card containing the answer options and verbally identified the correct response(s) to the interviewer.

If the caregiver identified two or more ethnic groups they were asked 'Is there a group that your child belongs to most?' If the caregiver responded that there was, they were asked to identify the group using the same response card that was used for the initial determination of ethnic group(s).

The ethnicity question and response cards from the questionnaire are presented in Figure 8.

4.6.1.3 Classification and use of ethnicity in data analysis

At the time of the development of this project there was no documented protocol for the collection and use of ethnicity data in the health sector. SNZ had implemented ethnicity prioritisation by 1993 (Statistics New Zealand, 1993), although the use of this process was

still relatively uncommon in health research at the time this project was conceived and commenced.

Using the SNZ prioritisation system every person who identifies Māori as an ethnicity is assigned to the Māori ethnic group. Any person who nominates a Pacific ethnicity and does not nominate Māori is assigned to the Pacific ethnic group. All other participants, i.e. those who did not identify Māori or Pacific ethnicity, are assigned to the NZE/Other ethnic group. In this thesis this variable is referred to as the SNZ prioritised ethnicity.

The investigator team debated the use of ethnicity data in data analyses, particularly the use of SNZ prioritisation versus a caregiver nominated ethnicity. Elements discussed were:

- the appropriateness of prioritisation as outlined in Section 1.4.3 Ethnicity data in New Zealand
- whether people who indicate, for example, Māori ethnicity but prefer Other are systematically different in their experiences than those who are sole/prefer Māori, or have no preference (and the same for Pacific people)
- whether prioritisation would introduce misclassification bias if children were assigned to Māori or Pacific ethnic groups when their caregiver felt they had a stronger association with a different ethnic group
- that in the context of this project the health service's response to the mother and child was important and may be affected by the child's ethnicity as voiced or otherwise projected by the child or caregiver, or as perceived by service providers.

The caregiver prioritised ethnicity (CG prioritised) variable was developed from the initial ethnicity question and the subsequent questions about whether there was a stronger association with one of the ethnic groups. In this method children with a single identified ethnicity were assigned to that ethnic group. If more than one ethnicity was identified and the caregiver indicated a preferred ethnicity, the child was assigned to the caregiver's preferred ethnic group. If the caregiver had no preferred ethnicity or if data about preferred ethnic group was missing (three participants) the child was assigned according to SNZ prioritisation of the initial ethnicity question responses.

Figure 8 Ethnicity question from asthma questionnaire and answer options provided to caregiver

Ethnicity question from questionnaire	Answer options provided to caregiver on a response card
Which ethnic group or groups does your child belong to? *(Tick all that apply) Show card* New Zealand Maori ☐ (1) New Zealand European / Pakeha ☐ (2) Samoan ☐ (3) Cook Island Maori ☐ (4) Tongan ☐ (5) Niuean ☐ (6) Tokelauan ☐ (7) Fijian ☐ (8) Other Pacific Groups *Please Specify:*_____ ☐ (9) Other European *Please Specify:*_____ ☐ (10) Southast Asian ☐ (11) Other Asian *Please Specify:*_____ ☐ (12) Chinese ☐ (13) Indian ☐ (14) Other ethnic groups *Please Specify:*_____ ☐ (15) Don't know ☐ (16)	1: New Zealand Maori 2: New Zealand European / Pakeha 3: Samoan 4: Cook Island Maori 5: Tongan 6: Niuean 7: Tokelauan 8: Fijian 9: Other Pacific Groups 10: Other European 11: Southast Asian 12: Other Asian 13: Chinese 14: Indian 15: Other ethnic groups 16: Don't know

The variable CG prioritised ethnicity consists of three categories: Māori, Pacific, and Other. The Māori category contains all children with sole Māori ethnicity; children who have Māori ethnicity as the preferred ethnic group; and children who have Māori ethnicity and no preferred ethnic group.

The Pacific category contains all children who have sole Pacific ethnicity; children who have Pacific ethnicity as the preferred ethnic group; and children who have Pacific ethnicity, no preferred ethnic group, and do not have Māori ethnicity.

The Other ethnic group contains all children who have sole Other ethnicity; children who have Other ethnicity as the preferred ethnic group; and children who have Other ethnicity, no preferred ethnic group, and do not have Māori or Pacific ethnicity.

Table 10 presents information about the number of and preferred ethnic groups by SNZ prioritised ethnicity. Almost all (93.5%) Other and about two thirds (60.1%) of 'Pacific' caregivers identified a single ethnic group, whereas about one third (37.5%) of SNZ prioritised Māori participants were in the single ethnic group category.

One third of SNZ prioritised Māori who identified multiple ethnic groups had no preferred ethnicity, compared with 16.4% of Pacific and 4.0% of Other participants. About 15% of SNZ prioritised Māori preferred to be identified as Māori, 5.6% preferred Pacific, and 8.6% preferred the Other ethnic group.

On this basis, and in consideration of the ideological debates outlined above, the research investigators decided to use the caregiver prioritised ethnic group during data analyses. Sensitivity analyses for key outcome variables using the SNZ prioritised ethnicity have been undertaken and reported in the Results chapter (Chapter 5). The choice of ethnicity variable is also addressed in the Discussion (Chapter 6).

Table 10 Frequency distribution of the CG prioritised number of, and preferred, ethnic group variable by SNZ prioritised ethnic group (N=580)

CG prioritised ethnicity number of, and preferred, ethnic group	NZ Māori		SNZ Pacific		SNZ Other	
	n	%	n	%	n	%
>1 ethnic group and prefer Māori	34	14.7 10.1, 19.2	0	0	0	0
>1 ethnic group and prefer Pacific	13	5.6 2.7, 8.5	26	15.8 10.2, 21.5	0	0
>1 ethnic group and prefer Other	19	8.6 4.5, 12.8	11	7.7 3.0, 12.3	5	2.5 0.3, 4.7
>1 ethnic group and no preferred ethnic group	75	33.6 27.0, 40.2	30	16.4 11.0, 21.8	7	4.0 1.0, 7.1
1 ethnic group only	78	37.5 30.9, 44.1	105	60.1 52.6, 67.6	177	93.5 89.8, 97.2
Total	221	100	172	100	189	100
Missing preference data	2		1		0	

4.6.2 Outcome variables

The management of asthma in the primary care setting is the focus of this thesis. Asthma management refers to pharmacological management, the provision of asthma education, and the provision of self-management plans. This section describes the outcome variables used during the analyses of asthma management and the analyses of ethnic disparities in health service utilisation.

For the primary objectives of the study, outcome variables used to investigate pharmacological management were: inhaled β_2 agonist, inhaled anticholinergics, ICS, orals steroids, inhaled cromoglycates, and ketotifen use in the previous 12 months. Asthma education outcomes variables were: whether participants had received asthma education from a primary care health professional or not ('source of education'), and, among those who had received education from a primary care professional, whether the participant had received any

subsequent education ('further education'). Outcome variables relating to the provision of self-management plans were: 'had heard of self-management plans'; 'had ever been given a plan', and 'had a current plan'.

Outcome variables used to investigate the secondary (health service utilisation) objectives were: 'the number of visits for asthma-related GP care', 'high use of after hours medical care', 'high use of emergency departments', and the 'number of hospital admissions'.

The following sections describe the use of these outcome variables more fully.

A 12 month time frame was used for the variables relating to medications, the provision of action plans and health service utilisation. This time frame was used to minimise the effect of 'season of response' bias. Season of response bias may occur when participants are interviewed during different seasons of the year. Participants who are interviewed during times when asthma symptoms are more common (for example, winter) may recall symptoms and management more effectively because their symptoms are more common around the time of interview. Asking participants to recall the previous 12 months contributes to the management of this bias.

4.6.2.1 Outcome variables for the description of asthma management and the investigation of ethnic disparities in asthma management

The outcome variables described in this section relate to the primary objectives of the study, namely to:

- describe the use of medications, medication delivery systems, asthma education, and self-management plans in primary care for the three ethnic groups
- ascertain whether there were any ethnic disparities in the use of medications, medication delivery systems, asthma education, and self-management plans in primary care after controlling for differences in socio-economic position and other potential confounders.

Medication, asthma education, and asthma action plan outcome variables used to describe asthma management and assess ethnic differences in management are described in this section.

4.6.2.1.1 Asthma medication and modes of delivery of medicines

Response cards with pictures of all the asthma medications available at the time of data collection were given to the participant when they were being questioned about medications. The response cards were used to assist caregiver recall and improve the accuracy of the information obtained.

During data analysis each medication was categorised according to the type of medication. At the time the interviews were conducted leukotriene receptor antagonists (LTRA) were not available in NZ. The categories for medication type were inhaled β_2 agonist, inhaled anticholinergics, ICS, orals steroids, inhaled cromoglycates, and ketotifen. Binary yes/no variables for use of each medication type in the previous 12 months were developed and used in descriptive analyses.

Descriptive analyses of the types of medication delivery systems reported by participants were also undertaken. Binary variables for inhaler use, spacer use with inhaler, nebuliser use, and oral syrup medication use were developed and used in descriptive analyses.

Two medication variables were used as outcome variables in logistic regression analyses: 'ICS in the previous 12 months' and 'oral steroid use in the previous 12 months'.

4.6.2.1.2 Asthma education

Participants reported the sources that had initially provided them with information about asthma. The reported sources were categorised into: lay sources (family, friends or self education); primary care health professionals (GPs, practice nurses, and community-based district, public health, and Plunket nurses) and secondary care health professionals (hospital staff, asthma educators, and the Asthma Society). Asthma educators were included in secondary care because at the time of the study asthma educators worked in the hospital environment.

Descriptive analyses of the data about methods of asthma education, topics covered, and the participants' assessments of the comprehensibility, amount, and usefulness of initial asthma

education were restricted to participants who had received education from a primary care source. That is, participants who had only received education from a secondary care health professional (25 participants) or from a lay source (87 participants) were excluded from these analyses. Participants (178) who had received education from primary and secondary care sources were included in the primary care health professional education group. Analyses of data about the provision of subsequent education were also restricted to the subgroup that had received initial education from a primary care health professional.

Data about the comprehensibility of initial asthma education were recoded into two categories: 'clear, easily understood' and 'some/most things unclear, not understood'. The amount of information provided during the initial education session was categorised as 'too little', 'enough' and 'too much'. Responses to the question about usefulness were recoded into two categories: 'very useful' and 'some use/not very/not useful'.

Two outcome variables were used in multivariable analyses. The primary outcome variable was a binary categorical variable that classified education as having been from a lay source or a primary care health professional. The participants who had only received education in secondary care were excluded. The second outcome variable was restricted to participants who had received education from a primary care health professional, and categorised participants according to whether they had received any further asthma education.

4.6.2.1.3 Asthma action plans

Participants were asked if they had heard of action plans, ever been given an action plan, and (if they had been given one) whether the plan had been updated in the previous 12 months. A composite variable, 'has a current action plan', was created. Action plans were deemed to be current if they had been supplied or updated in the previous 12 months. Participants who had never been given an action plan were classified as not having a current action plan.

Data about the caregiver's experiences, perceptions, and use of asthma action plans was collected. Descriptive analyses of these data were restricted to participants who had been given an action plan. Information about the comprehensibility of the initial explanation of action plans was recoded into binary form ('explanation clear, easily understood' and 'some/most information not understood'). The amount of information provided when the

plan was initially explained was categorised as 'too little', 'enough' and 'too much'. The caregivers' perception of the usefulness of the initial plan was re-categorised into binary form ('very useful' and 'some use/not very/not useful'). Similarly the caregiver's use of the initial plan was re-categorised into 'all/most of the time' and 'sometimes/hardly ever/never'.

Multivariable analyses for the following outcome variables were undertaken: 'has heard about action plans', 'ever given an action plan', and 'has a current action plan'.

4.6.2.1.4 PEFR meters

During the development of the questionnaire the investigators considered including questions about PEFR meters use. However, these questions were not included because previous work suggested PEFR meters were of limited usefulness and acceptability to people with asthma in clinical settings (New Zealand Guidelines Group, 2002). In addition, the draft questionnaire was lengthy and removing these questions addressed this issue.

4.6.2.2 Outcome variables used to assess health service utilisation and ethnic differences in health service utilisation

The outcome variables described in this section relate to the secondary objectives of the study, namely to:

- describe the asthma-related utilisation of GP, after hours medical care, emergency departments, and hospital admissions among children with asthma
- ascertain whether differences in medication use, the provision of asthma education, and the provision of self-management plans explained ethnic differences in health service utilisation.

Data about the utilisation of GP services, after hours doctors, Accident and Medical clinics (A&M), emergency departments, and hospital admissions in the previous 12 months were collected. As noted previously, a 'previous 12 months' timeframe was used to minimise season of response bias.

4.6.2.2.1 GP services

Data about the use of the routine source of GP care and 'other GPs' were integrated to ascertain the overall use of GP services for routine and acute asthma care. Questions about acute and routine asthma care were worded in such a way as to minimise caregiver confusion between the two different types of care.

In descriptive analyses these data are presented as the mean number of visits in the previous 12 months for acute care, routine care, and both types of care combined. The variables for the number of GP visits were not normally distributed. Log transformation of these variables was undertaken and the log transformed variables used to calculate the mean number of visits. The results of the log transformed analyses were then back transformed and are reported in Chapter 5 (Results).

A variable indicating whether the child had been a high user of GP services was developed. High use of GP services was defined as six or more visits to a GP for acute or routine asthma care in the previous 12 months. This definition was taken from the 1996/97 New Zealand Health Survey which defined high use of GP services as six or more visits per annum (Ministry of Health, 1999).

Multivariable analysis was used to determine whether there were ethnic differences in the number of GP visits (routine and acute care combined). Multivariable analyses for the outcomes 'number of GP visits for acute care' and 'number of GP visits for routine care' were not undertaken. The log transformed 'number of acute and routine visits in previous 12 months' was used as the outcome in the multivariable analysis.

4.6.2.2.2 Use of after hours doctors and Accident and Medical Centres (After hours medical care)

Caregivers reported the number of visits to after hours doctors and A&M clinics for acute and routine asthma care in the previous 12 months. This information was combined to provide an estimate of the total number of visits for after hours medical care (AHMC) in the previous 12 months. In descriptive analysis these data are presented as the mean number of AHMC visits in the previous 12 months. The 'number of AHMC visits' variable was not normally distributed. Log transformation of the variable was undertaken and the log transformed

variable used to calculate the mean number of visits. The result of the log transformed analysis was then back transformed and is reported in Chapter 5 (Results).

A variable indicating whether the child had been a high user of AHMC was developed. High use was defined as more than one visit in the previous 12 months.

'High use of AHMC' was used as the outcome variable for the multivariable analysis undertaken to determine whether there were ethnic differences in AHMC utilisation. This variable was used because 'high use' was deemed to be more important clinically, and for the examination of ethnic differences.

4.6.2.2.3 Visits to hospital emergency departments

Asthma-related visits to hospital emergency departments (EDs) for acute and routine asthma care in the previous 12 months were reported by caregivers. This information was combined to provide an estimate of the total number of visits to EDs in the previous 12 months. In descriptive analysis these data are presented as the mean number of ED visits in the previous 12 months. The 'number of ED visits' variable was not normally distributed. Log transformation of the variable was undertaken and the log transformed variable used to calculate the mean number of visits. The result of the log transformed analysis was then back transformed and is reported in Chapter 5 (Results).

A variable indicating whether the child had been a high user of EDs was developed. High use of EDs was defined as one or more visits in the previous 12 months (Mitchell et al., 1997).

'High use of EDs' was used as the outcome variable for the multivariable analysis undertaken to determine whether there were ethnic differences in ED utilisation. This variable was used because 'high use' was deemed to be more important clinically, and for the examination of ethnic differences.

4.6.2.2.4 Hospital admissions in the previous 12 months

Information about the number of asthma-related hospital admissions in the previous 12 months was collected. In descriptive analysis these data are presented as the mean number of

admissions in the previous 12 months. The 'number of admissions' variable was not normally distributed. Log transformation of the variable was undertaken and the log transformed variable used to calculate the mean number of admissions. The result of the log transformed analysis was then back transformed and is reported in Chapter 5 (Results).

Experiencing one or more admissions in a 12 month period is considered a marker of high health need (Mitchell et al., 1997; Scottish Intercollegiate Guideline Network, 2003). A variable indicating whether the child had experienced one or more admissions in the previous year was developed. This variable was used as the outcome variable for the multivariable analysis undertaken to determine whether there were ethnic differences in admissions. This variable was used because it was deemed to be more important clinically, and for the examination of ethnic differences.

4.6.3 Other variables

This section describes the collection of information about other variables included in the study. These include demographic, caregiver-related and family factors, socio-economic position, and caregiver's asthma knowledge. The collection of morbidity data is also described. The results of descriptive analyses of these variables are presented in Chapter 5 (Results). Where appropriate, these variables have been included in multivariable modelling. The process used for constructing the multivariable models is described in Section 4.9.

4.6.3.1 Potential confounding variables

Nine factors were theorised a priori to be potential confounding factors and it was planned to include these variables in multivariable analyses. These factors were: age; sex; parental history of asthma; sibling history of asthma; having a routine source of GP care; and four measures of SEP.

Data was collected on the age of the child at the time of interview and the sex of the child. Parental and sibling history of asthma were included as potential confounders, as the occurrence of asthma in a parent or sibling may influence factors such as the caregiver's asthma knowledge, management of asthma, and health service utilisation. These two variables were included separately, as the correlation between these two variables was low.

Information about use of a routine source of GP care was collected and this data was included as a potential confounding variable because having a routine source of care is a key determinant of high quality primary care (Global Initiative for Asthma, 2005; Paediatric Society of New Zealand, 2005; Starfield, 1998). The 'regular source of GP care' variables has two levels: 'has a regular source of care that is used all the time' and 'no regular source of care or has regular source of care and also uses other GPs'.

Many factors influence SEP and there is no single tool or measure that is able to adequately and comprehensively quantify SEP. Measures of SEP may be assigned at individual, group or geographic area levels. This study has used four measures that examine different aspects of SEP:

- two individual level (total gross household income and the main caregiver's education level)
- one group level (New Zealand Socio-economic Index of Occupational Status[39])
- one small area level measure (1996 New Zealand Index of Deprivation decile).

Total gross household income was determined by asking, 'What is the total income for your household from all sources (wages and benefits), before tax or anything was taken out of it, in the last 12 months?' Participants were shown a card with six income bands of varying sizes and were asked to identify their household's income band (see Appendices 10 and 11). The use of income bands may increase the accuracy of income data, particularly if the informant has a general idea of the income but does not know the exact amount. In this study the use of unequal bands meant that the variable was categorical rather than interval or continuous. During data cleaning and exploratory analysis two difficulties with the original variable became apparent. Firstly, the bands did not allow sufficient differentiation of income at the upper end of the range, and secondly the cell sizes of some of the levels in the original variable were small. To address these issues, the variable was re-coded to ≤$40 000 or >$40

[39]The occupation of the main income earner in the household is used to assign socio-economic status.

000 per annum. This categorisation was consistent with the median gross household income for households with children in the year 2000, which was $42 900[40]. Approximately half of the participants were in each category. This binary variable was used for analyses.

The education level of the main caregiver, rather than the highest education level of either parent/caregiver[41], was used. The rationale for this decision was that the education of the main caregiver not only reflected SEP but was also likely to influence the caregiver's interactions with the health system and the child's asthma care. The main caregiver's highest education level was categorised into primary/intermediate school, secondary school, and tertiary education. Tertiary education included completed courses at technical institutes, teacher's training college, and universities.

Occupational status of the main income earner was classified using the New Zealand Socio-economic Index of Occupational Status 1996 (NZSEI) (Davis, McLeod, Ransom, & Ongley, 1997). This index has six socio-economic groups based on the occupation of the main income earner in the household. The scores for each occupation were developed from 1996 census data. Thus, the index is a group measure rather than an individual measure. Group one contains occupations with the highest socio-economic position and group six consists of occupations with the lowest SEP. The NZSEI does not include students and people who are not in the workforce – an important limitation. Galbraith et al. (2003) suggests that students are either coded according to the occupation of a family reference person, classified separately, or are included in a 'not in the labour force' category. Six participants were the main income earner and stated their occupation was student. Using a 'family reference person' was not possible, as these respondents were the main income earners and would be the hypothesised reference person. Making a separate 'student' category was not feasible, as only six participants were in this category. A 'not in the labour force' category was developed that included students and participants whose income was derived from

[40]Source Statistics New Zealand. New Zealand Income Survey 2000. Personal communication Ann Ball, Statistics New Zealand, 12 March 2003.

[41]Where both parents lived in the household.

government income support benefits such as domestic purposes benefit, sickness benefit, and unemployment benefit.

The New Zealand Index of Deprivation 1996 (NZDep96) is a small-area measure that was used in order to capture effects arising from the neighbourhood deprivation conditions. The NZDep96 is derived from data in the 1996 Census of Populations and Dwellings[42]. Each census mesh block (approximately 80 households) is assigned to a NZDep96 decile that reflects the level of deprivation in the mesh block area (Salmond, Crampton, & Sutton, 1998). The NZDep96 decile was obtained for each participant's residential address. During preliminary data analysis use of all ten deciles was problematic as some cells had very low counts. Therefore, the decile variable was grouped into two levels: deciles one to seven, and eight to ten. This grouping gave approximately half of the total Māori population in each level (Reid, Robson, & Jones, 2000).

As exploratory analysis of the data found that the correlation between these four variables was low (correlation coefficients 0.1 – 0.4), all four variables were included in analyses.

4.6.3.2 Other socio-demographic variables

Two other socio-demographic variables were considered. Information about the child's country of birth was collected. The country of birth variable was converted into binary form – born or not born in an English speaking country – because cell sizes were too small if more categories were used. Data was also collected about the language spoken in the home. The associations between these two variables and each outcome were examined and if a significant association was observed, the variable was included in multivariable analysis for that outcome.

---

[42]The nine factors derived from the census and used in the development of the index were: people with no access to a telephone; people aged 18–59 receiving a means tested benefit; people aged 18–59 unemployed; people living in households with equivalised income below an income threshold; people with no access to a car; people aged <60 living in a single parent family; people aged 18–59 without any qualifications; people not living in own home; and people living in households below equivalised bedroom occupancy threshold.

4.6.3.3 Caregiver's asthma knowledge

Differences in caregiver's asthma knowledge could contribute to ethnic differences in health service utilisation. In addition, these differences may arise as a result of differences in the asthma education people have received. The caregiver's knowledge about asthma, competency in managing their child's asthma and asthma self-efficacy were assessed.

4.6.3.3.1 Caregiver's asthma knowledge

Knowledge about four areas of asthma knowledge (symptoms, pathophysiology, general asthma knowledge, and exacerbating factors) was assessed using questions that had been developed and used in NZ. Details of the questions and scoring were provided by Prof. H Rea[43]. Each topic contained a number of items that were answered in yes/no or true/false formats. Exacerbating factor knowledge was assessed using six items. Five items were used in each of the other three areas. For each item a correct answer scored one and an incorrect answer scored zero. The number of correctly answered items was summed to provide an overall score for that knowledge area. The scores for each area were included separately in descriptive and multivariable analyses. The data for the four asthma knowledge scores were not normally distributed. Descriptive analyses that examined the median, range, and interquartile range were undertaken.

Medication knowledge was assessed by asking which of the child's medication(s) were used for immediate relief of wheezing. Responses were categorised according to whether the caregiver was able to correctly identify all of the child's reliever medications or not.

4.6.3.3.2 Asthma self-management competency

Caregiver competency at managing their child's asthma was assessed using an asthma management scenario that had been developed and tested in NZ (Taylor et al., 1991). The

[43]Prof. H Rea, personal communication 15th March 1999.

original tool was developed to measure the self-management behaviour of families whose child(ren) had asthma and was tested on the caregivers of children aged 5–11 years who had been identified in schools, through their GP or when admitted to hospital for asthma. Testing found that the tool had good inter-rater reliability, inter-rater agreement, and test-retest reliability. Furthermore, patients who were identified by their physicians as 'very good' and 'very bad' managers of asthma had, respectively, high and low scores for the scenarios (Taylor et al., 1991). The scenario tool had been used in other studies (Garrett et al., 1994; Matthews, Dickinson, & Cram, 1998).

The original tool consists of three scenarios that describe three different asthma episodes – exercise-induced asthma, a severe precipitous attack and asthma that develops during an upper respiratory tract infection. Each scenario has a number of parts. At the end of each part caregivers are asked how they have responded to this situation in the past (or how they would respond if they have not experienced the situation previously). Responses are scored using a standardised scoring schedule. (Taylor et al., 1991)

In the current study pragmatic considerations about the length of the questionnaire led to a decision to include only one of the scenarios. The scenario about asthma associated with an upper respiratory tract infection was chosen, as the investigators believed the majority of caregivers would have faced this situation whereas fewer were likely to have experienced managing exercise-induced asthma or a severe precipitous attack.

Caregiver responses to the asthma management scenario were scored by the author of this thesis using the standardised scoring schedule. The maximum possible score was 15. The data were normally distributed.

4.6.3.3.3 Parental confidence managing asthma

Towns (1993) developed a self-efficacy (confidence managing asthma) scale for parents of children aged 11 to 18 years with asthma. In Towns' work three questions[44] were scored on a ten point scale ('not at all certain' – 'completely certain'). This scale has also been used by Matthews during work piloting a self-management programme for families with preschool children who had asthma (Matthews, Dickinson, & Cram, 1998).

As the current study involved children aged 2–14 years for whom the caregiver would have a more active role in managing asthma, the questions were modified by substituting, 'How certain are you that your child can…' with, 'How certain are you that you can…'.

Parents were provided with a response card illustrating a five point visual analogue scale ('not at all certain' – 'completely certain') and asked to indicate their response to the question. The responses to the questions were summed to provide an overall 'parental confidence score' with a maximum possible score of 15. The data were not normally distributed. Descriptive analyses that examined the median, range, and interquartile range were undertaken.

4.6.3.4 Medication, asthma education, and action plan variables

Some asthma management variables were included in multivariable analyses that examined health service utilisation, and ethnic differences in utilisation. The variables were: received ICS in the previous 12 months, received oral steroids in the previous 12 months, has a current action plan, and the source of asthma education. Further details about these variables are contained in Section 4.6.2.1 (Outcome variables for the description of asthma management and the investigation of ethnic disparities in asthma management).

---

[44]How certain are you that your child can recognise the signs of an asthma attack?
How certain are you that your child can prevent an asthma attack?
How certain are you that your child can control an asthma attack?

4.6.4 Asthma morbidity

Asthma is an ambulatory care sensitive condition. The majority of asthma morbidity is preventable with high quality asthma care, asthma morbidity is largely the consequence of inadequate care and morbidity is, therefore, situated on the causal pathway rather than a confounder. For this reason, morbidity is not included as a confounder in multivariable analyses. However, morbidity does influence treatment recommendations, especially for preventative medication use. In order to examine the impact of morbidity on outcomes, sensitivity analyses that included morbidity in the multivariable models for the major outcomes were undertaken.

In 1997 Mitchell et al. proposed a number of new measures of asthma morbidity, compared them with traditional measures, and developed a new tool for measuring asthma morbidity over the previous 12 months. The traditional measures were: admission to hospital, ambulance use, Emergency Department visits, GP utilisation, and use of after hours clinics. The new tool consisted of four questions that rated the severity of the child's asthma in general, and determined how often asthma had stopped the child's and family's activities, and frightened the caregiver. Scoring of the responses resulted in a 5 point composite scale of morbidity, with very mild scoring 0 and very severe scoring 4. The composite score obtained using the new tool was significantly correlated with the composite score derived from the traditional measures of morbidity (Mitchell et al., 1997). In the current study the new tool was used to measure morbidity.

4.7 Ethics approval

Ethics approval was obtained from the University of Auckland Human Subjects Ethics Committee (1999/018).

4.8 Organisation of study and staff

This section describes the study staff, staff training, consultation, and meetings that were held prior to the implementation of the study, and the dissemination of study results that has occurred to date.

4.8.1 Staff

The author was the principal investigator of the study and was responsible for: developing the research questions; identifying co-investigators; developing the study design; writing the grant application; developing the questionnaire and the protocols, coding and training manuals, and the data entry program; obtaining ethics approval; appointing and training staff; overseeing the data collection phase; and undertaking data analysis and interpretation.

Three co-investigators were involved in the study – Dr Colin Tukuitonga, Associate Professor Cameron Grant, and Ms Elizabeth Robinson. The research team met regularly over the course of the study. Specific expertise that the co-investigators brought to the study were: GP and Pacific ethnicity and culture expertise; paediatrics expertise; and biostatistics expertise. My co-investigators reviewed drafts of the grant application, questionnaire, ethics application, and protocols used with project staff. Ms E. Robinson provided advice about data analysis; however, I planned and undertook all analyses myself.

Funding was provided for a study coordinator, a team of recruiters, and a team of interviewers. The study coordinator position was shared by two people who each worked half time. The study coordinators were responsible for recruiting other staff, developed the forms used by recruiting staff, coordinated the day to day running of the project, data coding, data entry, comparison of the two databases, and clarification of any discrepancies. The coordinators also reviewed the questionnaire during its development. The author was available to the coordinators to discuss any issues that arose.

The recruitment and interview staff were from a variety of ethnic backgrounds and spoke a range of languages (see Section 4.5 Data collection and quality control for more information).

4.8.2 Staff training

The people employed as research coordinators had worked together as research coordinators on a number of research projects in the past. The author provided training to the coordinators about the participant recruitment and enrolment processes, data coding, and the data entry program developed for this study.

The author developed a training manual that briefly outlined the study and provided detailed information about selection of the study sample, recruitment processes and procedures, and processes for arranging and undertaking interviews. The manual is appended in Appendix 5. A copy of the questionnaire was included in the training manual. Training sessions were held with recruitment and interview staff. All information in the training manual was covered and considerable time was spent training interviewers in the administration of the questionnaire. Further information about staff training for recruiters and interviewers is contained in Sections 4.5 (Data collection and quality control) and 4.6 (The questionnaire).

4.8.3 Consultation and meetings

The author and the research coordinators were available to recruitment and interview staff throughout data collection. Meetings of investigators and research team staff were held throughout the study. While the author was undertaking a Harkness Fellowship in Health Care Policy in the USA from August 1999–2000 a co-investigator was available to research team staff, and the author remained available by telephone and email. Recruitment and data collection had been established and was proceeding well prior to the author's departure and no major problems arose while the author was based in the USA.

Consultation with various interest groups including Māori, Pacific peoples, and organisations with an interest in child health were undertaken prior to the implementation of the study.

An advisory board consisting of representatives from child health agencies and the Māori, Pacific, and Asian communities was established and met regularly during the implementation of the study and data collection. The role of the board was to provide advice to the investigators about any issues that may arise during the implementation of the study and to act as sources of information about the study within their communities.

4.8.4 Dissemination of results

The results of this study have been presented at a wide array of fora including:

- GP peer review group meetings in Auckland
- PHO continuing medical education meetings in Auckland
- seminars at the School of Population Health, University of Auckland

- national conferences of medical professional bodies (public health, paediatrics, and Te ORA (the national Māori Medical Practitioner's Association)
- the national Māori asthma hui (meeting)
- international conferences (the Pacific Region Indigenous Doctors Conference and International Network for Indigenous Health Knowledge and Development).

One paper, based on the critical appraisal of the literature chapter, is currently being reviewed for publication in Epidemiologic Reviews 2009. Three other papers addressing the findings in relation to pharmacological management (drugs and delivery devices), asthma self-management (education, action plans, and knowledge), and the contribution of ethnic disparities in management to health service utilisation are in the late stages of preparation. A fifth paper that examines the effect of the two different methods of classifying ethnicity on demographic, asthma management, and health service utilisation outcomes is planned.

4.9 Data analysis

Data analysis was undertaken using SUDAAN (Version 7.5.6; Research Triangle Institute) for the calculation of chi-square statistics and SAS (Version 8.0 SAS Institute Inc., Cary, NC, USA) for all other analyses. However, the next version of SAS had the capacity to analyse datasets that required weighting and adjustment for cluster effects so all analyses were repeated using SAS (Version 9.1; SAS Institute Inc., Cary, NC, USA) and these results are presented in this thesis.

Exploratory analyses of the data were undertaken first. This was followed by descriptive analysis, by ethnicity, for the outcome, potential confounding and other variables. For asthma management and health service utilisation outcomes descriptive and multivariable analyses were undertaken. The processes used for these analyses are described below.

4.9.1 Exploratory analyses.

Exploratory analyses of the data included:

- examining the distribution of responses for variables in order to assess whether data was normally distributed
- testing correlations between variables that examined similar concepts

- assessing the distribution of data across response levels.

The results of these analyses were used to inform subsequent analyses. For example, variables that were not normally distributed were transformed using log transformation; where two variables were highly correlated, one was chosen for inclusion in analyses; and some variables were re-categorised.

4.9.2 Descriptive analyses by ethnicity

Descriptive data analyses included frequency distributions, calculation of mean values, and comparison of data across ethnic groups. Comparison across ethnic groups involved chi-square analysis for categorical variables, analysis of variance for normally distributed or log transformed continuous variables, and the calculation of median, range, and interquartile ranges for non-normally distributed ordinal variables. Statistical tests of significance to assess whether the distribution of the outcome variable differed by ethnicity were undertaken for the ethnicity variable as a whole. That is, individual tests of significance for Māori versus Other, Pacific versus Other, and Māori versus Pacific differences were not undertaken.

4.9.3 Multivariable analyses

Logistic regression modelling was used for categorical outcome variables and linear regression modelling was employed for the continuous variable.

Ethnicity was the main explanatory variable in all models. Potential confounders were age, sex, household income, NZDep96 decile, occupational class, caregiver's education level, use of a routine source of GP care, parental history of asthma, and sibling history of asthma.

In relation to the primary objectives of the study, multivariable models were developed for seven asthma management outcome variables: 'inhaled corticosteroids in the previous 12 months', 'oral steroids in the previous 12 months', 'had asthma education from a primary care health professional', 'had received further asthma education', 'had heard of action plans', 'had ever received an action plan', and 'has a current action plan'. Multivariable modelling for outcomes relating to the secondary objectives of the study were developed for 'number of GP visits', 'high use of AHMC', 'high use of EDs', and 'hospital admissions'.

Two models were developed for each outcome. Ethnicity was the only explanatory variable in the first model. In the second model ethnicity was entered first followed by the group of potential confounding variables and, where relevant, other variables with significant associations with the outcome. The potential confounding and other variables were added according to the strength of their association with the outcome variable, with stronger associations preceding weaker ones.

This modelling was undertaken for all outcomes, including those that did not exhibit a significant association with ethnicity in descriptive analyses. For outcomes that were not significantly associated with ethnicity in descriptive analyses, multivariable modelling incorporating ethnicity and potential confounders was undertaken to assess whether the outcomes for the Māori and Pacific groups (in relation to the Other ethnic group) differed, even though the overall effect of ethnicity had not been statistically significant.

In the reporting of results, p values are reported to a maximum of two significant figures. Odds ratios and regression coefficients are reported to two decimal places.

Testing for effect modification was undertaken for the asthma management outcome variables. These analyses investigated whether the effect of ethnicity was modified by use of a routine source of care. That is, whether asthma management varied by ethnicity within each type of 'routine source of care' ('always uses routine source of care' and 'no routine source of care/has a routine source of care and uses other GPs').

This chapter has described the methods used to collect and analyse data for this study. The following chapter documents the findings of this study.

Chapter 5 Results

This chapter presents the results of the study. There are six sections within this chapter. Section 5.1 provides information about the sampling frame, completion of the study, and a comparison of participants who completed the study with those that did not.

Results obtained from participants who completed the study are presented in Sections 5.2 to 5.5. Descriptive analyses, by ethnicity, of socio-demographic factors, morbidity, health service utilisation, pharmacological management, and asthma self-management are presented in Section 5.2. Section 5.3 describes the results of multivariable analyses that assess whether ethnicity is independently associated with pharmacological management and self-management outcomes. Section 5.4 examines the contribution of asthma management practices to ethnic differences in health service utilisation. Section 5.5 presents the results of sensitivity analyses using the SNZ prioritised ethnicity variable rather than the CG prioritised variable, and Section 5.6 contains the results of sensitivity analyses that include morbidity as a variable in the models.

As discussed in the Methods chapter (section 4.6.1), ethnicity data was collected at two points in this study: during the identification of eligible children in the recruitment phase, and during the interview. Two methods of assigning ethnicity were available for children who completed the interview: assignment using the SNZ method for prioritising ethnicity data[45] (SNZ prioritised), and assignment using the caregiver's preference for the child's ethnic group ('caregiver prioritised ethnicity'; CG prioritised). Table 10 in Section 4.6.1 compares the distribution of ethnicity using the two different methods ('CG prioritised' and 'SNZ prioritised') of assigning ethnicity.

CG prioritised ethnicity is not available for children who were eligible for the study but not enrolled. Nor is it available for children who were enrolled but did not complete the interview. Consequently, information about the sampling frame, enrolment, and completion

[45]See pages 17 and 119 for further information about the Statistics New Zealand ethnicity data prioritisation process.

of the study that is presented in Section 5.1 uses SNZ prioritised ethnicity data. The data in this section has not been adjusted for the cluster effect in the study design, nor weighted to adjust for the number of eligible children in each household.

Data analyses reported in Section 5.2 to Section 5.4 use CG prioritised ethnicity as the ethnicity variable. The ethnicity data sensitivity analyses use both CG prioritised and SNZ prioritised ethnicity (Section 5.5). The sensitivity analyses that include morbidity as a potential confounding variable use the CG prioritised ethnicity variable (Section 5.6).

The majority of analyses presented in Sections 5.2 to 5.6 are adjusted for the cluster effect in the study design and weighted to adjust for the unequal probability of selection in households where there was more than one eligible child. The exceptions are the analyses of asthma knowledge scores and parental confidence data (median, range, and interquartile ranges), which are not adjusted for these effects because the statistical software could not perform these analyses while simultaneously adjusting for clustering and the unequal probability of selection.

5.1 Sampling information, completion information, and comparison of participants who completed the study with those that did not complete the study

Table 11 through Table 13 provide information about the sample composition, reasons for non-completion of the interview, and comparison of available socio-demographic data by completion status.

Table 11 contains information about sample composition during recruitment, enrolment, and at the completion of the study. A total of 2 113 start points were used to identify 1 034 eligible children: 31.9% Māori, 18.9% Pacific, and 49.2% Other ethnic groups.

After application of the sampling ratio, 649 children were enrolled into the study and offered an interview. Māori children made up 37.1% of this group, with Pacific children accounting for a further 30.1%, and Other children for the remaining 32.8% of the group (Table 11).

Sixty-four children who had been enrolled into the study did not complete the interview. The final sample size was 583 children. Using SNZ prioritisation the completion rates were: Māori 92.1%, Pacific 88.7%, and Other ethnic group 89.2% (Table 11).

After the completion of the study, two children (one from the Māori and one from the Other ethnic group) were found to be outside the age range of the study and were excluded from data analysis (Table 11).

Table 12 presents the reasons for non-completion of the interview. Most (70.3%) had changed their minds and no longer wanted to participate. A further 14.1% were not able to be contacted to arrange an interview time, 9.4% had moved or were about to move from the neighbourhood, and 6.2% were found to be ineligible.

Table 13 contains the available socio-demographic information for enrolled participants who did and who did not complete the study. There were no significant differences in either the distribution of SNZ prioritised ethnicity or the distribution of NZDep96 decile groups among completers and non-completers. The mean age of those who were enrolled into the study but did not complete the interview was significantly lower (8.71 years) than that of those who did complete (9.80 years; p=0.009). Note that the mean age of 'completers' is higher than the 'mean age at interview' presented in Section 5.2.2. For the comparison between completers and non-completers the date on which ages were calculated was the date the analysis was run, whereas the age used in Section 5.2.2 is the age on the date of interview.

The final sample sizes using each ethnicity variable are presented in Table 14. In total, 583 participants completed the interview. Within the CG prioritised ethnicity variable 32.6% were Māori, 29.7% were Pacific, and 37.8% were the Other ethnic group. Within the SNZ prioritised ethnicity variable 37.9% were Māori, 29.8% were Pacific, and 32.3% were the Other ethnic group.

Table 11 Composition of sample population by SNZ ethnicity*

	Māori		Pacific		Other		Total	
	n	%	n	%	n	%	n	%
Number of children identified as eligible	330	31.9	195	18.9	509	49.2	1034	100
Number enrolled into study by applying sampling ratio	241	37.1	195	30.1	213	32.8	649	100
Sampling ratio	241/330	73.0	195/195	100	213/509	41.8	649/1034	62.8
Children found to be ineligible (outside age range) after completion of interview	1/241	0.4	0	0	1/213	0.5	2/649	0.3
Number of enrolled participants who did not complete interview	19/240	7.9	22/195	11.3	23/212	10.8	64/647	9.9
Number enrolled into study that completed interview	221/240	92.1	173/195	88.7	189/212	89.2	583/647	90.1

*SNZ method of assigning ethnicity prioritises Māori then Pacific ethnicities (see pages 17 and 119 for further explanation). SNZ prioritised ethnicity data is used here because caregiver preferences about ethnicity were not available for children who were not interviewed.

Table 12 Reasons for non-completion of study by enrolled participants

Reason for non-completion	**n**	**%**
Unable to be contacted to arrange interview time	9	14.1
Not eligible (did not have asthma or other reason)	4	6.2
Changed mind and didn't want to participate	45	70.3
Was moving or had moved from neighbourhood	6	9.4
	64	100

Table 13 SNZ prioritised ethnicity, NZ Index of Deprivation 1996 decile, and mean age by completion status

	Completers		**Non-completers**		**p value**
	n	**%** **95% CI**	**n**	**%** **95% CI**	
SNZ prioritised ethnic group					
Māori	221	37.9 34.0, 41.9	19	29.7 18.5, 40.9	
Pacific	173	29.7 26.0, 33.4	22	34.4 22.7, 46.0	0.43
Other	189	32.4 28.6, 36.2	23	35.9 24.2, 47.7	
Total	583	100	64	100	
NZDep96 decile					
1–7	323	55.4 51.4, 59.4	36	57.1 44.9, 69.4	
8–10	260	44.6 40.6, 48.6	27	42.9 30.1, 55.1	0.79
Total	583	100	63	100	
	Completers Mean 95% CI		Non-completers Mean 95% CI		
Mean age (years) N=639	9.80 9.53, 10.06		8.71 7.92, 9.51		0.009

Table 14 Final sample size for the CG prioritised and SNZ prioritised ethnicity variables

	Māori		Pacific		Other		Total	
	n	%	n	%	n	%	n	%
CG prioritised ethnicity	189	32.6	175	29.7	219	37.8	583	100
SNZ prioritised ethnicity	221	37.9	173	29.8	189	32.3	583	100

5.2 Descriptive analyses: ethnicity, potential confounding variables, asthma morbidity, pharmacological management, self-management, and health service use

This section presents the results of the descriptive analyses undertaken in the study. The distribution of ethnicity is presented first, followed by analyses of the potential confounding variables by ethnicity. Results of analysis, by ethnicity, of data relating to morbidity, pharmacological management, asthma education, action plans, and health service utilisation are then described. Finally, the results of analysis of the remaining other variables are presented at the end of this section. The CG prioritised ethnicity variable is used in all analyses presented in this section.

5.2.1 Ethnicity

About one third (32.6%) of the total sample was of Māori ethnicity, 29.7% Pacific, and 37.8% Other ethnic groups (Table 15).

5.2.2 Potential confounding variables

Overall, males accounted for 55.4% of the sample. There was no difference in the distribution of sex across ethnic groups. The mean age at interview for the total sample was 7.6 years. There was no significant difference in the mean age of participants in each ethnic group. (Table 15)

Parental and sibling histories of asthma were more commonly reported by Māori participants. A positive parental history of asthma was present in 52.5% of Māori, 47.2% of Other, and 31.7% of Pacific participants (p=0.0005). A history of asthma in a sibling was reported by 48.0% of Māori, 32.2% of Pacific, and 30.9% of Other participants (p=0.0009) (Table 15).

The proportion of participants who reported they did not have a routine source of care was low (7.7% overall; data not shown). Just over half of the caregivers (51.0%) reported having a regular source of care they saw all the time for the management of their child's asthma. Significant ethnic differences in the use of a routine source of care were observed. A higher proportion of Māori (56.5%) and Pacific (48.1%) than Other (43.3%) caregivers reported that they did not have a routine source of care or had a routine source of care but sometimes used other GPs (p=0.04; Table 15).

Marked differences in indicators of socio-economic position between ethnic groups were observed, with Māori and Pacific caregivers over-represented in lower socio-economic positions. The majority of Māori (58.2%) and Pacific (60.7%) participants resided in high deprivation areas (NZDep96 deciles 8, 9 and 10) in comparison to 20.2% of the Other ethnic group participants (p<0.0001).

The majority of Māori (65.7%) and Pacific (67.5%) caregivers reported a gross annual household income of less than forty thousand dollars per year. In comparison, 31.7% of Other ethnic group households reported this level of income (p<0.0001) (Table 15).

The proportion of Other ethnic group caregivers (62.2%) who had completed tertiary education of any type was higher than that seen in the Māori (50.0%) and Pacific (37.6%) ethnic groups (p<0.0001).

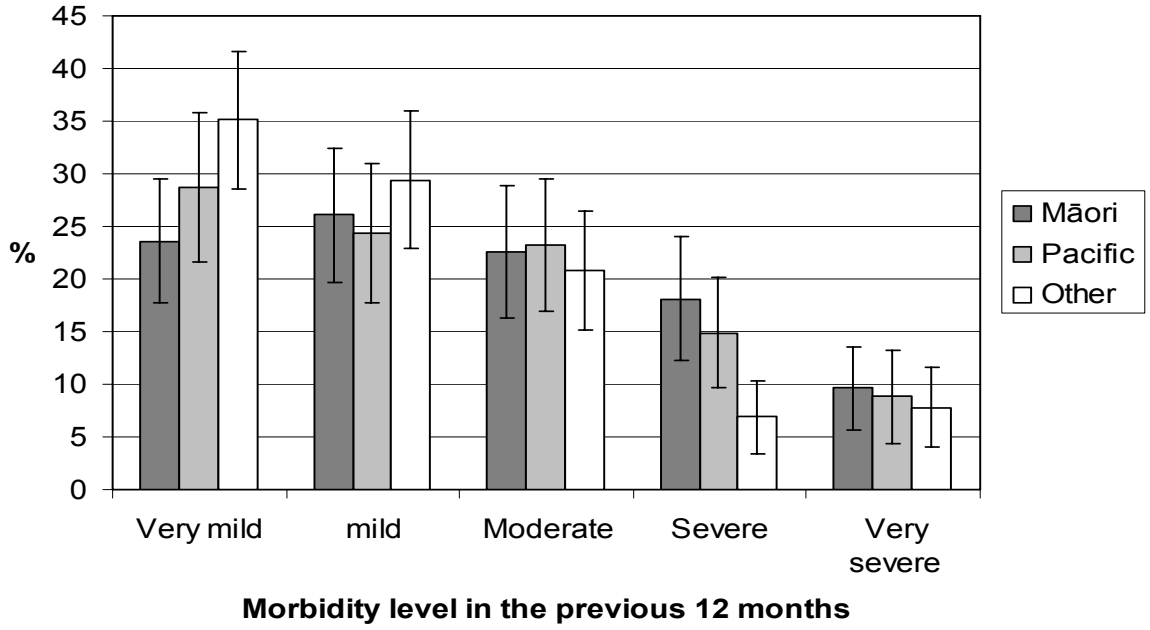
NZSEI group distributions showed similar significant differences, with higher proportions of the Māori and Pacific caregivers in the low SEP occupations and 'not in the labour force' groups (p<0.0001). For example, 32.0% of Māori and 24.9% of Pacific participants were in the 'not in the labour force' group, compared with 12.1% of the Other ethnic group (p<0.0001). Conversely, 20.8% of the Other participants were in the highest occupational group compared with 5.0% of Māori and 5.6% of Pacific participants (Table 15).

5.2.3 Other socio-demographic variables and morbidity

The majority of children participating in the study were born in New Zealand (data not shown). Overall, 95.8% of children were born in an English speaking country. All the Māori children, 94.0% of Pacific children, and 93.6% of Other ethnic group children were born in an English speaking country (Table 15).

Ninety percent of participants lived in households where English was the language usually used at home. English was spoken in fewer Pacific homes (71.6%) compared with Māori (99.5%) and Other (96.1%) ethnic groups ($p<0.0001$) (Table 15). Figure 9 and Table 15 present findings about asthma morbidity in the 12 months prior to the interview. The proportion of the participants within each level of severity decreased as severity increased. The distribution of asthma morbidity varied significantly across ethnic groups ($p=0.038$). A higher proportion of Other ethnic group participants reported very mild and mild asthma. Conversely, the proportions of the Māori and Pacific ethnic groups with severe morbidity were higher than that of the Other ethnic group.

Figure 9 Distribution of asthma morbidity by CG prioritised ethnicity*



*Adjusted for design effects.

Table 15 Socio-demographic characteristics, potential confounding variables, and morbidity by CG prioritised ethnicity*

	Māori		Pacific		Other		Total		
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	p value
Ethnicity N=583	189	32.6	175	29.7	219	37.8	583	100	
Sex N=583									
Male	103	54.2	96	54.6	126	57.1	325	55.4	0.83
		46.9, 61.6		47.3, 62.0		50.4, 63.8		51.3, 59.6	
Female	86	45.8	79	45.4	93	42.9	258	44.6	
		38.4, 53.1		38.0, 52.7		36.2, 49.6		40.4, 48.7	
Total	189	100	175	100	219	100	583	100	
Mean age (years) at interview N=583	189	7.4	175	7.3	219	7.9	583	7.6	0.12
		6.9, 7.9		6.8, 7.8		7.5, 8.3		7.3, 7.8	
Parental history of asthma N=582									
Yes	99	52.5	55	31.7	101	47.2	255	44.3	0.0005
		44.8, 60.2		24.8, 38.6		40.2, 54.2		40.2, 48.4	
No	89	47.5	120	68.3	118	52.8	327	55.7	
		39.8, 55.2		61.4, 75.2		45.8, 59.8		51.6, 59.8	
Sibling history of asthma N=582	84	48.0	53	32.2	62	30.9	199	36.9	0.0009
Yes		41.0, 55.0		24.9, 39.6		24.1, 37.7		32.7, 41.0	
	104	52.0	122	67.8	157	69.1	383	63.1	
No		45.0, 59.0		60.4, 75.1		62.3, 75.9		59.0, 67.3	

Use of regular source of care									
N=580	80	43.5	92	51.9	123	56.7	295	51.0	0.04
All of the time		35.7, 51.3		43.8, 60.0		49.9, 63.6		46.5, 55.5	
No regular source of care or has RSC but uses other GPs too	108	56.5	83	48.1	94	43.3	285	49.0	
		48.7, 64.3		40.0, 56.2		36.4, 50.1		44.5, 53.5	
NZDep96 score N=583									
1–7	79	41.8	68	39.3	176	79.8	323	55.4	<0.0001
		33.8, 49.8		31.1, 47.5		74.0, 85.6		50.3, 60.6	
8–10	110	58.2	107	60.7	43	20.2	260	44.6	
		50.2, 66.2		52.5, 68.8		14.4, 26.0		39.4, 49.7	
Household income N=510									
<= $40 000	110	65.7	98	67.5	59	31.7	267	53.1	<0.0001
		58.1, 73.3		59.9, 75.2		24.6, 38.8		48.3, 58.0	
>$40 000	56	34.3	50	32.5	137	68.3	243	46.9	
		26.7, 41.9		24.8, 40.1		61.2, 75.4		42.0, 51.7	
Highest completed education level of main caregiver N=578									
Primary/intermediate	29	14.5	33	19.3	11	5.2	73	12.4	<0.0001
		9.8, 19.2		13.2, 25.5		2.1, 8.3		9.6, 15.2	
Secondary	63	35.5	74	43.1	71	32.6	208	36.7	
		28.3, 42.7		35.4, 50.8		26.2, 39.0		32.5, 40.8	
Tertiary	96	50.0	66	37.6	135	62.2	297	50.9	
		42.8, 57.2		29.8, 45.3		55.5, 68.9		46.5, 55.3	

NZSEI group N=574									
1/2	9	5.0	10	5.6	45	20.8	64	11.2	<0.0001
		1.7, 8.3		2.2, 9.1		15.1, 26.5		8.4, 14.0	
3	9	4.5	12	7.3	41	18.6	62	10.7	
		1.6, 7.4		3.2, 11.5		13.1, 24.1		8.0, 13.4	
4	25	13.0	27	15.3	55	24.7	107	18.1	
		8.1, 17.9		9.8, 20.8		19.0, 30.3		14.9, 21.3	
5/6	84	45.5	81	46.9	51	23.8	216	37.7	
		38.2, 52.8		39.1, 54.7		17.9, 29.7		33.4, 41.9	
Not in the labour force	61	32.0	39	24.9	25	12.1	125	22.4	
		25.2, 38.8		17.5, 32.2		7.5, 16.8		18.5, 26.3	
Child born in English speaking country N=582									
Yes	189	100	163	94.0	204	93.6	556	95.8	0.0001 †
				90.5, 97.4		90.4, 96.7		94.2, 97.4	
No	0	0.0	11	6.0	15	6.4	26	4.2	
				2.6, 9.5		3.3, 9.6		2.6, 5.8	
English spoken at home N=583									
No									
	1	0.50	47	28.4	8	3.9	56	10.0	<0.0001
Yes		0.0, 1.5		20.8, 36.1		1.1, 6.6		7.2, 12.8	
	188	99.5	128	71.6	211	96.1	527	90.0	
		98.5, 100.0		63.9, 79.2		93.4, 98.9		87.1, 92.8	
Morbidity score N=577									
Very mild	46	23.6	52	28.7	79	35.1	177	29.5	0.038
		17.7, 29.6		21.6, 35.8		28.6, 41.6		25.6, 33.3	
Mild	49	26.1	40	24.3	63	29.4	152	26.8	

		19.7, 32.5		17.7, 30.9		22.9, 36.0		23.0, 30.7	
Moderate	42	22.6	41	23.2	44	20.8	127	22.1	
		16.3, 28.9		16.9, 29.5		15.0, 26.5		18.5, 25.7	
Severe	31	18.1	25	14.9	15	6.9	71	12.9	
		12.2, 24.0		9.7, 20.2		3.4, 10.4		10.0, 15.9	
Very severe	19	9.5	15	8.8	16	7.8	50	8.7	
		5.5, 13.6		4.5, 13.2		4.0, 11.6		6.2, 11.2	
Total	187	100	173	100	217	100	577	100	

* All percentages are weighted and adjusted for cluster effect

† Fishers exact test for significance undertaken without adjustment for cluster and unequal probability of selection. Percentages presented are adjusted for these design effects

5.2.4 Pharmacological management

This section presents findings about the use of medications to relieve and prevent asthma symptoms and attacks and the delivery systems used with these medications.

5.2.4.1 Medication

Reliever medications include short and long-acting inhaled β_2 agonists, inhaled anticholinergics, and oral steroids. With regard to oral steroids, it was not possible to determine whether the oral steroids had been prescribed for acute symptom management or for preventive management in very severe asthma. However, as very severe asthma is relatively uncommon, it is reasonable to assume that most of the courses of oral steroids will have been for the management of acute asthma.

Preventive medications include inhaled corticosteroids and inhaled cromoglycates. Occasionally, people with severe, difficult to control asthma may use oral steroids as a preventive medication.

5.2.4.1.1 Reliever medications

Nearly all children had received inhaled β_2 agonists, with 96.0% of Māori, 97.3% of Pacific, and 93.6% of Other children having received these medicines in the preceding 12 months. There were no significant differences between ethnic groups in the proportions of children who received these medications (Table 16).

Just over 2% of participants reported receiving inhaled anticholinergics in the previous 12 months. There were no ethnic differences in the reporting of this medication (Table 16).

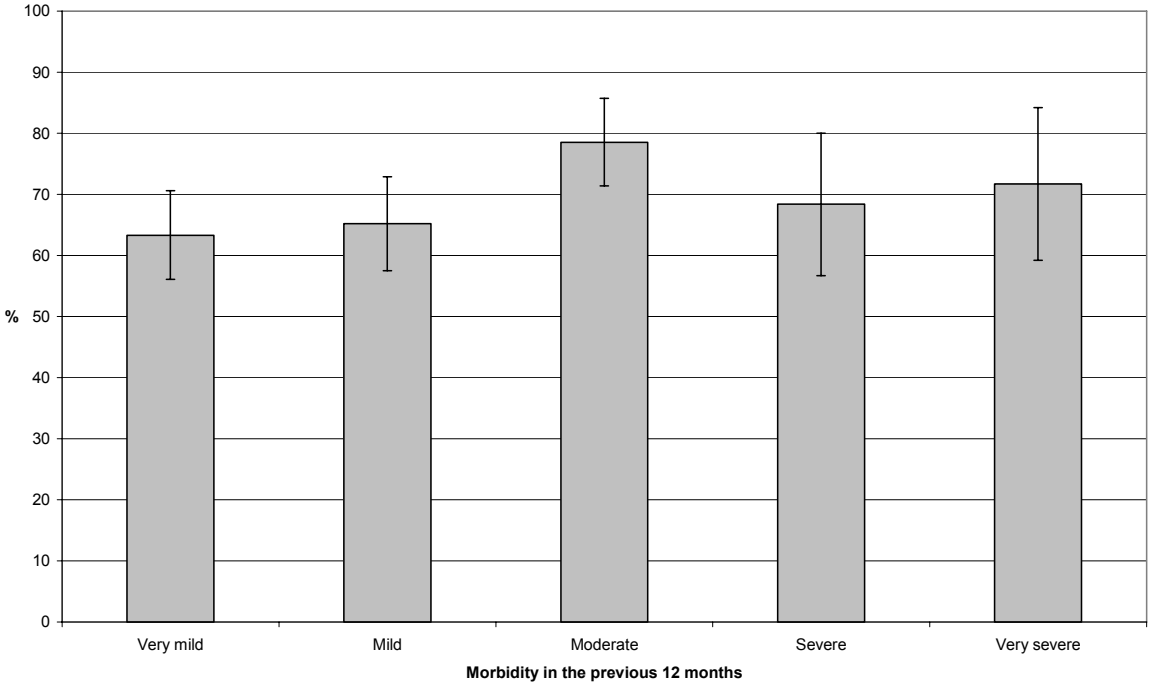
Overall, 13.3% of participants had received oral steroids in the 12 months prior to interview. A higher proportion of the Other ethnic group (17.6%) had received these medications, compared with 13.4% of Māori and 7.7% of Pacific children (p=0.028).

5.2.4.1.2 Preventive drug management

Around two thirds of all children (68.7% Māori, 65.6% Pacific, 71.2% Other) had received ICS in the 12 months prior to interview. There were no significant ethnic differences in the proportions of children who received ICS (Table 16).

Statistically significant differences in the proportion of children within each morbidity level who had received ICS were not observed (Figure 10).

Figure 10 Percentage with inhaled corticosteroids in the previous 12 months by morbidity*



*Adjusted for design effects

Inhaled cromoglycates were used less frequently than inhaled corticosteroids and, when used, were more frequently given to children of the Other ethnic group (8.6% versus 4.0% Māori and 2.2% Pacific). Differences in the receipt of inhaled cromoglycates across ethnic groups were significant (p=0.008) (Table 16).

As already noted, oral steroids may be used in the preventive management of very severe asthma. Data about the type of oral steroid use (acute or preventive management) was not collected, although use in acute management is more common than in preventive care. The results for oral steroids are presented in Section 5.2.4.1.1 Reliever medications.

Only two children reported the use of the medication ketotifen (Table 16).

Table 16 Medications received in the previous 12 months by ethnicity*

	Māori		Pacific		Other		Total		p value
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	
Inhaled β2 agonists in previous 12 months N=583									
Yes	182	96.0 93.0, 99.1	170	97.3 94.9, 99.6	204	93.6 90.4, 96.7	556	95.5 93.7, 97.2	0.21
No	7	4.0 0.93, 7.0	5	2.7 0.36, 5.1	15	6.4 3.3, 9.6	27	4.5 2.8, 6.3	
Inhaled anticholinergics in previous 12 months									
Yes	3	1.5 0.0, 3.2	4	2.2 0.05, 4.3	6	2.6 0.6, 4.6	13	2.1 1.0, 3.2	0.73
No	186	98.5 96.8, 100.0	171	97.8 95.7, 100.0	213	97.4 95.4, 99.4	570	97.9 96.8, 99.0	
Oral steroids in previous 12 months N=583									
Yes	24	13.4 8.8, 18.8	13	7.7 3.5, 11.8	37	17.6 12.1, 23.1	74	13.3 10.3, 16.2	0.028
No	165	86.6 81.2, 91.9	162	92.3 88.2, 96.5	182	82.4 76.9, 87.9	509	86.7 83.8, 89.7	

Inhaled corticosteroids (ICS) in previous 12 months N=583									
Yes	128	68.7 62.2, 75.1	114	65.6 58.3, 72.8	154	71.2 65.1, 77.3	396	68.7 64.9, 72.5	0.49
No	61	31.3 24.9, 37.8	61	34.4 27.2, 41.7	65	28.8 22.7, 34.9	187	31.3 27.5, 35.1	
Cromoglycates in previous 12 months N=583									
Yes	8	4.0 1.3, 6.6	4	2.2 0.1, 4.3	20	8.6 5.0, 12.2	32	5.2 3.5, 6.9	0.008
No	181	96.0 93.4, 98.7	171	97.8 95.7, 99.9	199	91.4 87.8, 95.0	551	94.8 93.1, 96.5	
Ketotifen in previous 12 months N=583									
Yes	0	0.0	1	0.5 0.0, 1.6	1	0.4 0.0, 1.3	2	0.3 0.0, 0.8	0.76[†]
No	189	100	174	99.5 98.4, 100	218	99.6 98.7, 100	581	99.7 99.2, 100	

[*]Adjusted for design effects.

[†]Fishers exact test for significance undertaken without adjustment for cluster and unequal probability of selection. Percentages presented are adjusted for these design effects.

5.2.4.2 Medication delivery mechanisms

Table 17 presents data about the types of medication delivery systems that had been used in the 12 months prior to interview.

Ninety-five percent of children used an inhaler (with or without a spacer). The proportions of Māori, Pacific, and Other ethnic group children who had used inhalers were similar (Table 17).

About half of all children (54.3%) reported using a spacer device with their inhaler. The proportions of children who reported this were similar across ethnic groups, with 53.7% of Māori, 52.5% of Pacific, and 56.2% of Other children in the study using a spacer (Table 17).

Spacer use was heavily influenced by age, with a higher proportion of children aged six or fewer years (79.6%) using spacers compared with 33.9% of those aged seven or more years. No ethnic differences were observed in either age strata (Table 17).

Over half (52.6%) of all children had received medication through a nebuliser in the preceding 12 months. Ethnic differences in the use of nebulisers were observed; 58.9% of Māori, 64.6% of Pacific, and 37.1% of Other children reported nebulisation ($p<0.0001$) (Table 17).

A small percentage of children (9.2%) had received medication in syrup form during the preceding 12 months. A higher percentage of Māori children were given medication in this form (14.0%) compared with 7.7% of Pacific, and 6.1% of Other children ($p=0.02$) (Table 17).

Table 17 Medication delivery systems used in last 12 months*

	Māori		Pacific		Other		Total		p value
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	
Inhaler† (N=583)	179	94.5 91.1, 97.9	165	94.5 91.2, 97.9	209	95.7 93.1, 98.3	553	95.0 93.2, 96.7	0.82
Spacer +/- mask (N=583)	101	53.7 46.3, 61.2	93	52.5 44.9, 60.0	126	56.2 49.4, 63.0	320	54.3 50.0, 58.6	0.75
Proportion within each age group who report spacer use (+/- mask)									
6 years and under (N=265)	78	77.7 68.9, 86.4	62	76.8 66.9, 86.7	75	84.4 76.0, 92.9	215	79.6 74.5, 84.8	0.46
7 years and over (N=318)	23	28.6 18.1, 39.0	31	32.7 23.4, 41.9	51	38.5 29.7, 47.2	105	33.9 28.2, 39.6	0.32
Nebuliser (N=565)	108	58.9 51.9, 65.9	112	64.6 56.9, 72.3	78	37.1 30.5, 43.7	298	52.6 48.3, 56.9	<0.0001
Syrup (N=576)	26	14.0 8.9, 19.1	14	7.7 3.8, 11.6	13	6.1 2.8, 9.4	53	9.2 6.8, 11.6	0.02

*Adjusted for design effects.

†Includes children who used a spacer device with their inhaler.

5.2.5 Asthma self-management skills

This section presents data relating to the skills necessary for asthma self-management. Effective asthma self-management requires the provision of asthma action plans and asthma education by health professionals. The caregiver then needs to translate their knowledge and action plan strategies into practice.

5.2.5.1 Asthma education

This section presents data about the delivery of asthma education and the caregivers' experiences and perceptions of the asthma education they had received.

Table 18 contains information about source (lay or primary care) of asthma education and excludes 25 participants who had only received education from a secondary care source.

Table 18 also presents information about the methods used to deliver education, topics covered, the caregivers' perceptions and experiences of asthma education, referral to asthma educators, and whether there had been any subsequent asthma education. The information contained in Table 18 is derived from the subsample of participants who had received education from a primary care source (471 participants).

Just over 15% of participants had not received education from a primary care health professional (i.e. had only received information from a lay source – friends, family or self-education). There were no significant ethnic differences in the proportions participants receiving education from lay or primary care sources ($p=0.17$; Table 18).

The methods of delivering asthma education that were most frequently used were: verbal communication, practical demonstrations, and the provision of written material. Verbal communication was cited by 98.4% of participants; practical demonstrations by 86.1%; and written material by 81.5%. Videos were used with 13.8% of participants. With the exception of practical demonstrations, ethnic differences in the different methods of delivering information were not statistically significant. Practical demonstrations were reported less frequently by

Pacific caregivers (79.7%) when compared with Māori (86.2%) and Other (90.5%) participants (p=0.04; Table 18).

The majority of participants were taught about asthma medication (97.0%) and medication delivery devices (94.4%). Lower percentages of the total sample were taught about asthma triggers (82.9%), general information about asthma (76.2%), pathophysiology (69.7%), and asthma action plans (31.4%).

Ethnic differences in the proportion taught about asthma triggers, pathophysiology and action plans were observed. Information about asthma triggers was given to 89.2% of Other, 79.8% of Māori, and 77.7% of Pacific participants (p=0.01). Higher percentages of Other participants received information about pathophysiology (75.9% compared to 68.1% of Pacific, and 63.6% of Māori, p=0.05) and about asthma action plans (36.5% compared to 32.9% of Māori and 22.7% of Pacific, p=0.04) (Table 18).

Over two thirds (70.8%) of all participants reported they found the information provided was clear and easy to understand. However, 35.8% of Māori and 31.5% of Pacific participants reported they did not understand some or most of the information. In contrast, only 22.1% of Other participants reported this (p=0.03) (Table 18).

Although the majority (66.0%) of participants felt they had been given enough information, 32.6% reported they had not been given sufficient information. Few (1.4%) participants reported they had been provided with too much information. No significant ethnic differences in caregivers' perceptions of the amount of information they had been given were observed (Table 18).

Overall, 55.2% of participants found the information they had been given was very useful in assisting them to understand asthma and how to manage it. A further 36.4% found the information of some use. The remainder found the information was of little or no use. No significant ethnic differences in caregivers' perceptions of the usefulness of the education were observed (Table 18).

In total, 57.2% of participants had received further asthma education. Ethnic differences were observed. Further education was reported by 65.5% of Other, 60.6% of Māori, and 42.4% of Pacific participants (p=0.0002) (Table 18).

Table 18 Source of asthma education, experience of asthma education, and caregiver's perceptions of education by ethnicity[*]

	Māori		Pacific		Other		Total		
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	p value
Source of asthma education (N=558)[†]									
Lay	25	13.3 8.5, 18.1	34	19.6 13.4, 25.7	28	13.3 8.6, 18.1	87	15.2 12.2, 18.2	0.17
Primary care health professional	151	86.7 81.9, 91.5	137	80.4 74.3, 86.6	183	86.7 81.9, 91.4	471	84.8 81.8, 87.8	
Methods of asthma education (N=471)[‡]									
Verbal (N=458)	143	98.1 95.3, 100	130	97.9 95.5, 100	178	98.9 97.5, 100	451	98.4 97.1, 99.6	0.75
Written information (N=444)	112	79.5 72.4, 86.5	105	83.3 76.6, 90.0	144	81.8 76.1, 87.6	361	81.8 77.7, 85.2	0.72
Practical demonstrations (N=446)	122	86.2 80.0, 92.4	101	79.7 72.7, 86.7	162	90.5 86.0, 94.9	385	86.1 82.7, 89.4	0.04
Video (N=432)	16	11.8 5.9, 17.7	15	11.5 6.0, 17.1	29	16.8 10.9, 22.8	60	13.8 10.3, 17.2	0.34
Topics covered in asthma education (N=471)[‡]									
Medications and how to use them (N=470)	148	98.2 96.1, 100	131	96.5 93.5, 99.5	177	96.4 93.4, 99.4	456	97.0 95.4, 98.6	0.60
Devices used to give medicines (N=467)	142	94.5 91.0, 98.0	122	90.8 86.1, 95.6	175	96.9 94.4, 99.3	439	94.4 92.4, 96.4	0.06

Pathophysiology (N=468)	95	63.6 55.7, 71.4	92	68.1 60.1, 76.1	138	75.9 69.5, 82.3	325	69.7 65.4, 73.9	0.05
General information about asthma (N=456)	112	76.8 69.5, 84.1	95	71.4 63.6, 79.3	140	79.3 73.1, 85.4	347	76.2 72.1, 80.3	0.30
Asthma triggers (N=467)	120	79.8 73.6, 85.9	102	77.7 70.3, 85.1	162	89.2 84.9, 93.6	384	82.9 79.5, 86.3	0.01
Asthma action plans (N=463)	48	32.9 25.3, 40.6	31	22.7 15.5, 29.9	62	36.5 28.6, 44.3	141	31.4 27.0, 35.7	0.04
Understanding asthma education (N=469)‡									
Clear, easy	98	64.2 56.1, 72.3	95	68.5 60.1, 77.0	142	77.9 71.8, 84.1	335	70.8 66.5, 75.1	0.03
Some/most not understood	52	35.8 27.7, 43.9	41	31.5 23.0, 39.9	41	22.1 15.9, 28.2	134	29.2 24.9, 33.5	
Amount of information given (N=469)‡									
Too little	53	36.4 28.6, 44.2	45	35.0 26.5, 43.4	51	27.7 20.9, 34.5	149	32.6 28.1, 37.1	0.39
Enough	95	62.3 54.4, 70.3	88	62.9 54.5, 71.4	131	71.3 64.3, 78.2	314	66.0 61.4, 70.6	
Too much	2	1.2 0, 4.4	3	2.1 0, 4.4	1	1.0 0, 3.0	6	1.4 0.01, 2.8	

Usefulness of asthma education (N=469)[‡]									
Very useful	86	56.8 48.6, 65.0	86	61.5 53.0, 70.1	92	49.2 41.7, 56.7	264	55.2 50.5, 59.9	0.45
Of some use	52	35.8 27.8, 43.8	37	29.4 21.3, 37.5	74	42.1 34.7, 49.4	163	36.4 31.9, 40.9	
Not very useful	11	6.8 2.9, 10.7	11	7.7 3.2, 12.1	15	7.7 3.9, 11.5	37	7.4 5.1, 9.7	
Of no use	1	0.6 0, 1.8	2	1.4 0, 3.3	2	1.0 0, 3.0	5	1.0 0, 2.0	
Given further education (N=467)[‡]									
Yes	88	60.6 52.5, 68.7	59	42.4 33.5, 51.2	121	65.5 58.4, 72.6	268	57.2 52.5, 62.0	0.0002

[*]All percentages are weighted and adjusted for cluster effect.

[†]Excludes 25 participants who received education only from secondary care source.

[‡]Only includes participants who had received education from primary care source (i.e. excludes participants with only lay or secondary source of education).

5.2.5.2 Asthma action plans

The findings relating to asthma action plans, including whether caregivers had heard of plans, been given plans, and their perceptions and experiences of asthma action plans are described below.

Table 19 contains information about awareness and provision of action plans for the whole sample and by ethnicity.

Just over one third (35.3%) of the total sample had heard about action plans. Significant ethnic differences in whether caregivers had heard about action plans were observed, with fewer Māori (33.8%) and Pacific (23.0%) caregivers reporting they had heard about action plans (Other ethnic group 46.4%; $p<0.0001$) (Table 19).

A smaller number of participants (23.3%) had ever been given an action plan. There were no statistically significant differences in the percentages of each ethnic group that had ever been given an action plan (Table 19).

A current action plan, defined as being provided or updated within the previous 12 months, was held by 10.9% of participants. There were no significant ethnic differences in the proportion of participants that held current action plans (Table 19).

Figure 11 illustrates the provision of action plans stratified by morbidity level. The proportion of children who had ever been given a plan and had a current plan increased with increasing morbidity. Nevertheless, the provision of action plans within each morbidity level was low.

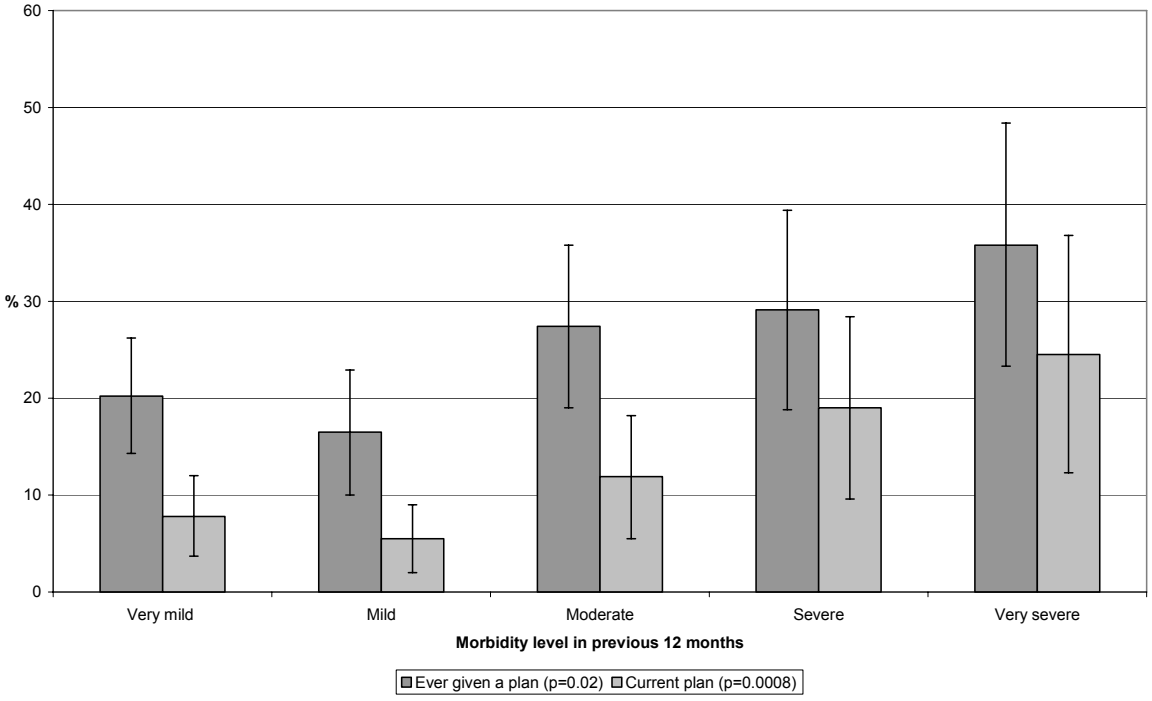
Table 19 also presents information about the caregivers' perceptions and experiences of action plans. This information is derived from the subsample of participants (N=131) who had been given an action plan (at any time).

The majority of participants (86.4%) felt that they had been provided with a sufficient amount of information during the initial explanation. Significant ethnic differences in the caregiver's perception of the amount of information were not observed (Table 19).

The majority of participants (85.0%) found the initial explanation clear and easy to understand. There were no significant ethnic differences in understanding of the explanation (Table 19)

The majority of participants (91.4%) reported that, after being given the plan, they found it useful. No significant ethnic differences were observed (Table 19).

Figure 11 'Ever had an action plan' and 'current action plan' by morbidity*



*Adjusted for design effects

Table 19 Awareness, provision, experience and perception of asthma action plans by ethnicity*

	Māori		Pacific		Other		Total		p value
	n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	
Had heard of action plans (N=583)	64	33.8 27.0, 40.7	41	23.0 16.5, 29.4	99	46.4 39.4, 53.3	204	35.3 31.4, 39.3	<0.0001
Had been given a plan (ever) (N=581)	44	23.9 17.7, 30.1	34	19.2 13.3, 25.2	53	25.9 19.6, 32.1	131	23.3 19.8, 26.7	0.33
Had a current action plan (N=581)	21	12.0 6.9, 17.1	18	9.9 5.5, 14.3	22	10.7 6.4, 15.1	61	10.9 8.3, 13.5	0.83
Amount of information during initial explanation (N=128)†									
Too little	3	8.5 0, 18.3	4	12.1 1.1, 23.1	1	1.7 0.0, 5.0	8	6.4 1.9, 11.0	0.22
Enough	35	80.9 68.2, 93.5	27	84.8 72.8, 96.9	48	91.7 84.5, 98.9	110	86.4 80.3, 92.5	
Too much	5	10.6 1.6, 19.7	1	3.0 0, 9.0	4	6.7 0.2, 13.1	10	7.1 2.8, 11.5	
Understanding of initial explanation (N=128)†									
Clear, easy to understand	36	83.0 71.1, 94.9	26	81.8 68.8, 94.9	47	88.3 79.0, 97.7	109	85.0 78.3, 91.7	0.65
Some/most not understood	7	17.0 5.1, 28.9	6	18.2 5.2, 31.2	6	11.7 2.3, 21.0	19	15.0 8.3. 21.7	

Usefulness of initial plan (N=128)[†]									
Very useful/useful	40	93.6	28	84.8	50	93.3	118	91.4	0.37
		86.5, 100		70.4, 99.3		85.5, 100		85.7, 97.2	
Little/not useful	3	6.4	4	15.2	3	6.7	10	8.6	
		0, 13.5		0.7, 29.6		0, 14.5		2.8, 14.3	

[*]Adjusted for design effects.

[†]Only includes those who had ever been given an action plan (N=131).

5.2.5.3 Asthma knowledge

This section contains results from analyses of data from: the four asthma knowledge scales; the parental confidence managing asthma scale; identification of reliever medication; and the scoring of the asthma management scenario. The results are presented in Table 20 and discussed below.

5.2.5.3.1 Knowledge of asthma symptoms

Knowledge of asthma symptoms was assessed using a five point scale. Although the median score for each ethnic group was high, the median score for Māori and Pacific (4) was lower than that of the Other ethnic group (5). The interquartile ranges were 1–5 for Māori, 2–5 for Pacific, and 3–5 for the Other ethnic group. There was one outlying case in the Other ethnic group (2). The distribution of scores within each ethnic group varied, with Other ethnic group's distribution skewed to the top of the scale. Differences between ethnic groups were statistically significant ($p<0.0001$) (Table 20).

5.2.5.3.2 Knowledge of asthma pathophysiology

Knowledge of asthma pathophysiology was assessed using a five point scale. There were no significant ethnic differences in the median score, interquartile range, and distribution of scores. There were two outlying (low) scores in each ethnic group (Table 20).

5.2.5.3.3 Asthma general knowledge scores

Asthma general knowledge was assessed using a five point scale. The median score was the same (4) for all ethnic groups. The interquartile ranges were the same in each ethnic group (3–5). There was one outlying score in the Māori and Other ethnic groups and two outlying scores in the Pacific ethnic group. However, the differences between ethnic groups were statistically significant ($p<0.0018$) suggesting that the scores within quartiles were distributed differently in each ethnic group (Table 20).

5.2.5.3.4 Knowledge of exacerbating factors

Knowledge of exacerbating factors was assessed using a six point scale. Although the median score for each ethnic group was high, the median score for Māori and Pacific (5) was lower than that of the Other ethnic group (6). The interquartile ranges were 4–6 for the Māori and Other ethnic groups and 2–6 for the Pacific group. There was a single (low) outlying score in the Māori ethnic group. The distribution of scores within each ethnic group varied, with the Other ethnic group distribution more skewed to the top of the scale. Differences between ethnic groups were statistically significant ($p<0.0001$) (Table 20).

Table 20 Asthma knowledge and parental confidence by ethnicity (Wilcoxin rank sums scores and Kruskal-Wallis tests)

	Māori Median Interquartile range Min., max.	**Pacific** Median Interquartile range Min., max.	**Other** Median Interquartile range Min., max.	**p value**
Symptom knowledge (N=562)	4 1–5 1, 5	4 2–5 2, 5	5 3–5 2, 5	<0.0001
Pathophysiology knowledge (N=552)	4 2–5 0, 5	4 2–5 0, 5	4 2–5 0, 5	0.55
General asthma knowledge (N=576)	4 3–5 2, 5	4 3–5 1, 5	4 3–5 2, 5	0.0018
Exacerbating factor knowledge (N=573)	5 4–6 3, 6	5 2–6 2, 6	6 4–6 4, 6	<0.0001
Parental confidence managing asthma (N=583)	12 6–15 3, 15	11 6–15 3, 15	11 3–15 3, 15	0.13

5.2.5.3.5 Parental confidence managing asthma

Parental confidence managing asthma was assessed using a fifteen point scale. The median score for Māori (12) was higher than that of Pacific and Other ethnic groups (11). The interquartile ranges were 6–15 for Māori and Pacific, and 3–15 for the Other ethnic groups. There were two outlying cases in the Māori ethnic group and three in the Pacific group. The differences between ethnic groups were not statistically significant (Table 20).

5.2.5.3.6 Identification of reliever medication

The majority (90.5%) of participants were able to correctly identify reliever medications. The proportions correctly identifying reliever medications were similar for Māori (88.4%), Pacific (90.8%), and Other (92.1%) ethnic groups (p=0.48) (Table 21).

Table 21 Percentage and 95% confidence interval of participants who were able to correctly identify reliever medication by ethnicity (N=583)*

Māori		Pacific		Other		Total		p value
n	% 95% CI	n	% 95% CI	n	% 95% CI	n	% 95% CI	
168	88.4 83.2, 93.7	151	90.8 86.5, 95.1	196	92.1 88.6, 95.7	515	90.5 88.1, 93.0	0.48

*Weighted and adjusted for cluster effect.

5.2.5.3.7 Asthma management scenario scores

Significant ethnic group differences in the mean score for the asthma management scenario were observed. The mean scores of Māori (6.4) and Pacific (6.6) participants were lower than that of Other participants (7.0) (p=0.05) (Table 22).

Table 22 Mean and 95% confidence interval for asthma management scenario score by ethnicity*

	Māori		Pacific		Other		
	n	Mean 95% CI	n	Mean 95% CI	n	Mean 95% CI	p value
Asthma management scenario score (N=583)	189	6.4 6.0, 6.8	175	6.6 6.3, 7.0	219	7.0 6.7, 7.4	0.05

*Adjusted for design effects.

5.2.6 Asthma-related health services utilisation

This section describes asthma-related hospital admissions and utilisation of GP, AHMC, and ED services in the 12 months prior to interview. These results are presented for the total sample and for each ethnic group.

5.2.6.1 GP services

Table 23 presents information about the mean number of asthma-related visits to GPs in the 12 months prior to interview. Visits for acute asthma care, regular asthma care, and both types of care combined are reported. The data presented is for visits to the regular source of care and to other GPs combined. Visits to after hours doctors and medical centres are excluded. Statistically significant ethnic group differences in the mean number of GP visits were observed. Māori and Pacific children had a higher mean number of GP visits for acute care, routine care, and both types of care combined than Other ethnic group children. Pacific children had 3.89 visits for GP care (acute and routine combined), while Māori had 3.56 visits and Other children had 2.47 visits in the previous 12 months ($p<0.0001$) (Table 23).

Overall, 29.8% of participants were high users of GP services[46]. Significant ethnic differences in high GP utilisation were observed. Over one third of Māori (36.8%) and Pacific (33.3%) participants were high users of GP services for asthma care, compared with about 21% of the Other ethnic group (p=0.001). (Table 23)

5.2.6.2 Use of after hours medical care

Participants' use of after hours medical care (AHMC) is described in Table 24.

The mean number of visits for AHMC in the 12 months prior to interview ranged from 0.25 visits for Māori to 0.33 for Pacific participants. Other ethnic group children were intermediate at 0.26 visits. The ethnic differences were not statistically significant (Table 24).

Overall, 15.2% of participants were high users[47] of AHMC services. The differences between ethnic groups were not statistically significant (Table 24).

[46]High use of GP services is defined as six or more GP visits for acute or routine asthma care in the previous 12 months.

[47]High use of AHMC was defined as more than one AHMC visit for asthma care in 12 months prior to interview.

Table 23 Visits to GP for asthma care in previous 12 months by CG prioritised ethnicity[*†]

	Māori	Pacific	Other	Total	p value
Mean number of visits for acute asthma care in previous 12 months (N=583)					
n	189	175	219	583	
Mean	2.36	2.56	1.62	2.09	0.0009
95% CI	1.98, 2.82	2.11, 3.10	1.36, 1.94	1.89, 2.36	
Mean number of visits for routine asthma care in previous 12 months (N=583)					
n	189	175	219	583	
Mean	0.77	0.75	0.51	0.66	0.03
95% CI	0.59, 0.99	0.56, 0.95	0.39, 0.64	0.56, 0.76	
Mean number of GP visits for acute and regular asthma care in previous 12 months (N=583)					
n	189	175	219	583	
Mean	3.56	3.89	2.47	3.21	<0.0001
95% CI	3.03, 4.16	3.28, 4.60	2.11, 2.85	2.89, 3.51	
Was a high user of GP (≥ 6 acute and routine visits) in previous 12 months (N=583)					
n	68	58	46	172	
%	36.8	33.3	21.0	29.8	0.001
95% CI	29.7, 43.9	26.2, 40.5	15.7, 26.4	26.0, 33.6	

[*]All percentages are weighted and adjusted for cluster effect.

[†]Excludes visits to AHMC.

5.2.6.3 Use of hospital emergency departments

Table 24 documents the use of hospital emergency departments for asthma care.

Significant ethnic differences in the mean number of ED visits were apparent. Pacific children had a higher mean number of visits (0.23) than Māori (0.09) and Other (0.04) ethnic group children ($p<0.0001$) (Table 24).

Overall, 12.5% of participants were high users of ED[48] services. Significant differences in the proportion of each ethnic group who were high users of ED services were observed. About one quarter of Pacific children had visited an ED at least once compared with around ten percent of Māori and five percent of Other children ($p<0.0001$) (Table 24).

5.2.6.4 Asthma-related hospital admissions

Overall, 10.4% of participants had been admitted to hospital in the 12 months prior to the interview. Marked ethnic differences were observed, with 19.1% of Pacific children, 11.9% of Māori, and 2.2% of Other children experiencing at least one admission ($p<0.0001$) (Table 24).

Differences in the mean number of admissions for each ethnic group were also observed. Māori and Pacific children had a higher mean number of admissions (0.07 and 0.13 respectively) than Other ethnic group children (0.01; $p<0.0001$) (Table 24).

[48]High use of ED services was defined as one or more visits to the ED for asthma care in the 12 months prior to interview.

Table 24 Use of after hours medical care, emergency departments and hospital admissions in previous 12 months by CG prioritised ethnicity[*]

	Māori	Pacific	Other	Total	p value
High use of AHMC (>1 visit) in previous 12 months (N=583)[†]					
n	28	30	32	90	
%	14.9	17.5	13.7	15.2	0.60
95% CI	9.5, 20.4	11.6, 23.4	9.3, 18.2	12.2, 18.2	
Number of visits for AHMC in previous 12 months (N=583)[†]					
Mean	0.25	0.33	0.26	0.27	0.43
95% CI	0.15, 0.35	0.23, 0.44	0.18, 0.34	0.22, 0.33	
High use of (≥ 1 ED visit) in the previous 12 months (N=583)					
n	20	42	9	71	
%	10.4	24.6	4.7	12.5	<0.0001
95% CI	5.8, 15.1	18.2, 31.0	1.5, 7.9	9.7, 15.3	
Number of visits to ED in previous 12 months (N=583)					
Mean	0.09	0.23	0.04	0.11	<0.0001
95% CI	0.04, 0.14	0.15, 0.31	0.01, 0.07	0.08, 0.13	
Admissions (≥ 1) in previous 12 months (N=582)					
n	21	32	4	57	
%	11.9	19.1	2.2	10.4	<0.0001
95% CI	6.9, 17.0	13.3, 25.0	0.0, 4.4	7.6, 13.2	
Number of admissions in the previous 12 months (N=578)					
Mean	0.07	0.13	0.01	0.07	<0.0001
95% CI	0.03, 0.11	0.08, 0.19	0.00, 0.03	0.04, 0.08	

[*]All percentages are weighted and adjusted for cluster effect.

[†]Excludes visits to hospital emergency departments.

5.3 Are there ethnic differences in asthma management outcomes?

This section presents results relating to the primary objectives of the study; that is, whether there are ethnic differences in asthma management outcomes. The process used for the analyses is outlined in section 4.9.3. Seven outcomes were examined: 'inhaled corticosteroids in the previous 12 months', 'oral steroids in the previous 12 months', 'had asthma education from a primary care health professional', 'had received further asthma education', 'had heard of action plans', 'had ever received an action plan', and 'has a current action plan'.

5.3.1 Pharmacological management

5.3.1.1 Receipt of inhaled corticosteroids in the previous 12 months

Odds ratios, before and after adjustment for potential confounders, are presented in Table 25. The adjusted odds ratios and confidence intervals confirmed that ethnicity was not independently associated with receiving inhaled corticosteroids in the previous 12 months. Testing for effect modification by including an interaction term for ethnicity and routine source of care was also undertaken. The interaction term was not statistically significant.

This observation led to consideration of the use of ICS within asthma morbidity levels and whether there might be ethnic differences in ICS within each morbidity stratum. A post-hoc analysis calculating odds ratios and 95% confidence intervals for receipt of ICS stratified by morbidity level was undertaken. The results are presented in Table 26.

Care must be taken when interpreting these results as they are derived from a post-hoc analysis, the study was not powered to address this specific question, and the numbers in each cell are relatively small. In addition adjustment for the potential confounding variables has not been undertaken which may result in an over-estimation of the effect of ethnicity within each morbidity level. Nevertheless, the results suggest that Māori (OR 0.12; 95% CI 0.01, 1.08) and Pacific (OR 0.11; 95% CI 0.01, 1.10) children in the severe morbidity group may be less likely to have received ICS in the previous 12 months compared with their Other ethnic group peers. This finding requires further investigation.

5.3.1.2 Receipt of oral steroids in 12 months prior to interview

Statistically significant ethnic differences in the proportion of children who had received oral steroids in the previous 12 months were observed (Table 16). Odds ratios, before and after adjustment for potential confounders, are presented in Table 25. The unadjusted odds ratio and confidence interval for Pacific children were all below 1.0. The unadjusted odds ratio for Māori children was below 1.0; however, the confidence interval included 1.0. The p value for ethnicity was significant (0.03). Adjustment of the odds ratios to account for potential confounders removed the effect of ethnicity and the confidence intervals for the Pacific ethnic group widened to include 1.0 (Table 25).

No significant effect modification between ethnicity and routine source of care were identified.

Table 25 Unadjusted[*] and adjusted[†] associations between inhaled corticosteroids in previous 12 months, oral steroids in previous 12 months, and ethnicity

	Ethnicity (N=583)			
	Māori N=189	**Pacific N=175**	**Other N=219**	**p value**
Received inhaled steroids in previous 12 months				
n	128	114	154	
%	68.7	65.6	71.2	
OR	0.88	0.77	1.00	0.51
95% CI	0.58, 1.35	0.50, 1.20		
Adj OR	1.1	1.00	1.00	0.90
95% CI	0.65, 1.93	0.58, 1.74		
Received oral steroids in previous 12 months				
n	24	13	37	
%	13.4	7.7	17.6	
OR	0.73	0.39	1.0	0.03
95% CI	0.40, 1.32	0.19, 0.78		
Adj OR	0.85	0.45	1.0	0.17
95% CI	0.41, 1.77	0.19, 1.06		

[*] Adjusted for design effects.

[#] Adjusted for income, caregivers education level, occupational class, NZDep96 decile, age, sex, parental history of asthma, sibling history asthma and regular source of care.

Table 26 Māori:Other and Pacific:Other odds ratios and 95% confidence intervals for inhaled corticosteroids in the previous 12 months stratified by morbidity*

Had received inhaled steroids in previous 12 months										
	Very mild (N=177)		Mild (N=152)		Moderate (N=127)		Severe (N=71)		Very severe (N=50)	
	% (n)	OR 95% CI	% (n)	OR 95% CI	% (n)	OR 95% CI	% (n)	OR 95% CI	% (n)	OR 95% CI
Māori	14.7 (26)	0.72 0.33, 1.58	22.4 (34)	1.26 0.54, 2.92	27.6 (35)	1.25 0.40, 3.92	26.8 (19)	0.12 0.01, 1.08	24 (12)	0.34 0.07, 1.82
Pacific	18.1 (32)	0.60 0.28, 1.29	17.1 (26)	1.10 0.45, 2.65	22.8 (29)	0.58 0.20, 1.64	22.5 (16)	0.11 0.01, 1.10	20 (10)	0.60 0.11, 3.43
Other	30.5 (54)	1.00	24.3 (37)	1.00	6.8 (34)	1.00	19.7 (14)	1.00	26 (13)	1.00
p value		0.40		0.86		0.34		0.15		0.45

*Adjusted for design effects

5.3.2 Asthma education

There were no ethnic differences in the proportions of children who had received asthma education from a lay or primary care health professional source (Table 18 and Table 27).

Amongst those people who had received previous asthma education from a primary care source, ethnicity was significantly associated with the likelihood of having been given further asthma education (Table 27). Unadjusted odds ratios for the Māori and Pacific ethnic groups and the Pacific confidence intervals were all under 1.00 although the confidence interval for the Māori ethnic group included 1.0 (p=0.0003). Adjustment for potential confounders diminished, but did not fully account for, the ethnic differences. The adjusted odds ratios and confidence interval for the Pacific ethnic groups remained under 1.00 (OR 0.57; 95% CI 0.33, 0.96). The Māori ethnic group odds ratio was 0.96 and the confidence interval included 1.00. The effect of ethnicity remained significant (p=0.05) (Table 27).

There was no evidence of effect modification for the variable 'had received further asthma education'.

Table 27 Unadjusted and adjusted associations between source of initial asthma education, having received further asthma education and CG prioritised ethnicity*

	Ethnicity			
	Māori (N=189)	**Pacific (N=175)**	**Other (N=219)**	**p value**
Had a lay source of initial asthma education (N=558)†				
n	25	34	28	
%	13.3	19.6	13.3	
OR	1.00	1.58	1.00	0.18
95% CI	0.56, 1.79	0.90, 2.78		
Adj OR ‡	0.59	0.91	1.00	0.32
95% CI	0.28, 1.26	0.46, 1.78		
Had received further asthma education (N=385/471)§				
n	96	66	136	
%	53.3	37.2	61.9	
OR	0.81	0.39	1.00	0.0003
95% CI	0.51, 1.28	0.24, 0.62		
Adj OR ‡	0.96	0.57	1.00	0.05
95% CI	0.57, 1.62	0.33, 0.96		

* All % and OR are adjusted for design effects.

† Does not include the 25 participants who only received asthma education from a secondary care source.

‡ Adjusted for income, caregiver's education level, occupational class, NZDep96 decile, age, sex, parental history of asthma, sibling history of asthma, and regular source of care.

§ Includes the 471 participants who had received previous asthma education from a primary care source.

5.3.3 Action plans

About one third (35.3%) of participants had heard of action plans, and significantly fewer Māori and Pacific caregivers reported having heard about action plans ($p<0.0001$; Table 19). Unadjusted odds ratios and confidence intervals for the Māori and Pacific ethnic groups were all under 1.00 ($p<0.0001$). After adjustment for potential confounders the Pacific odds ratios and confidence intervals remained under 1.00 (OR 0.54; 95% CI 0.30, 0.96). However, the Māori ethnic group confidence interval included 1.00, and the effect of ethnicity was no longer statistically significant (Table 28).

A smaller number of participants (23.3%) reported they had been given an action plan at some point ever (Table 19). There were no significant ethnic differences in the proportions and odds ratios for 'had ever been given an action plan' (Table 28).

Only 61 participants (10.9%) had a current action plan (Table 19). No significant ethnic differences in the odds ratios for 'had a current action plan' were observed (Table 28).

Testing for effect modification between ethnicity and having a routine source of care were undertaken for each of these outcome variables. No effect modification was identified.

Table 28 Unadjusted[*] and adjusted[†] associations for heard about action plans, ever given an action plan, has a current action plan and ethnicity

	Māori (N=189)	Pacific (N=175)	Other (N=219)	p value
Had heard about action plans (204/583)				
n	64	41	99	
%	33.8	23.0	46.4	
OR	0.59	0.35	1.00	<0.0001
95% CI	0.39, 0.90	0.22, 0.55		
Adj OR	0.80	0.54	1.00	0.11
95% CI	0.47, 1.36	0.30, 0.96		
Had ever been given an action plan (131/581)				
n	44	34	53	
%	23.9	19.2	25.9	
OR	0.90	0.68	1.00	0.32
95% CI	0.56, 1.45	0.41, 1.13		
Adj OR	1.10	0.95	1.00	0.89
95% CI	0.59, 2.07	0.50, 1.84		
Had a current action plan (61/581)				
n	21	18	22	
%	12.0	9.9	10.7	
OR	1.14	0.91	1.00	0.83
95% CI	0.58, 2.20	0.47, 1.78		
Adj OR	1.84	1.47	1.00	0.32
95% CI	0.83, 4.10	0.65, 3.35		

[*]All % and OR are adjusted for design effects.

[†]Adjusted for income, caregiver's education level, occupational class, NZDep96 decile, age, sex, parental history of asthma, sibling history of asthma and regular source of care.

5.4 Do differences in medication use, asthma education, and self-management plans explain ethnic differences in health service utilisation?

This section presents findings about the effect of asthma management on ethnic differences in health service utilisation for asthma. Four health service utilisation outcomes are investigated:

number of GP visits, use of after hours medical care, use of EDs, and admissions to hospital. The methods used for the analyses are outlined in Section 4.9.

Descriptive and multivariable analyses that examined the associations between the utilisation outcome variable, ethnicity, and potential confounding variables were undertaken. If there was no significant association between the outcome and ethnicity after controlling for potential confounders further modelling was not undertaken. If a significant association was identified the multivariable modelling was extended to include examination of other possible explanatory variables, including asthma management variables. The purpose of the multivariable models is to estimate the effect of ethnicity and other potential explanatory variables while controlling for potential confounding variables.

5.4.1 Number of general practitioner visits for acute and regular asthma care (combined) in the previous 12 months

Visits to both the regular source of GP care and to other GPs were included in this variable. Visits for after hours medical care were not included.

The mean number of GP visits was higher in the Māori (3.56) and Pacific (3.89) ethnic groups compared with the Other ethnic group (2.47; $p<0.0001$; Table 23).

The detailed tables of descriptive analyses that examined the association between the number of GP visits and other variables are contained in Table 29 (ethnicity and potential confounding variables), Table 30 (other socio-demographic and asthma management variables) and Table 31 (asthma knowledge variables). Seven of the asthma management, knowledge, and other socio-demographic variables were significantly associated with the number of GP visits and were included in the multivariable model in addition to ethnicity and the potential confounding variables. These seven variables were: child born in an English speaking country, received ICS in the previous 12 months, received oral steroids in the previous 12 months, has a current action plan, source of asthma education, knowledge of asthma pathophysiology, and asthma management scenario score.

Table 32 contains the results of multivariable modelling. In the unadjusted model the correlation coefficients indicated that Māori children experienced about one third more visits than Other ethnic group children (regression coefficient (RC) 0.31) and Pacific children experienced forty percent more visits (RC 0.40) ($p<0.0001$). Adjustment for potential confounders, other demographic, and management variables reduced but did not fully account for the ethnic disparities. After adjustment Māori experienced 22% more visits and Pacific children 28% more than Other children ($p=0.05$). (Table 32)

Six other variables had a significant effect on the number of GP visits. Participants who had a regular source of care they always used had more visits to GPs for asthma care (RC 0.24) than those who did not have a regular source of care or had a regular source of care and used other GPs ($p<0.01$). Lower household income (RC 0.31; $p=0.004$) and having a current action plan (RC 0.38; $p=0.006$) were associated with a higher number of GP visits. Increasing age (RC -0.04; $p=0.003$), a lay source of asthma education (RC -0.41; $p=0.001$), and higher scores for the asthma management scenario (RC -0.03; $p=0.05$) were all associated with a lower number of GP visits (Table 32).

Table 29 Ethnicity and potential confounding variables by outcome variables (%, means, regression coefficients, 95% confidence intervals)*

Ethnicity and potential confounding variable	Number of GP visits for acute and routine asthma care in previous 12 months		Had used emergency department at least once in previous 12 months		Had been admitted at least once in previous 12 months	
	n	Mean (95% CI) p value	n	% (95% CI) p value	n	% (95% CI) p value
Ethnicity (N=583)	583		71		57	
Māori	189	3.56 (3.03, 4.16)	20	10.4 (5.8, 15.1)	21	11.9 (6.9, 17.0)
Pacific	175	3.89 (3.28, 4.60)	42	24.6 (18.2, 31.0)	32	19.1 (13.3, 25.0)
Other	219	2.47 (2.11, 2.85)	9	4.7 (1.5, 7.9)	4	2.2 (0.0, 4.4)
		<0.0001		<0.0001		<0.0001
Sex (N=583)	583		71		57	
Male	325	3.13 (2.75, 3.60)	48	15.2 (11.1, 19.3)	32	10.9 (6.8, 14.9)
Female	258	3.24 (2.82, 3.72)	23	9.1 (5.4, 12.7)	25	9.8 (6.1, 13.5)
		0.74		0.03		0.71
Household income (N=510)	510		58		46	
<=$40 000	267	3.81 (3.32, 4.35)	42	15.3 (10.9, 19.8)	36	13.9 (9.5, 18.3)
>$40 000	243	2.69 (2.36, 3.10)	16	7.1 (3.7, 10.6)	10	4.8 (1.8, 7.8)
		0.0004		0.0006		0.001
Main caregiver's highest completed education level (N=578)	578					
<high school	73	3.60 (2.82, 4.55)	70	17.1 (8.6, 25.7)	57	11.8 (3.9, 19.8)
high school	208	2.89 (2.44, 3.44)	13	11.6 (7.3, 15.9)	8	12.5 (7.2, 17.8)
tertiary	297	3.36 (2.96, 3.81)	24	11.9 (7.9, 15.9)	24	8.7 (5.1, 12.4)
		0.24	33	0.44	25	0.45

NZSEI group (N=574)	574		70		57	
1/2	64	2.53 (1.84, 3.44)	8	14.7 (5.1, 24.3)	4	8.8 (0.37, 17.3)
3	62	3.40 (2.53, 4.50)	3	4.6 (0.0, 9.8)	2	4.7 (0.0, 11.4)
4	107	2.50 (1.98, 3.10)	12	10.9 (5.0, 16.8)	7	6.4 (1.8, 10.9)
5/6	216	3.40 (2.89, 3.94)	26	11.8 (7.6, 15.9)	32	15.3 (10.0, 20.5)
Not in labour force	125	3.81 (3.03, 4.71)	21	17.6 (10.2, 25.1)	12	9.6 (4.3, 14.8)
		0.04		0.15		0.10
Decile score (N=583)	583		71		57	
1–7	323	3.06 (2.69, 3.44)	37	11.7 (8.0, 15.4)	26	8.2 (5.0, 11.4)
8–10	260	3.36 (2.89, 3.94)	34	13.5 (9.2, 17.7)	31	13.1 (8.2, 17.9)
		0.35		0.54		0.08
Parental history of asthma (N=582)	582		71		57	
Yes	255	3.32 (2.89, 3.81)	23	9.5 (5.7, 13.4)	15	5.9 (2.9, 8.8)
No	327	3.10 (2.72, 3.51)	48	14.9 (10.8, 19.0)	42	14.0 (9.8, 18.2)
		0.47		0.08		0.0017
Sibling history of asthma (N=582)	582		71		57	
Yes	199	3.17 (2.66, 3.76)	20	10.6 (6.1, 15.1)	25	14.1 (8.4, 19.8)
No	383	3.21 (2.85, 3.60)	51	13.6 (10.1, 17.1)	32	8.2 (5.5, 10.9)
		0.92		0.31		0.036
Regular source of care (N=580)	580		71		57	
Yes – uses all the time	295	3.36 (2.96, 3.81)	31	10.9 (7.1, 14.6)	34	11.9 (8.0, 15.7)
No RSC or RSC and uses other GPs	285	3.03 (2.63, 3.51)	40	14.3 (10.0, 18.6)	23	9.0 (5.3, 12.7)
		0.02		0.24		0.26

Regression coefficient or mean for 'age at interview' and outcome variables*

	Number of GP visits for acute and routine asthma care in previous 12 months		Had used emergency department at least once in previous 12 months		Had been admitted at least once in previous 12 months	
	n	**Regression coefficient p value**	**n**	**Mean (95% CI) p value**	**n**	**Mean (95% CI) p value**
Age (N=583)	583	-0.06 <0.0001	Yes 71 No 512	6.7 (6.0, 7.4) 7.7 (7.4, 8.0) 0.008	Yes 57 No 525	6.7 (5.8, 7.7) 7.7 (7.4, 8.0) 0.057

*Adjusted for design effects.

Table 30 Other socio-demographic and asthma management variables (mean or odds ratios and 95% confidence interval) by outcome variables*

	Number of GP visits in previous 12 months		Had used emergency department at least once in previous 12 months		Had been admitted at least once in previous 12 months	
	n	Mean (95% CI) p value	n	% (95% CI) p value	n	% (95% CI) p value
Child born in English speaking country (N=582)	582		70		581	
Yes	556	3.28 (2.96, 3.60)	68	12.5 (9.7, 15.4)	57	10.9 (7.9, 13.8)
No	26	1.58 (0.76, 2.89)	2	7.7 (0.0, 18.0)	0	0
		0.01		0.46		
English spoken at home (N=583)	583		71		57	
No	56	3.72 (2.69, 5.08)	16	29.0 (17.9, 40.2)	10	19.4 (8.7, 30.0)
Yes	527	3.13 (2.82, 3.47)	55	10.6 (7.9, 13.4)	47	9.4 (6.6, 12.1)
		0.28		<0.0001		0.020
Given inhaled corticosteroids in previous 12 months (N=583)	583		71		57	
Yes	396	3.44 (3.06, 3.89)	53	13.9 (10.4, 17.4)	42	11.1 (7.7, 14.6)
No	187	2.66 (2.25, 3.13)	18	9.3 (5.2, 13.4)	15	8.8 (4.5, 13.1)
		0.01		0.11		0.41
Oral steroids in previous 12 months (N=583)	583		71		57	
Yes	74	4.92 (3.85, 6.32)	13	19.5 (9.7, 29.3)	10	14.8 (5.9, 23.8)
No	509	2.99 (2.69, 3.28)	58	11.4 (8.6, 14.2)	47	9.7 (7.0, 12.5)
		0.0003		0.06		0.19
	581		71		57	
Has a current action plan (N=581)	61	4.92 (3.72, 6.46)	18	31.3 (18.9, 43.7)	20	34.3 (21.7, 46.9)

Yes	520	3.03 (2.72, 3.36)	53	10.2 (7.5, 12.9)	37	7.5 (5.1, 9.8)
No		0.001		<0.0001		<0.0001
Source of asthma education (N=558)	558		68		51	
Lay source	87	2.22 (1.66, 2.96)	15	16.7 (9.1, 24.2)	5	5.6 (0.9, 10.2)
Primary care source	471	3.44 (3.10, 3.81)	53	11.8 (8.7, 14.8)	46	10.6 (7.4, 13.8)
		0.004		0.20		0.14
Correctly identified reliever medications (N=568)	568		71		56	
Yes	515	3.24 (2.92, 3.60)	67	13.4 (10.3, 16.5)	48	9.9 (7.1, 12.8)
No	53	2.99 (2.14, 4.16)	4	7.0 (0.32, 13.7)	8	15.8 (5.3, 26.3)
		0.64		0.18		0.20

*Adjusted for design effects

Table 31 Asthma knowledge variables (regression coefficient (standard error) or mean (95% CI)) by outcome variables*

	Number of GP visits in previous 12 months		Used emergency department at least once in previous 12 months		Had been admitted at least once in previous 12 months	
	n	Regression coefficient (standard error) † p value	n	Mean (95% CI) p value	n	Mean (95% CI) p value
Asthma symptoms score	562	-0.08 (0.05) 0.12	Yes 67 No 495	4.1 (3.9, 4.3) 4.1 (4.0, 4.2) 0.99	Yes 56 No 505	4.0 (3.7, 4.3) 4.1 (4.1, 4.2) 0.30
Asthma pathophysiology	552	0.11 (0.04) 0.006	Yes 66 No 486	3.6 (3.3, 3.8) 3.5 (3.4, 3.6) 0.38	Yes 54 No 497	3.7 (3.3, 4.1) 3.5 (3.4, 3.5) 0.26
General asthma knowledge score	576	0.009 (0.06) 0.88	Yes 69 No 507	4.2 (4.0, 4.4) 4.3 (4.2, 4.3) 0.59	Yes 56 No 519	4.2 (4.0, 4.4) 4.2 (4.2, 4.3) 0.61
Exacerbating factors knowledge score	573	-0.07 (0.05) 0.14	Yes 68 No 505	5.1 (4.8, 5.3) 5.3 (5.2, 5.3) 0.10	Yes 56 No 516	5.1 (4.9, 5.3) 5.3 (5.2, 5.3) 0.26
Parental confidence managing asthma score	583	0.01 (0.02) 0.38	Yes 71 No 512	10.5 (10.0, 11.0) 11.1 (10.9, 11.4) 0.05	Yes 57 No 525	10.7 (9.9, 11.5) 11.1 (10.8, 11.3) 0.43
Scenario score	583	-0.04 (0.02) 0.01	Yes 71 No 512	6.6 (6.0, 7.3) 6.7 (6.5, 7.0) 0.77	Yes 57 No 525	6.1 (5.4, 6.8) 6.8 (6.5, 7.0) 0.07

*Adjusted for design effects

Table 32 Multivariable modelling for outcome variable 'number of GP visits for routine or acute care in the previous 12 months

	Unadjusted* model Correlation coefficients (SE) p value	Adjusted model Correlation coefficients (SE) p value
Ethnicity		
Māori	0.31 (0.10)	0.22 (0.12)
Pacific	0.40 (0.10)	0.28 (0.12)
Other	0.0 (0.0)	0.0 (0.0)
	<0.0001	0.05
Has a regular source of care		
Yes – always uses		0.24 (0.09)
No or had a RSC and uses others		0.0 (0.0)
		0.01
Age at interview		-0.04 (0.01)
		0.0003
Household income		
<=$40000		0.31 (0.11)
>$40000		0.0 (0.0)
		0.004
NZSEI group		
Group 1/2		-0.006 (0.15)
Group 3		0.14 (0.15)
Group 4		-0.05 (0.13)
Group 5/6		0.0 (0.0)
Not in the labour force		0.02 (0.14)
		0.77
Main caregiver's highest completed education level		
<high school		-0.04 (0.15)
high school		-0.14 (0.10)
tertiary		0.0 (0.0)
		0.28
NZDep96		
Decile 1–7		0.0 (0.0)
Decile 8–10		-0.02 (0.10)
		0.87
Parental history of asthma		
Yes		-0.004 (0.09)

No		0.0 (0.0) 0.97
Sex Male Female		 -0.11 (0.08) 0.0 (0.0) 0.20
Sibling history of asthma Yes No		 -0.11 (0.10) 0.0 (0.0) 0.30
Oral steroids in previous 12 months Yes No		 0.27 (0.15) 0.0 (0.0) 0.06
Has a current action plan Yes No		 0.38 (0.14) 0.0 (0.0) 0.006
Source of asthma education Lay Primary care		 -0.41 (0.13) 0.0 (0.0) 0.001
Child born in English speaking country Yes No		 0.41 (0.29) 0.0 (0.0) 0.16
Inhaled steroids in previous 12 months Yes No		 0.17 (0.10) 0.0 (0.0) 0.07
Asthma pathophysiology score		0.08 (0.04) 0.06
Scenario score		-0.03 (0.02) 0.05

*Adjusted for design effects.

5.4.2 Use of after hours medical care

Ethnicity was not associated with high use of AHMC in descriptive analysis (Table 24). Ethnic group odds ratios, before and after controlling for potential confounders, are presented in Table 33. Māori and Pacific children were no more likely to be high AHMC users than Other children. The small number of children who were high users of AHMC services is likely to have limited the precision of the estimates, as the confidence intervals are relatively wide.

Table 33 Unadjusted and adjusted associations between 'were high users of after hours medical clinics' and ethnicity

Were high users of AHMCs	Māori (N=189)	Pacific (N=175)	Other (N=219)	Total (N=583)	p value
n	28	30	32	90	
%	14.9	17.5	13.7	15.2	
OR*	1.10	1.33	1.00		0.60
95% CI	0.62, 1.95	0.76, 2.33			
Adj OR†	1.09	1.53	1.00		
95% CI	0.52, 2.27	0.72, 3.27			0.46

*Adjusted for design effects.

†Adjusted for study design, income, parental history of asthma, age, sibling history of asthma, occupational class, decile, education level, routine source of care, sex.

5.4.3 Use of hospital emergency departments

The proportion of children who had received asthma care in an ED in the previous 12 months varied significantly across the ethnic groups. Pacific (24.6%) and Māori (10.4%) children were more likely to have used an ED in the previous 12 months than Other children ($p<0.0001$) (Table 24).

The detailed tables of descriptive analyses that examined the association between the use of EDs and other variables are contained in Table 29 (ethnicity and potential confounding variables), Table 30 (other socio-demographic and asthma management variables), and Table 31 (asthma knowledge variables). Three of the asthma management, knowledge, and other socio-demographic variables were significantly associated with use of EDs and were included in the multivariable model in addition to ethnicity and the potential confounding variables. These

variables were: English spoken at home, having a current action plan, and the parental confidence managing asthma score.

Table 34 contains the results of multivariable modelling. In the unadjusted model ethnicity was a significant determinant of ED use ($p<0.0001$). Pacific children were more than six times as likely (OR 6.58), and Māori children over twice as likely (OR 2.36), to have used EDs as Other children ($p<0.0001$). However, the confidence intervals for both odds ratios were wide, reflecting the low numbers and resulting reduction in precision, and the lower CI for the Māori odds ratio was 0.99.

Adjustment for potential confounders, other demographic, and management variables made little difference to the odds ratios but did reduce the precision of the estimates, with widened confidence intervals for both odds ratios. The Pacific odds ratio was 6.93 (95% CI 2.40, 19.98) and Māori odds ratio was 2.60 (95% CI 0.87, 8.32). The effect of ethnicity remained statistically significant ($p=0.0007$) (Table 34).

Four other variables had a significant effect on the use of EDs in the multivariable model. Participants who did not speak English in the home (OR 3.72; 95% CI 1.52, 9.09; $p=0.004$), were male (OR 2.43; 95% CI 1.15, 5.15; $p=0.02$), and had a current action plan (OR 7.85; 95% CI 3.49, 17.66; $p<0.0001$) were more likely to have used an ED in the previous 12 months. Increasing age was associated with a reduced likelihood of using EDs (OR 0.90; 95% CI 0.81, 1.00; $p=0.05$) (Table 34).

Table 34 Multivariable modelling for outcome variable 'high use of emergency department in last 12 months' (n=71/583)

	Unadjusted model*	Adjusted model
	Odds ratio (95% CI)	Odds ratio (95% CI)
	p value	p value
Ethnicity		
Māori (n=20)	2.36 (0.99, 5.62)	2.69 (0.87, 8.32)
Pacific (n=42)	6.58 (3.00, 14.44)	6.93 (2.40, 19.98)
Other (n=9)	1.00	1.00
	<0.0001	0.0007
Household income		
<=$40000		1.62 (0.72, 3.66)
>$40000		1.00
		0.25
Age at interview		0.90 (0.81, 1.00)
		0.05
Sex		
Male		2.43 (1.15, 5.15)
Female		1.00
		0.02
Regular source of care		
Yes – uses all the time		1.01 (0.50, 2.05)
No or RSC and uses others		1.00
		0.97
Parental history of asthma		
Yes		1.06 (0.54, 2.11)
No		1.00
		0.86
NZSEI group		
Group 1/2		2.71 (0.73, 10.01)
Group 3		0.41 (0.08, 2.21)
Group 4		1.62 (0.65, 4.00)
Group 5/6		1.00
Not in the labour force		2.00 (0.88, 4.58)
		0.17
Sibling history of asthma		
Yes		0.64 (0.31, 1.32)
No		1.00
		0.23

Main caregiver's highest completed education level		
<high school		0.84 (0.31, 2.29)
high school		0.78 (0.31, 1.55)
tertiary		1.00
		0.77
NZDep96		
Decile 1–7		1.60 (0.74, 3.48)
Decile 8–10		1.00
		0.23
English spoken in the home		
No		3.72 (1.52, 9.09)
Yes		1.00
		0.004
Has a current action plan		
Yes		7.85 (3.49, 17.66)
No		1.00
		0.0001
Parental confidence managing asthma score		0.94 (0.84, 1.05)
		0.26

*Adjusted for design effects.

5.4.4 Admission to hospital

The proportion of children who had at least one asthma-related hospital admission in the previous 12 months was significantly higher for Māori (11.9%) and Pacific (19.1%) children compared to that of the Other ethnic group (2.2%; p<0.0001) (Table 24).

The detailed tables of descriptive analyses that examined the association between hospital admission and other variables are contained in Table 29 (ethnicity and potential confounding variables), Table 30 (other socio-demographic and asthma management variables), and Table 31 (asthma knowledge variables).

Two of the asthma management and other socio-demographic variables were significantly associated with hospitalisation and were included in the multivariable model in addition to ethnicity and the potential confounding variables. These variables were English spoken at home and having a current action plan.

Table 35 contains the results of multivariable modelling. In the unadjusted model ethnicity was a significant determinant of hospitalisation. Pacific children were more than ten times as likely (OR 10.73), and Māori children over six times as likely (OR 6.16), to have been hospitalised as Other children (p=0.0001). The confidence intervals for both odds ratios were wide, reflecting the low numbers and resulting reduction in precision; however, the lower confidence intervals for both odds ratios were well over 1.00.

Adjustment for potential confounders and the other demographic and management variables reduced both the odds ratios and the precision of the estimates (confidence intervals widened further). Nevertheless, the observed ethnic group differences persisted. Hospitalisations were more likely in the Pacific (OR 8.94; 95% CI 2.25, 35.62) and Māori (OR 5.40; 95% CI 1.28, 23.06) ethnic groups (p=0.007) (Table 35).

Four other variables had a significant effect on hospital admissions in the multivariable model. Participants who had a low income (OR 3.70; 95% CI 1.49, 9.18; p=0.005), and those who had a current action plan (OR 8.39; 95% CI 3.85, 18.30; p<0.0001) were more likely to have been admitted to hospital in the previous 12 months. Increasing age (OR 0.88; 95% CI 0.80, 0.98;

p=0.02) and parental history of asthma (OR 0.39; 95% CI 0.18, 0.85; p=0.02) were associated with reduced likelihood of admission (Table 35).

Table 35 Multivariable modelling for outcome variable 'admitted to hospital in previous 12 months' (n=57/582)

	Unadjusted model* **Odds ratio (95% CI) p value**	**Full model Odds ratio (95% CI) p value**
Ethnicity		
Māori (n=21)	6.16 (2.05, 18.44)	5.40 (1.27, 23.06)
Pacific (n=32)	10.73 (3.51, 32.82)	8.94 (2.25, 35.62)
Other (n=4)	1.00	1.00
	0.0001	0.007
Parental history of asthma		
Yes		0.39 (0.18, 0.85)
No		1.0
		0.02
Household income		
<=$40000		3.70 (1.49, 9.18)
>$40000		1.00
		0.005
Age at interview		0.88 (0.80, 0.98)
		0.02
NZDep96		
Decile 1–7		1.10 (0.45, 2.69)
Decile 8–10		1.00
		0.84
NZSEI group		
Group 1/2		3.31 (0.84, 13.11)
Group 3		1.05 (0.18, 5. 96)
Group 4		0.71 (0.25, 2.05)
Group 5/6		1.00
Not in the labour force		0.54 (0.21, 1.40)
		0.19
Sibling history of asthma		
Yes		2.01 (0.93, 4.32)
No		1.0
		0.08

Main caregiver's highest completed education level		
<high school		0.92 (0.27, 3.07)
high school		1.12 (0.49, 2.55)
tertiary		1.00
		0.93
Has a regular source of care		
Yes – uses all the time		1.78 (0.86, 3.68)
No or RSC and uses others		1.00
		0.12
Sex		
Male		1. 20 (0.58, 2.49)
Female		1.00
		0.61
Has a current action plan		
Yes		8.39 (3.85,18.30)
No		1.00
		<0.0001
English spoken at home		
Yes		1.24 (0.40, 3.84)
No		1.00
		0.71

*Adjusted for design effects

5.5 Sensitivity analysis: preferred versus prioritised ethnicity

The impact of using SNZ prioritised ethnicity rather than CG prioritised ethnicity was examined by repeating the multivariable modelling after changing the ethnicity variable from CG prioritised to SNZ prioritised. The results are presented in Table 36. The second column reports the odds ratios, confidence intervals, and p values for the major outcome variables that are reported in the preceding sections of this chapter ('Model with CG prioritised ethnicity and without morbidity'). The third column of the table ('Model with SNZ prioritised ethnicity and without morbidity') contains the odds ratios, confidence intervals, and p values which were obtained after changing the ethnicity variable in the model from CG prioritised to SNZ prioritised ethnicity.

The reclassification of ethnicity from CG to SNZ prioritised ethnicity primarily affected the Māori ethnic group. Reclassification of ethnicity resulted in the movement of children who had both Māori and a preferred non-Māori ethnic group from the CG preferred ethnic group into the SNZ Māori ethnic group. Compared with the CG prioritised ethnic group, the SNZ Māori group contained 32 more children, the Pacific ethnic group contained two fewer children and the Other ethnic group contained 30 fewer children (Table 14).

Changes to the point estimates and confidence intervals for some outcomes were observed (Table 36). The most marked changes were seen with the variables 'use of EDs' and 'admission to hospital'. Significant ethnic differences had been observed in analyses using CG prioritised ethnicity. The use of the SNZ prioritised ethnic group increased the variation within the ethnic subgroups, resulting in the marked reduction in precision illustrated by widening of the confidence intervals.

The use of SNZ prioritised ethnicity also resulted in changes to the number of GP visits, with a reduction in Māori and Pacific regression coefficients so that ethnicity accounted for less of the ethnic differences in GP visits. The effect of ethnicity was no longer significant.

The use of SNZ prioritised ethnicity also resulted in changes to confidence intervals for either the Māori or Pacific odds ratios in three other variables. Using CG prioritised ethnicity the Māori odds ratio for 'having a current action plan' was 1.84 (CI 0.83, 4.10). The odds ratio increased to 2.52 (95% CI 1.10, 5.80) using SNZ prioritised ethnicity. However, the overall effect of ethnicity remained non-significant (Table 36).

Results for the outcome 'had heard about action plans' also changed for the Pacific ethnic group, with widening of the confidence interval to include 1.0 when SNZ prioritised ethnicity was used (Table 36).

The use of SNZ prioritised ethnicity resulted in changes to the Pacific odds ratio, confidence interval, and test of statistical significance for the outcome 'has received further education'. Using CG prioritised ethnicity the findings for the Pacific group were odds ratio 0.53, confidence interval 0.30, 0.95 and p value 0.06. Repeat modelling using SNZ prioritised ethnicity resulted in a reduction in the Pacific odds ratio (0.46), tightening of the confidence interval (0.25, 0.85), and the effect of ethnicity became statistically significant (p=0.04) (Table 36).

5.6 Sensitivity analysis: morbidity included as confounder

The impact of morbidity in the previous 12 months was examined by multivariable modelling with and without morbidity included as a potential confounding variable. The results are presented in Table 36.

The second column of the table ('Model with CG prioritised ethnicity and without morbidity') contains the odds ratios, confidence intervals, and p values for the major outcome variables that are reported in the preceding sections of this chapter. That is, the models for each outcome that use CG prioritised ethnicity and do not include morbidity. The fourth column ('Model with CG prioritised ethnicity and morbidity') contains the odds ratios, confidence intervals, and p values for models that use CG prioritised ethnicity and include morbidity in the model.

Major changes to point estimates, confidence intervals, and p values were not observed for the outcome variables except for 'admission to hospital'. For the admissions outcome the inclusion of morbidity in the model resulted in an increase in the point estimates accompanied by a more marked increase in the upper confidence limit for both Māori and Pacific odds ratios. That is, controlling for morbidity reduced the precision of the estimates for admission to hospital (Table 36).

This chapter has described the findings of the study and presented the results of sensitivity analyses undertaken to examine the impact of using a different ethnicity classification variable, and the impact of including morbidity in multivariable models. The following chapter discusses the findings and draws conclusions about the study.

Table 36 Sensitivity analyses for major outcome variables*

	Model with CG prioritised ethnicity and without morbidity	Model with SNZ prioritised ethnicity and without morbidity	Model with CG prioritised ethnicity and morbidity
Received inhaled corticosteroids OR (95% CI)	Māori 1.12 (0.65, 1.93) Pacific 1.00 (0.58, 1.74) 0.90	Māori 1.23 (0.71, 2.12) Pacific 1.22 (0.69, 2.17) 0.72	Māori 1.14 (0.65, 1.98) Pacific 1.00 (0.57, 1.77) 0.87
Received oral steroids OR (95% CI)	Māori 0.85 (0.41, 1.77) Pacific 0.45 (0.19, 1.06) 0.17	Māori 1.23 (0.61, 2.49) Pacific 0.63 (0.26, 1.51) 0.27	Māori 0.74 (0.34, 1.61) Pacific 0.44 (0.18, 1.07) 0.19
Source of education OR (95% CI)	Māori 0.59 (0.28, 1.26) Pacific 0.91 (0.46, 1.78) 0.32	Māori 0.55 (0.27, 1.13) Pacific 0.87 (0.44, 1.72) 0.22	Māori 0.65 (0.31, 1.39) Pacific 0.95 (0.48, 1.89) 0.45
Had received further asthma education OR (95% CI)	Māori 0.96 (0.54, 1.72) Pacific 0.53 (0.30, 0.95) 0.06	Māori 0.77 (0.44, 1.36) Pacific 0.46 (0.25, 0.85) 0.04	Māori 0.90 (0.50, 1.62) Pacific 0.51 (0.29, 0.92) 0.05
Heard about action plans OR (95% CI)	Māori 0.80 (0.47, 1.36) Pacific 0.54 (0.30, 0.96) 0.11	Māori 0.92 (0.54, 1.57) Pacific 0.69 (0.39, 1.24) 0.43	Māori 0.78 (0.45, 1.33) Pacific 0.54 (0.30, 0.96) 0.11
Ever been given an action plan OR (95% CI)	Māori 1.10 (0.59, 2.07) Pacific 0.95 (0.50, 1.84) 0.89	Māori 1.09 (0.58, 2.05) Pacific 0.98 (0.50, 1.92) 0.93	Māori 1.07 (0.56, 2.04) Pacific 0.96 (0.49, 1.89) 0.94
Has a current action plan OR (95% CI)	Māori 1.84 (0.83, 4.10) Pacific 1.47 (0.65, 3.35) 0.32	Māori 2.52 (1.10, 5.80) Pacific 1.74 (0.70, 4.31) 0.09	Māori 1.74 (0.75, 4.02) Pacific 1.50 (0.64, 3.53) 0.42

Number of GP visits Mean (SE)	Māori 0.22 (0.12) Pacific 0.28 (0.12) 0.05	Māori 0.12 (0.12) Pacific 0.23 (0.11) p= 0.13	Māori 0.22 (0.12) Pacific 0.28 (0.11) p = 0.04
High use of AHMCs OR (95% CI)	Māori 1.09 (0.52, 2.27) Pacific 1.53 (0.72, 3.27) 0.46	Māori 1.30 (0.62, 2.73) Pacific 1.82 (0.84, 3.94) 0.30	Māori 0.99 (0.46, 2.15) Pacific 1.57 (0.72, 3.45) 0.36
Use of EDs OR (95% CI)	Māori 2.69 (0.87, 8.32) Pacific 6.93 (2.40, 19.98) 0.0007	Māori 6.68 (1.68, 26.52) Pacific 16.24 (4.22, 62.37) 0.0001	Māori 2.20 (0.66, 7.27) Pacific 7.13 (2.29, 22.23) 0.0007
Admitted to hospital OR (95% CI)	Māori 5.40 (1.27, 23.06) Pacific 8.94 (2.25, 35.62) 0.007	Māori 22.59 (2.03, 250.91) Pacific 37.64 (3.73, 379.72) 0.004	Māori 5.78 (1.18, 28.41) Pacific 10.70 (2.24, 51.09) 0.008

*Adjusted for study design, income, parental history of asthma, age, sibling history of asthma, occupational class, decile, education level, routine source of care, sex, and other variables as appropriate from descriptive analyses.

Chapter 6 Discussion and conclusion

In this chapter the results of the study are summarised; the strengths and weaknesses of the study are identified and discussed; the results of the study are discussed in relation to other literature; the implications of the findings for health policy, the health sector, health services, and clinicians are discussed; and unanswered questions and future directions are identified. The chapter ends with the conclusions that can be drawn from the study.

6.1 Main findings

The primary objectives of the study were to:

- describe the use of medications, medication delivery systems, asthma education, and self-management plans in primary care for the three ethnic groups
- ascertain whether there were any ethnic disparities in the use of medications, medication delivery systems, asthma education, and self-management plans in primary care after controlling for differences in socio-economic position and other potential confounders.

Secondary objectives were to:

- describe the asthma-related utilisation of GP, after hours medical care, emergency departments, and hospital admissions among children with asthma
- ascertain whether differences in medication use, the provision of asthma education, and the provision of self-management plans explained ethnic differences in health service utilisation.

The following sections summarise the findings in relation to the primary (section 6.1.1) and secondary objectives (section 6.1.2).

Overall, the results suggest that there are ethnic differences in the management of children's asthma, with Māori and Pacific children experiencing poorer quality of care than Other ethnic group children for some outcomes. Given that Māori and Pacific children experience a greater burden of disease, findings that there are no ethnic differences for other outcomes may also be viewed as indicative of poorer quality of care.

6.1.1 The management of asthma in primary care

The main findings for asthma management outcomes are presented in this section. Pharmacological findings are presented first, followed by the self-management and knowledge outcomes.

6.1.1.1 Pharmacological management outcomes

The majority (over 93%) of children in all ethnic groups had received inhaled β_2 agonists in the previous 12 months. No significant ethnic differences in the receipt of β_2 agonists were observed. Few (2.1%) participants had received inhaled anticholinergic medications in the previous 12 months; no ethnic differences were observed. After adjustment for potential confounders there were no ethnic differences in the receipt of oral steroids in the previous 12 months.

Inhaled corticosteroids had been received in the previous 12 months by about two thirds of children. There were no ethnic differences in receipt of ICS in the previous 12 months after adjustment for potential confounders. A post-hoc analysis that stratified the data by morbidity level and examined the effect of ethnicity on the likelihood of having received ICS suggested that Māori and Pacific children in the severe morbidity group may be less likely to have received ICS. This finding is worthy of future study that is designed to specifically examine the issue and includes adjustment for potential confounding variables.

Compared with ICS, cromoglycate use was much less common, with only 5.2% of caregivers reporting the use of this medication type. A greater proportion of Other ethnic group children (8.6%) had received cromoglycates than Māori or Pacific children (4.0% and 2.2% respectively; p=0.0008).

Two participants (0.3% of the total sample) had received ketotifen for asthma management in the previous 12 months. Testing for statistical significance (Fishers exact test) was undertaken on data that had not been adjusted for the study's design effects because the statistical software could not perform this test while simultaneously adjusting for clustering and the unequal probability of selection. While worth noting, there are no implications for the findings of the study as the unadjusted p value was non-significant. Adjustment for study design effects is likely to have increased the p value further.

Use of inhalers for the delivery of medication was almost universal, with 95% of caregivers reporting inhaler use in the previous 12 months. Use of a spacer device, with or without a mask, was reported by just over half of caregivers. Spacer use was significantly influenced by the child's age; about 80% of children aged ≤6 years had used a spacer compared with 33.9% of children aged seven years or over. There were no ethnic differences in the use of spacer devices.

Just over half of the caregivers reported their children had received a nebuliser in the 12 months prior to interview. Significant ethnic differences in the reporting of nebuliser use were observed. The use of this delivery system was reported by 64.6% of Pacific, 58.9% of Māori, and 37.1% of Other caregivers ($p<0.0001$).

Syrup form medications were reported by 14% of Māori, 7.7% of Pacific, and 6.1% of Other ethnic group caregivers ($p=0.02$).

6.1.1.2 Asthma self-management outcomes

6.1.1.2.1 Asthma education and knowledge

About 15% of the total sample had not received asthma education from a health professional. There were no ethnic differences in the proportions that had received education from a health professional. Among those who had received education from a primary care source, only 57.2% had received further education. After adjustment for potential confounders the Pacific ethnic group were less likely to have received further asthma education than the Other ethnic group (OR 0.55; 95% CI 0.31, 0.98).

High proportions of the total sample reported the use of verbal communication (98.4%), practical demonstrations (86.1%), and written material (81.8%) to deliver asthma education. Practical demonstrations were cited less frequently by Pacific caregivers (79.7%), compared with 86.2% of the Māori and 90.5% the Other ethnic groups ($p=0.04$).

The topics covered in asthma education showed some variation by ethnic group. Education about asthma medications and the devices used to deliver them was almost universally reported (97.9% and 94.4% respectively), with no evidence of ethnic differences. However, fewer Māori (63.6%) and Pacific (68.1%) caregivers reported education about asthma

pathophysiology (Other 75.0%; p=0.05) and asthma triggers (Pacific 77.7%, Māori 79.8%, and Other 89.2%; p=0.01). Similarly, fewer Pacific (22.7%) caregivers reported education about action plans compared with 32.9% of Māori and 36.5% of Other caregivers (p=0.04).

A lower proportion of Māori (64.2%) and Pacific (68.5%) caregivers reported that the education had been clear and easy to understand (Other 77.9%; p=0.03). However there were no ethnic differences in the caregivers' perceptions of the amount of information received or in the usefulness of the information.

The assessment of caregiver's asthma knowledge identified significant ethnic differences on testing of knowledge of asthmas symptoms (p<0.0001), asthma general knowledge (p=0.0018), and triggers (p<0.0001). In these three instances the median and distribution of the scores reflected lower knowledge levels among Māori and Pacific caregivers. Similarly, the scores obtained for the asthma management scenario were lower for the Māori and Pacific ethnic groups compared with the Other ethnic group (6.4, 6.6, and 7.0 respectively; p=0.05). No ethnic differences in knowledge of pathophysiology, reliever medications or parental confidence managing asthma were observed.

6.1.1.2.2 Asthma action plans

Just over one third of all participants had heard of action plans. Significantly fewer Pacific (23.0%) and Māori (33.8%) caregivers reported having heard of action plans (Other 46.4%). After adjustment for potential confounders, the Māori ethnic group odds ratio for having heard about action plans was 0.80 (95% CI 0.47, 1.36) and the Pacific odds ratio was 0.55 (95% CI 0.31, 0.99).

A smaller proportion, 23.3% of the total sample, had ever been given an action plan. Current action plans, defined as having been provided or updated in the previous 12 months were uncommon, with only 10.9% of participants having a current action plan. There were no observable ethnic differences in the reporting of ever having been given a plan, or having a current action plan.

Among those who had ever been given an action plan, there were no ethnic differences in caregivers' experiences of the amount of information provided about action plans, their understanding of the explanations, or their perceptions of the usefulness of the plan.

6.1.2 Health service utilisation outcomes

Just over half of caregivers (51.0%) reported having a regular source of care they saw all of the time for the management of their child's asthma. Only 7.7% of the total sample did not have a regular source of care. Significant ethnic differences in the use of a routine source of care were observed. A higher proportion of Māori (56.5%) and Pacific (48.1%) than Other (43.3%) caregivers reported they did not have a routine source of care or had a routine source of care but sometimes used other GPs. The majority of these participants had a regular source of care but also used other GPs.

The mean number of visits for both acute and routine asthma care was higher for Māori and Pacific children and these differences were statistically significant. Likewise, significantly greater proportions of Pacific and Māori caregivers reported their child had attended an ED at least once in the previous year. Admission to hospital was also reported significantly more frequently by Pacific and Māori caregivers.

Multivariable analyses to investigate the association between ethnicity and health service utilisation outcomes after adjustment for potential confounders and primary care asthma management variables were undertaken.

Adjustment for potential confounders and primary care asthma management variables reduced, but did not fully account for, ethnic differences in the number of GP visits for acute and routine care (combined). Māori children experienced 22% more GP visits and Pacific children had 28% more GP visits than Other ethnic group children (p=0.05).

Ethnic differences in ED use persisted after adjustment for potential confounding and asthma management variables. Māori children were over twice as likely (OR 2.69, 95% CI 0.87, 8.32) and Pacific children nearly seven times (OR 6.93; 95% CI 2.40, 19.98) as likely to have used an ED in the previous 12 months. The overall effect of ethnicity was statistically significant (p=0.0007).

Adjustment for potential confounding and asthma management variables did not fully account for ethnic differences in the likelihood of admission to hospital and the overall effect of ethnicity was statistically significant (p=0.007). Pacific children were most likely to have

been hospitalised (OR 8.94; 95% CI 2.25, 35.62). Māori children were over five times as likely to have been hospitalised (OR 5.40; 95% CI 1.27, 23.06).

6.1.3 Sensitivity analyses

Sensitivity analyses that included morbidity in the multivariable models did not result in major changes to point estimates, confidence intervals, and p values except for the outcome variable 'admission to hospital'. For this outcome, the inclusion of morbidity in the model resulted in an increase in the strength of the association, and a more marked increase in the upper confidence limit for both Māori and Pacific odds ratios. That is, controlling for morbidity reduced the precision of the estimates for admission to hospital. Without morbidity in the model, Māori children were over five times as likely to have been admitted to hospital than Other children (OR 5.40; 95% CI 1.27, 23.06). The inclusion of morbidity in the model resulted in an odds ratio of 5.78, and the confidence interval was 1.18 to 28.41. The changes were more marked in the Pacific group. Without morbidity in the model Pacific children were about nine times more likely (OR 8.94; 95% CI 2.25, 35.62) to have been admitted to hospital in the previous 12 months than Other children. The addition of morbidity in the model resulted in an odds ratio of 10.70 and the confidence interval ranged from 2.24 to 51.09.

The effects of using the SNZ prioritised ethnicity variable rather than the CG prioritised variable were more complex. The reclassification of ethnicity from CG to SNZ prioritised ethnicity primarily affected the Māori ethnic group. Reclassification of ethnicity resulted in the movement of children who had Māori and a preferred non-Māori ethnic group from the CG preferred ethnic group into the SNZ Māori ethnic group.

The use of SNZ prioritised ethnicity resulted in no or minor changes in the precision of the estimates, as evidenced by minor changes to confidence intervals for five of the eleven outcome variables. The effect on the other outcome variables varied. Major increases in the strength of association (point estimates), and reduction in precision (wider confidence intervals) were seen in Māori and Pacific odds ratios for ED use and admission to hospital. Changes to findings for other outcomes included both increases and reductions in ethnic differences. The effect estimate for GP visits was reduced in the Māori ethnic group from 0.22 CG prioritised to 0.12 SNZ prioritised, and the overall effect of ethnicity was no longer statistically significant when the SNZ prioritised ethnicity variable was used. On the other

hand, the use of SNZ prioritised ethnicity increased the strength of the association for the variable 'has a current action plan' for the Māori ethnic group (odds ratio 2.52; 95% CI 1.10, 5.80), although the Pacific OR and CI were essentially unchanged and the overall effect of ethnicity was not statistically significant.

The use of the SNZ prioritised variable was associated with an increase in the strength of association and precision in the Pacific ethnic group for the outcome 'received further asthma education', with little change to the Māori estimates. In addition, the effect of ethnicity became significant for this variable (p=0.04). Using SNZ prioritised ethnicity the Pacific odds ratio was 0.46 (95% CI 0.25, 0.85) compared with CG prioritised odds ratio 0.53 (95% CI 0.30, 0.95).

Finally, the use of SNZ prioritised ethnicity resulted in a reduction in the precision of Pacific estimates for the variable 'heard about action plans', with the confidence intervals widening to include 1.00 while the Māori estimates were essentially unchanged.

The effects of using different ethnicity variables differed according to the outcome being examined. In addition, the direction of the observed changes varied across different outcomes i.e. ethnic differences were reduced for some outcomes and increased for others. These observations provide some evidence that the use of different methods for classifying ethnicity influences study outcomes. Further research is required to provide a greater understanding of these effects and why they occur. Furthermore, the use of ethnicity variables in future research must be carefully considered and grounded in a strong understanding of the theoretical issues underlying the determination, collection, classification and interpretation of ethnicity data.

6.2 Strengths and weaknesses of the study

6.2.1 Internal validity

The internal validity of a study is "the degree to which the results of an observation are correct for the particular group of people being studied" (Beaglehole, Bonita, & Kjellstrom, 1993 p. 52). The internal validity of the study may be compromised by both random and systematic error. The threats to internal validity are managed by ensuring that the study is

well designed. This section discusses the strengths and weaknesses of the study, and the strategies used to minimise the threats to the internal validity of the study.

6.2.1.1 Study design

Studies that specifically address whether there are ethnic differences in the management of asthma or the quality of asthma care received are uncommon. This study specifically asked whether there were ethnic differences in aspects of asthma management; this is one of the strengths of the project.

The location of the study within KMR methodology, and the focus on identifying ethnic differences in management and the role that these may play in asthma outcomes are also important strengths of the study. The use of equal explanatory power and non-deficit analysis remains relatively uncommon in epidemiological and health services research, and the application of these approaches in this study provides a useful example to others, as well as contributing to the growing body of information about the implementation of KMR in quantitative research.

The study is a cross-sectional survey. Studies using this design are able to report associations between exposures and outcomes but are unable to attribute causation. In relation to this study this means that, while associations between ethnicity and outcomes can be reported, it is not possible to say that there is a causal relationship. In order to identify a causal relationship the outcome information would need to be collected after exposure (ethnicity) information had been gathered (i.e. a cohort study). Ideally this would involve prospective collection of the outcome information rather than retrospective collection as prospective data collection will minimise recall bias. However, both types of cohort study are more able to provide evidence of causation than the cross-sectional survey design. To some extent the design limitations of the cross-sectional survey design are counter-balanced by its logistical and financial advantages, particularly in relation to data being gathered at a single time point.

Similar caution must be exercised when considering study findings and guideline recommendations for quality of care. The study was not designed to quantify care against specific quality of care indicators. Therefore, although attention can be drawn to results or associations that suggest there may be quality of care issues, the study is not able to make definitive findings in this regard.

The study collected data on a comprehensive array of components of asthma management. This is one of the strengths of the study.

6.2.1.2 Selection issues

Selection bias is error that is introduced if there are systematic differences between the people selected for the study and those who are not selected (Beaglehole, Bonita, & Kjellstrom, 1993). This section discusses issues relating to the selection of participants in the study.

6.2.1.2.1 Sampling frame

The purpose of the study was to describe asthma management in the community and ascertain if there were ethnic differences in management. It is important that the frame from which the participants were drawn was representative of the range of children with asthma, asthma morbidity, and management practices that occur in the community. Sampling frames drawn from children who have been admitted to hospital, seen in EDs or seen in hospital clinics will not be representative of all children with asthma in the community and are likely to be biased towards children with higher morbidity. The use of GP databases to identify a sample may also result in selection bias, as eligible children who do not have a regular source of GP care, and those who are infrequent attendees or have incomplete medical record documentation, will not be identified in a sampling frame using GP databases. The sampling frame used in this study is a major strength. A list of residential addresses from the study region was drawn up by an independent agency and was produced in a random manner. The use of residential address start points as the basis for identifying eligible children in the community meets the criteria for ensuring representativeness of asthma in the community and avoids the potential biases associated with the other sampling frames that, if present, are likely to result in an underestimation of the true effect.

Once children were identified as eligible, a sampling ratio was used to ensure approximately equal numbers of Māori, Pacific, and Other ethnic group children were enrolled into the study. All eligible Pacific children were enrolled into the study. Seventy-three percent of eligible Māori children (SNZ prioritised ethnic group) and 41.8% of Other children were enrolled into the study after application of the sampling ratio. The sampling ratio was applied

using a table of random digits and therefore the enrolled sample in the Māori and Other ethnic groups should not differ systematically from those who were excluded.

Ideally, data about the children whose caregiver declined to put the child forward for the application of the sampling ratio would have been collected. This data would have allowed the investigators to assess characteristics of these children against those of the children who did go forward for enrolment and would have added to information regarding the representativeness of the study sample and the external validity of the results. Unfortunately, reliable data of this type is not available.

6.2.1.2.2 Ascertainment of asthma status

Prevalence studies of asthma have documented differences in the prevalence of doctor diagnosed asthma and wheeze (or other symptoms) without a diagnosis of asthma (see for example Barry, Burr, & Limb, 1991; Duran-Tauleria, Rona, Chinn, & Burney, 1996; Neville, Bryce, Robertson, Crombie, & Clark, 1992; Yeatts, Davis, Sotir, Herget, & Shy, 2003).

In this study the presence of asthma was determined by asking householders about children who had been diagnosed with asthma or had experienced wheeze or whistling in the chest. This approach was used to maximise the identification of children with asthma – both those who had a formal diagnosis and those who did not.

Children aged less than two years were not eligible for the study. The diagnosis of asthma in children under one year of age is very difficult, as non-asthma wheezy illnesses are common in this age group. In order to avoid misclassification of asthma status in this group, eligibility was limited to children over one year of age. As participants also had to have experienced asthma symptoms in the previous 12 months, the lower age limit for eligibility for the study was two years of age.

At the point of arranging an interview time, the eligibility of four enrolled children was determined to be incorrect because the caregiver stated the child ‘doesn’t have asthma’. This may reflect errors on the part of recruiting staff when ascertaining asthma status, or may have arisen through the use of the word ‘asthma’ when arranging interviews. The use of the word ‘asthma’ may have resulted in re-classification of the children as ineligible if their caregivers understood the symptoms as wheeze rather than asthma. It is not possible to ascertain

whether asthma status was misclassified at the time of recruitment or when arranging the interview. Misclassification at the time of arranging an interview could affect the outcomes of the study, particularly if those who were misclassified differed systematically from those who remained in the sample. The impact of any such differentially applied misclassification bias would be to under or overestimate the true effect estimates. There are no data that allow us to investigate possible systematic differences between these two groups. However, if such differences were present the effect on the results of the study is likely to be minimal as only four children are in the group 'doesn't have asthma'.

6.2.1.2.3 Design effects

Design effects relating to the cluster effects associated with the recruitment process and the unequal probability of selection for children in families with more than one eligible child were taken into account during data analysis.

6.2.1.3 Information biases

Errors in the collection of data about exposures and outcomes may result in biased estimates of these measures. The possible sources of information bias and the likely effect of these biases on the estimates obtained in the study are discussed in this section. As with other forms of bias, the impact of the bias on effect estimates will vary depending on whether the bias is differentially or non-differentially applied to subgroups within the study. If differentially applied, the study effect estimates will under or overestimate the true effect size.

6.2.1.3.1 Response bias

After application of the sampling ratio, 649[49] of the 1 034 children who had been identified as eligible for the study were enrolled and offered an interview. Sixty four participants did not complete the study. The completion rate for the interview was very high overall (90.1%).

[49]This number includes two participants who were found to be outside the age range, 583 participants who completed the study, and 64 who did not complete.

There were no ethnic differences in the completion rates. The high completion rate for all ethnic groups is a major strength of the study.

There was no statistically significant difference in the distribution of NZDep96 decile scores between those who completed the study and those who did not complete. However, the mean age[50] of those who did not complete the study (8.71 yrs; 95% CI 7.92, 9.51) was lower than that of interview completers (9.80 yrs; 95% CI 9.53, 10.06 p=0.009). The impact of this will vary according to the nature of the relationship between age and the specific outcome measure. For example, outcome measures that are more common in younger ages will be underestimated and measures that are less common in younger groups will be overestimated because of the significantly younger age of the non-completer group. However, the effect of the age difference will be non-differentially applied with respect to ethnicity because there is no difference in the distribution of ethnicity between completers and non-completers, and there are no differences in age between ethnic groups in the sample of children who completed the interview. That is, the effect of bias due to the younger age of non-completers will be to under or overestimate the effect size for the total sample and within each ethnic group, and will not impact on estimates of ethnic differences in outcomes.

6.2.1.3.2 Recall bias

The cross-sectional survey design is prone to recall bias if participants are asked to recall information over a time period. Longer time periods are more vulnerable to errors in recall than shorter ones. This study is prone to recall bias, as it asks participants to recall information over the 12 months prior to interview.

The extent of recall bias could have been assessed by validating the information provided by the caregivers against another information source such as the medical records held by the routine source of GP care. However, this would not have provided a complete and accurate assessment of recall bias, as information about management from other GPs and other services (AHMC, EDs, admissions, hospital outpatient clinics) would not be available from

[50]The mean age was calculated using a fixed date (the day the analysis was done) and the child's date of birth, which was available for all children who were enrolled into the study regardless of completion status.

these records. There is some evidence to suggest that parent recall for asthma-related doctor visits and hospitalisations is reliable (Pless & Pless, 1995). Nevertheless, should there be recall bias due to the length of time (i.e. poorer recall of events that occurred longer ago), there is no evidence that this bias would vary by ethnicity. That is, there is no evidence that different ethnic groups would vary in their ability to remember more distant events thereby introducing non-differential recall bias by ethnic group. Any recall bias would, therefore, be non-differentially applied, and would result in an underestimation of the effect.

Recall bias is also possible if caregivers of children with more severe asthma recall events such as the provision of medications differently from those with less severe asthma. The most rigorous method of assessing the extent of this potential bias would be to compare the caregivers' data with another valid data source such as medical records. For the reasons noted above, this method of validation was not undertaken. There is no evidence to suggest that this type of recall bias may vary by ethnic group per se. However, morbidity is lower in the Other ethnic group. Consequently, if recall was poorer among participants with lower morbidity, the bias may be non-differentially applied, be greater in the Other ethnic group, and result in an overestimation of ethnic differences in the outcomes. The findings that there were no significant differences in the proportions who reported use of inhaled β_2 agonists or ICS by morbidity provide some evidence against the presence of this type of recall bias.

The prevalence of asthma symptoms may vary by season, with increased morbidity during winter months (Stewart et al., 1997). A 12 month recall period was employed in this study to minimise the likelihood of this bias. The impact of this type of bias on the findings is likely to be non-differentially applied as there is no evidence that recall varies by ethnicity, and the use of the sampling ratio meant that participants in all three ethnic groups were recruited consistently across all months (and, therefore, seasons) of the study. In addition, data was collected continuously over a two year period, which reduces the likelihood of season-of-response bias.

6.2.1.3.3 Measurement issues

The phrasing of two questions did not allow sufficient differentiation of information. Participants were asked about the provision of oral steroids in the previous 12 months. Oral steroids may be prescribed for acute symptom management or for preventive management in very severe asthma. As very severe asthma is relatively uncommon it is reasonable to assume

that most of the courses of oral steroids will have been for the management of acute asthma. However, it would have been preferable to collect this information from the participants.

Similarly, participants were asked if they had taken medication in syrup form but were not asked what medication the syrup contained. As a result it is possible that syrups were (guideline appropriate) oral steroids, may have been non asthma-related medications such as antibiotics or cough mixtures, or asthma medications that are no longer recommended (oral salbutamol and ketotifen).

The wording of questions about medication use also leaves the study open to a face validity issue that influences the interpretation of this data to some extent. The aim of the study was to examine the care provided by GPs to children with asthma. This was explicitly stated in the participant's information sheet. Furthermore, most questions were phrased in such a way as to support this focus. However the medication question was, 'Has your child used any of the following medicines (regularly or occasionally) for asthma or wheeziness?'. Therefore, participants may have reported what medications they had given to the child rather than those that the doctor had provided (regardless of whether it had been given to the child or not). It is not possible to determine the extent to which this may have occurred. As a consequence, it is not possible to say definitively that findings in relation to medications reflect differences in GP management, as they may reflect differences in the caregiver's use of medications.

In order to reduce errors introduced by errors in data entry, data were double entered and the two datasets were compared. Any detected errors were corrected.

6.2.1.3.4 Missing data

Missing data was not a significant issue in this study. The variable with the greatest number of missing variables was the household income variable which had data from 510 of the 583 participants. The majority of the other 'total sample' variables had complete information. The number of participants in the variables that did not have complete information varied from 552–582.

Sample sizes were limited for several outcome variables. The variable 'given further education' only included those participants who had been given education by a primary care source (n=471). Similarly, the variable 'has a current action plan' was limited to those

participants who had ever been given an action plan (n=131). The impacts of these limits are discussed in the section on precision (Section 6.2.1.5).

6.2.1.4 Potential confounding

Multivariable modelling was used to control potential confounding in this study. Logistic regression modelling was used to examine the relationship between ethnic group and asthma management outcomes while controlling for a range of variables that could confound the relationship. Logistic and linear regression modelling were used to examine the effect of asthma management on ethnic differences in health service utilisation outcomes. The potential confounding variables were also included in these models.

During the design of the study potential confounders, identified using the literature and current understanding of the area, were identified. These potential confounders were explicitly measured and incorporated in multivariable models after assessment of collinearity between variables was undertaken. The ascertainment of potential confounders was more complete in this study than in previous NZ and international studies. This is a strength of the study.

Potential confounding by differences in access to care was partially accounted for by including a variable about having a routine source of GP care. Control of potential confounding by access to care differences could have been improved by collecting data about unmet need for asthma care in the previous 12 months.

The inclusion of four variables measuring different aspects of socio-economic position is also one of the strengths of the study. However, this approach may also be viewed as over-controlling for potential confounding by SEP. Where significant ethnic disparities are identified, over-control of confounding will bias the effect measures towards the null (i.e. underestimate the ethnic disparity for Māori and Pacific groups). Likewise, results that indicate there are no ethnic disparities may, at least in part, be explained by over-control for confounding by SEP. The author takes a conservative stance in this matter, believing that (if necessary) it is preferable to argue that the findings are underestimated rather than have the impact of the results affected by criticism about inadequate control of potential confounding by SEP.

Asthma management practices and potential confounding variables did not account for all the observed ethnic differences in the number of GP visits, use of EDs, or hospital admissions. It is likely that residual confounding explains, at least in part, the remaining ethnic differences. In particular, exposures to factors that are associated with morbidity and vary by ethnicity may be important residual confounders of health service utilisation variables.

Morbidity in the previous 12 months was not included as a confounder in multivariable modelling because morbidity is primarily an outcome (and determinant) of management rather than a confounding variable. However, as morbidity had been treated as a confounder in some previous publications, a sensitivity analysis was performed for the major outcome variables. Inclusion of morbidity in the models did not substantively alter the results of the modelling for the majority of outcomes. The exception was 'admission to hospital' where the strength of the association was increased for Māori and Pacific ethnic groups, but the precision of the estimates was reduced by the inclusion of morbidity in the model.

6.2.1.5 Sample size, and precision

Ensuring an adequate sample size is an important strategy for reducing the impact of random error on study findings. Sample size calculations (see Section 4.4) were undertaken to determine the number of participants that would be required in each ethnic group to detect ethnic differences in asthma management outcomes, and were based on estimates obtained in earlier studies.

Tests of statistical significance were undertaken to provide an estimate of the likelihood that findings were due to chance. Where the test of significance related to the ethnicity variable the test was applied across the variable. That is, tests comparing the three ethnic groups separately (i.e. Māori versus Pacific, Māori versus Other, and Pacific versus Other) were not undertaken. Findings were considered to be significant if the p value was ≤ 0.05. Measures of precision such as 95% confidence intervals and standard error were also used during data analysis and the interpretation of the results.

In the power calculations the proportion that would be 'currently on preventive medication' was lower than those observed in this study (Table 37). This suggests that overall use of preventive medications has increased since the earlier studies were undertaken. In addition, absolute differences in the proportion on ICS in each ethnic group were lower than those used

for the power calculations. The capability to detect ethnic differences in ICS in this study is limited by the higher prevalence of ICS use and the smaller absolute differences between ethnic groups than those seen in earlier studies. A greater sample size would have been required to detect significant ethnic differences with the prevalence of ICS observed in this study. Given the limited study power to test this association (as reflected by the wide confidence intervals) the study cannot draw robust conclusions about ethnic differences in the use of ICS.

Table 37 Proportions used in power calculations and proportions observed in study for 'inhaled corticosteroid' and 'has a crisis plan'

	On preventive medicine at interview		Action plan		
	Expected*	Observed (ICS)	Expected*	Observed (ever been given)	Observed (current plan)
Māori	13	63.7 (56.9, 70.5)	40	23.9 (17.7, 30.1)	12.0 (6.9, 17.1)
Pacific	4	61.7 (54.4, 69.1)	15	19.2 (13.3, 25.2)	9.9 (5.5, 14.3)
Other	25	65.2 (58.9, 71.6)	40	25.9 (19.6, 32.1)	10.7 (6.4, 15.1)

*Expected proportion used in power calculations

The reported overall prevalence for the variable 'ever been given an action plan' was lower than that used to power the study, and the observed prevalences for the Māori and Other ethnic groups were lower than those used in the power calculations. This reduced the precision of ethnic group estimates, illustrated by the wide confidence intervals, and reduced the power to detect ethnic differences. As with ICS, the findings in relation to ethnic group and action plans may reflect power issues rather than a 'true' lack of ethnic disparities, and consequently the study cannot draw robust conclusions about ethnic differences in the provision of action plans. Similar conclusions can be drawn for the variable 'has a current action plan'.

The lower than expected prevalence of action plan provision also limited the precision of estimates about participants' perceptions of action plans, and to a lesser extent asthma education, where the sample was limited to those who had ever been given an action plan, or those who had received education in primary care. The reduced power and limited precision adversely affected the ability of the study to identify ethnic differences in these data.

However, as these were not primary outcome variables this issue is of less importance than the reduced power and precision for estimates of the primary outcome variables.

Low frequency events in a community-based sample are likely to be associated with reduced precision of estimates and relatively wide confidence intervals. This effect is seen for the outcome variables ED use and admission to hospital. However, despite the low numbers and wide confidence intervals, significant ethnic differences for these outcomes are observed.

6.2.2 External validity

The external validity of a study relates to the degree to which the findings of the study can be generalised (applied) to populations other than the population in the study.

In order for a study to be generalisable to other populations the study itself should be internally valid. In addition, the study population should be representative of the population that one wishes to apply the findings to. The internal validity of this study, including issues related to the sampling frame and enrolment into the study, have been discussed in the preceding sections. This section discusses the external validity of this study. The representativeness of the study population is considered in relation to the population of children with asthma in the community and the ethnic populations in the community.

The study population was drawn from the community and is, therefore, more representative of the population of children with asthma than studies that drew their samples from other sampling frames such as hospital services. Two exclusion criteria were used to reduce the likelihood of including in the study children who did not have asthma. These criteria should have increased the representativeness of study participants in relation to children in the community with asthma. Children who were eligible for the study were identified using a random list of residential address start points and eligible children were enrolled into the study using a randomly applied sampling ratio for each ethnic group. These processes will have reduced systematic error in the identification and enrolment of participants and increased the representativeness of the study population in relation to the population of children with asthma in the community. Overall, the study population can be considered to be representative of children with asthma in the community.

As the primary aim of the study was to compare outcomes across ethnic groups, the sample size for each ethnic group needed to be sufficient to allow valid comparisons to be made. This was achieved through the use of a sampling ratio that resulted in different proportions of children within each ethnic group being enrolled into the study. If sampling ratios had not been used the proportion in each ethnic group would have been equivalent to the proportions in the population residing in the study region, resulting in a sample comprised of approximately 20% Māori, 22% Pacific, and 58% Other group participants,[51] and the required sample size to ensure equal explanatory power would have been much greater. The key issue in relation to representativeness is whether the samples of each ethnic group are representative of that ethnic group within the community. That is, does the Māori study population represent Māori children with asthma in the community, is the Pacific study population representative of Pacific children with asthma in the community, and is the Other ethnic group study population representative of Other ethnic group children with asthma in the community?

Eligible Pacific and Other ethnic group children were identified in a random manner. All the eligible Pacific children were enrolled into the study and eligible Other ethnic group children were enrolled using a randomly applied sampling ratio. The Pacific and Other ethnic group children in the study sample should be representative of those ethnic groups in the community, and the results of the study should be generalisable to those groups in the community.

Eligible Māori children were identified in a random manner, and at that point were representative of Māori children with asthma in the community. The application of the sampling ratio was applied to Māori using SNZ prioritised ethnicity. The data analysis used CG prioritised ethnicity. The extent to which either of these classification groups represents 'the' Māori community is, as outlined in the Introduction, a contentious and debated issue. In retrospect, it would have been preferable to use the same classification of ethnicity for application of the sampling ratio and data analysis. However, had this been done, the choice

[51]These percentages are calculated from the population estimates in the study area used to calculate the study sample size.

of classification would still have been open to debate about whether it was appropriate and how well it represented 'the' Māori community. The use of SNZ rather than CG prioritised ethnicity in multivariable models made little difference to the outcomes for asthma management. Taking into account the points made above, it is reasonable to conclude that the Māori study population is representative of Māori children in the community, and the results can be generalised.

To summarise, the external validity of the study is determined by its internal validity and the degree to which the ethnic groups in the study are representative of the ethnic groups in the community. The study is a robust example of cross-sectional design and has high internal validity. The study population is representative of the population of children with asthma in the community. The three ethnic groups are also considered to be representative of those ethnic groups in the community. Although the ethnicity classification for Māori differed between enrolment and data analysis the impact of this difference on asthma management outcomes was small. Taking these factors into consideration, the current study should be considered to have good representativeness and the findings of the study should be able to be generalised to the wider population of children with asthma in the Auckland, and nationally.

6.3 Comparison with other literature

This section compares the findings from this study with those obtained in NZ and in the international literature. It also compares the findings with the recommendations in the evidence-based guidelines for children's asthma management.

6.3.1 Medications and medications delivery systems

The current study found very high use of β_2 agonists with 96.0% of Māori, 97.3% of Pacific, and 93.6% of Other ethnic group caregivers reporting the use of these medications in the previous 12 months. The use of β_2 agonists is higher than that reported in previous NZ studies involving children. Mitchell & Quested (1988) reported that 59% of 'Polynesian' and 81% of European children who had been admitted to hospital had received these medications in the 24 hours before admission. Six months after discharge the proportion on these medications had increased to 77% for 'Polynesian' and 88% for European children. Mitchell reported that, in a community-based sample, 55% of European, 43% of Māori, and 21% of Pacific ethnic group children were currently taking a bronchodilator (Mitchell, 1991).

However, in a study involving children and adults presenting at EDs, Garrett, Mulder, & Wong-Toi reported higher use of β_2 agonists with about 98% of European, 95% of Māori, and 87% of Pacific participants receiving these medications (Garrett, Mulder, & Wong-Toi, 1989). The use of β_2 agonists in the current study is consistent with the findings of Kljakovic (1994) who reported that, among asthmatic children who had received prescriptions in a 12 month period, 93% had been prescribed a reliever medication. Four of the studies included in the critical appraisal reported on β_2 agonist medication use in the previous three months or year (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Ortega et al., 2002), or 'carries a β_2 agonist' (Moudgil & Honeybourne, 1998). The proportions of participants that reported β_2 agonist use in these studies were lower than the current study.

No significant ethnic differences in the use of β_2 agonists were observed in the current study. Statistically significant ethnic differences were reported by Mitchell & Quested (1988) and Mitchell (1991) but were not observed by Garrett, Mulder, & Wong-Toi (1989). Direct comparisons are difficult because previous studies reported on 'current use', rather than the previous 12 months, and used different sampling frames. However, comparing current findings with those of the study of children drawn from the community (Mitchell, 1991) suggests that the use of β_2 agonists in NZ has increased overall and that ethnic differences have decreased. In the international literature multivariable analyses found ethnic differences in the use of β_2 agonists in three of the four studies reporting on β_2 agonist use, with minority groups less likely (or White/European more likely) to have used or to carry these medications (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Moudgil & Honeybourne, 1998; Ortega et al., 2002). One study found no ethnic differences in the use of β_2 agonists in the previous 3 months (Inkelas, Garro, McQuaid, & Ortega, 2008) and Zoratti et al. (1998) found no ethnic differences in the average number of β_2 agonist prescriptions filled. Shields et al. (2004) found that Hispanic children were significantly less likely to have received 'excessive amounts' of β_2 agonist medication compared with White children, but there were no Black versus White differences in this indicator.

The use of oral steroids for acute asthma management appears to have increased when compared with the findings reported by Mitchell & Quested (1988). Ethnic differences in the use of oral steroids were not observed in previous studies or in the current study (Garrett, Mulder, & Wong-Toi, 1989; Mitchell & Quested, 1988). In all three studies these may reflect

'true' findings or may have arisen because the use of oral steroids is a low frequency event and the studies may have had insufficient power to detect ethnic differences.

Previous studies using non community-based samples of adults and children found that between 35% and 61% of participants were using preventive medications at enrolment into studies, and ethnic differences were described (Garrett et al., 1994; Garrett, Mulder, & Wong-Toi, 1989). One study of children observed that 8% of 'Polynesian' and 13% of European children had received inhaled steroids in the 24 hours prior to admission and about one quarter of both ethnic groups were on these medications when followed up six months later (Mitchell & Quested, 1988). In the current study 68.7% of the total sample had received ICS in the previous 12 months. Direct comparison of these studies is difficult as the sampling frames differed (site of recruitment and ages of participants) and the current study used 'in the last 12 months' rather than 'currently receiving'. On one hand, it may be expected that participants drawn from EDs and hospitals would have higher morbidity and be more likely to be prescribed preventive medications than participants in a community-based sample. On the other hand, assuming that preventive medications will reduce the need for EDs and hospitalisations, one may expect lower use of preventive medications in the group that utilises these services.

Statistically significant differences in the proportions of community-based European (25%), Māori (13%), and Pacific (4%) children receiving preventive medications were reported by Mitchell (1991). The community-based study by D'Souza et al. (1994) found that 61% of participants had preventive medications when they were enrolled into the study. Kljakovic (1994) reported that, among asthmatic children who were prescribed an asthma medication, 63% had received an inhaled or oral corticosteroid. The current findings are more consistent with these results, although it should be noted that the sample in D'Souza et al.'s (1994) study comprised Māori aged 14–65 years only, and over half the children with asthma in Kljakovic (1994) had not been prescribed any medication for asthma over the 12 month period. Overall, it is reasonable to conclude that the overall use of ICS has increased.

The use of inhaled corticosteroids or inhaled anti-inflammatory medications was reported in all the studies included in the critical appraisal (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Krishnan et al., 2001; Lieu et al., 2002; Moudgil & Honeybourne, 1998; Ortega et al., 2002; Shields, Comstock, & Weiss, 2004; Zoratti et al., 1998). The current study's finding that about two thirds of participants had

received an ICS in the previous 12 months is consistent with the proportions reporting possession of an ICS in Krishnan et al. (2001) but is higher than the proportions reporting daily use of ICS (Krishnan et al., 2001; Lieu et al., 2002), or use of ICS in the previous three months or year (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Inkelas, Garro, McQuaid, & Ortega, 2008; Ortega et al., 2002).

Multivariable analyses in four of the appraised studies found that the minority groups were less likely to have ICS (or, conversely, that 'Whites' were more likely to) (Duran-Tauleria, Rona, Chinn, & Burney, 1996; Krishnan et al., 2001; Lieu et al., 2002; Ortega et al., 2002). Inkelas et al. (2008) did not identify significant ethnic differences in use of an ICS in the previous three months, but all the minority groups were significantly less likely to have used 'any controller' in the previous three months. Ethnic differences in ICS were not identified in Mougdil & Honeybourne (1998). Zoratti et al. (1998) found that, for the total sample, African Americans received fewer prescriptions for ICS, but among a subsample of low income participants no ethnic differences in the average number of ICS prescriptions filled were identified. Shields et al. (2004) found there were no ethnic differences in the quality indicator 'prescribed more than three months supply of β_2 agonist in the previous six months and also received anti-inflammatory'.

The current study did not identify significant ethnic differences in ICS medications. This may reflect a 'true' reduction in ethnic differences, compared with the differences observed in previous NZ studies. However, the prevalence of ICS use in the current study was higher than that used in the power calculations and the results may reflect a lack of power to identify ethnic differences in the use of these medications.

This study found that after adjustment for potential confounders there were no ethnic differences in the receipt of cromoglycates in the previous 12 months. This is consistent with the finding of Ortega et al. (2002) and Zoratti et al. (1998).

Despite the overall increase in preventive medication use, the findings also provide evidence that medication-related management practices were not consistent with recommendations in evidence-based guidelines. 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 may be under-treated. The use of nebulisers was no longer recommended except in extreme circumstances. However, one third of Other and over half of Māori and Pacific caregivers

reported their child had received medications by nebuliser in the previous 12 months (Māori 58.9%, Pacific 64.6%, Other 37.1%; p<0.0001). The use of spacer devices for the delivery of medication to children under seven years is also recommended in the guidelines. In this study, about 80% of the caregivers of children under seven years reported use of spacer devices, suggesting that the use of these devices could be improved in the remaining 20% of children in this age group.

On the other hand, the limited use of anticholinergics (2.1% of participants) and ketotifen (0.3%) was consistent with recommendations that these drugs not be used.

6.3.2 Asthma education and asthma knowledge

Asthma management guidelines recommend that everyone with asthma should receive asthma education from an appropriately trained primary care health professional. Several findings in this study suggest that the provision of asthma education did not meet guideline recommendations.

Just over 15% of caregivers reported they had not received asthma education from a health professional. There were no ethnic differences in the proportions who had not received education from a health professional. Ellison-Loschmann, in a study of Māori 13–14 year olds with asthma, reported that 45% had been given asthma education in the previous 12 months. However, these findings need to be treated with caution as the study sample was small, the response rate was 52.4% (88/168), confidence intervals for the estimates were not reported, and the age ranges in the two studies were quite different (Ellison-Loschmann, 2004). Mougdil et al. (1998) reported that White/European males and females were more likely than Indian subcontinent participants to have ever been given asthma education, although the sample sizes were low and the confidence intervals included 1.0.

Asthma guidelines also recommend that education should be repeated over time. Just over half of those who had received asthma education reported receiving further education. There were ethnic differences in this outcome, with Pacific caregivers less likely to report having further education (adjusted OR 0.57; 95% CI 0.33, 0.96).

The guidelines also outline the topics that should be covered during asthma education. In this study the coverage of education topics varied. Education about medications and medication

delivery mechanisms was almost universal. However, the coverage of other topics was lower and only 31.4% of participants reported receiving information about asthma action plans. Significantly fewer Māori and Pacific caregivers reported receiving education about asthma pathophysiology, triggers, and action plans.

The current study's findings are consistent with those reported internationally as discussed in the critical appraisal. Mougdil et al. (1998) found no ethnic differences in the provision of information about medications, although Krishnan et al. (2001) reported that Whites were more likely to have received guideline consistent information about adjusting their medications. Ethnic differences in the provision of information about asthma symptoms and pathophysiology, and triggers were observed, with White participants more likely to have received this information (Krishnan et al., 2001; Moudgil & Honeybourne, 1998). Inkelas et al. (2008) found that, compared to White participants, Spanish speaking Latino caregivers were less likely to have been given education about recognition of early signs of asthma, what to do during an asthma attack, and changing the home environment.

The only previous NZ study that contains findings relating to the resources used during asthma education was that of Garrett, Mulder, & Wong-Toi (1989) who reported that about 60% of Māori and European participants and 40% of Pacific participants had been given written information about asthma. In this study a higher proportion of caregivers in each ethnic group had been provided with written information and significant ethnic differences were not observed. However, significantly fewer Māori (86.2%) and Pacific (79.7%) participants reported they had been given practical demonstrations (Other 90.5%, p=0.04). More recently Ellison-Loschmann (2004) reported that about 70% of Māori youth aged 13–14 years had (ever) been shown how to use inhalers by a doctor.

Neither the NZ literature nor the international literature that met criteria for inclusion in the systematic review has described caregivers' perceptions and experiences of asthma education.

Ethnic differences in asthma knowledge were not assessed in the international literature included in the critical appraisal but some aspects of asthma knowledge had been described in some of the NZ literature. Garrett, Mulder, & Wong-Toi (1989) found that a significantly higher proportion of European and Māori participants were able to recall their medications and knew which ones were preventive compared with Pacific participants. In a trial of an asthma education clinic the absolute scores for asthma management scenarios were not

reported, however, improvements in scores in the intervention group was greater among European than Māori and Pacific participants (Garrett et al., 1994). In the current study the reporting of asthma knowledge differed from that of these two studies. Nevertheless, the results are consistent with these studies in that Māori and Pacific caregivers' scores on tests of general asthma knowledge, symptom knowledge, triggers, and the asthma management scenario were significantly lower than the Other ethnic group caregivers.

6.3.3 Action plans

Previously published work undertaken with participants who were recruited from hospitals and EDs reported that around 40% of Māori, 40% of European, and 15% of Pacific people had an action plan (Garrett, Mulder, & Wong-Toi, 1989) and, in a later study, Garrett et al. (1994) reported that about 20% of participants had an action plan on entry to an intervention study. D'Souza et al. (1994) reported a smaller proportion (13%) of participants had action plans on entry into their study. The sample in D'Souza et al. (1994) was community-based and consisted entirely of Māori participants. More recently published work reported that about 9% of Māori adolescents 'had a written action plan' (Ellison-Loschmann, 2004) and 25% of community-based participants 'were using' an action plan when recruited into a study that examined the effects of pharmacist based asthma care intervention (Emmerton, Shaw, & Kheir, 2003).

In the current study 23.3% of participants had been given an action plan at some point. About 11% of participants were considered to have a current action plan. Ethnic group estimates for having a current plan were 12.0% Māori, 9.9% Pacific, and 10.7% Other. It is reasonable to expect that the proportion of participants with an action plan would be lower in a community-based sample because the distribution of morbidity in the community should differ systematically from that observed in a secondary care based setting, with higher morbidity observed in secondary care sites. The two community-based studies reported whether the participants 'had an action plan' and the findings were similar to those for 'has a current action plan' in the current study. Taking this into consideration, the current results suggest there has been little increase in the provision of action plans. Guidelines recommend that action plans are offered to people with mild asthma, and given to everyone with more symptomatic asthma. In this study a minority of children with moderate, severe, and very severe asthma had ever been given an action plan and even fewer had a current action plan (see Figure 11). The findings of this study suggest that action plans are under-utilised in the

management of asthma. This is consistent with the work of McNally et al. (2004) who repeated the survey undertaken by Garrett et al. (1997a). The proportion of GPs who reported they used action plans had decreased from 91.2% in 1995 to 70.8% in 2002 (McNally, Frampton, Garrett, & Pattemore, 2004).

Garrett et al. (1989) found significant ethnic differences in action plan possession, with Pacific people less likely to have an action plan than European or Māori people. Krishnan et al. (2001) found that 'White' participants were significantly more likely to have received guideline consistent information about action plan use than African Americans. In contrast, Inkelas et al. (2008) did not observe ethnic differences in 'ever' being given an action plan, and Lieu et al. (2002) found that 'Black' and 'Latino' participants were more likely to report having a written action plan than White participants. In this study, after adjusting for potential confounding, no significant ethnic differences in having ever been given an action plan or having a current action plan were observed. However, the sample size for these analyses was low, reducing the power to detect these differences.

Ninety percent of parents in a community-based trial of written action plans felt that the plan improved their care of the child's asthma (Gillies et al., 1996). A similar proportion of parents in this study (91.4%) reported that an action plan was useful for managing their child's asthma.

6.3.4 Health services utilisation

This study found that the mean number of GP visits for both acute and routine care was significantly higher among Māori and Pacific children. This finding supports that of Buetow et al. (2004) who, in a school-based sample of children with moderate to severe asthma, found that Māori and Pacific children had higher rates of GP visits than New Zealand European children.

The current study also found that the use of EDs and hospital admissions were significantly higher among Māori and Pacific children. These findings are consistent with national hospitalisation data (Robson & Harris, 2007) and the findings of previous studies (Garrett, Mulder, & Wong-Toi, 1989; Garrett, Mulder, & Wong-Toi, 1988; Mitchell, 1991). Ethnic differences in ED use were essentially unchanged after adjustment for potential confounding and management variables. Adjustment for potential confounding and management variables

diminished, but did not fully account for, ethnic differences in hospital admission. Some of the remaining differences may be explained by residual confounding by other factors that are associated with ethnicity and influence asthma morbidity such as exposure to cigarette smoke, dust mite exposure, housing quality and heating, and pet exposure (Wickens et al., 2001; Wickens, Fitzharris, & Crane, 1998). Incomplete control of confounding due to ethnic differences in access to care (particularly unmet need) may also explain some of the remaining ethnic differences.

6.4 Meaning of the study and implications

The results of this study suggest some aspects of asthma management, particularly in relation to the use of medications, are more consistent with asthma management guidelines than previously reported in NZ. The reported use of β_2 agonists was almost universal and the reported use of ICS in the previous 12 months was higher than that previously reported in NZ. Similarly, the reported use of medications that were no longer recommended by guidelines was very low. However, other findings suggested there may be room for further improvements to be made, especially in relation to the provision of preventive drugs to people with moderate, severe, and very severe asthma symptoms, and the appropriate use of devices such as spacers and nebulisers to deliver medications.

Successful self-management requires the person or caregiver to be provided with the skills (through education) and tools (action plans) necessary to manage asthma effectively. The findings in relation to asthma education and the provision of action plans suggest that these aspects of asthma management are underemployed by GPs. A minority of participants had been given an action plan, and even fewer had what could be considered a current action plan. Guidelines are clear that education should be provided in a structured way by a health professional, cover a range of topics, and be repeated over time. A sizeable proportion of participants reported they had not been given asthma education by a health professional, and of those that had, around half had not had any further asthma education. While the majority of those who had received education from a health professional reported being given information about medications, the coverage of other topics was lower.

The current study's findings suggest that ethnic differences in the use of reliever and preventive medications may have decreased, although it is possible that the limitations on power associated with higher than expected overall use of these drugs may have masked

ethnic disparities in the use of these medications types. Given the higher burden of disease experienced by Māori and Pacific children it is reasonable to expect that these children may be more likely to receive medications. There is no evidence of this in the current study, and this represents a relative under-treatment and ethnic disparity in care.

Some of the associations identified in this study suggest there may be ethnic differences in the pathways of care; however, the cross-sectional nature of the study means such observations should be viewed as indicative rather than definitive. Observations that could be regarded in this manner include: 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 analysis by morbidity suggesting Māori and Pacific children with severe morbidity may be less likely to receive preventive medications than Other ethnic group children. These observations may represent under-treatment of Māori and Pacific children, and may result in increased morbidity and hospitalisations.

Where comparisons with earlier NZ data are able to be made, the ethnic differences in asthma education and knowledge that have been identified in this study suggest that little improvement has occurred since the previous data was published. The current study provides new information about ethnic differences in asthma education and knowledge that strongly suggests improvements could be made in the provision of education, which should be followed by improvements in asthma knowledge and self-management skills.

Several important observations about health service utilisation can be made in relation to asthma-related health service utilisation. Firstly, compared to Other children, Māori and Pacific children make greater use of GP services for both routine and acute care. However, the reported care does not appear to reflect this higher level of service use, with findings that suggest that the visits may be associated with management of acute symptoms or events but are less likely to be accompanied by management strategies that will assist in the moderate and longer term control of asthma symptoms, particularly in relation to the resources required for effective self-management.

Implications for health policy

Detailed policy analysis and recommendations are beyond the scope of this thesis. Nevertheless, it is reasonable to comment that the findings of this survey in relation to the

observed ethnic disparities provide support for continuation of government policy and initiatives to reduce inequalities, and improve the health and well-being of Māori and Pacific people living in NZ (Ministry of Health, 2000, 2002a, 2002b).

Implications for the health sector, health services and clinical practice

The findings of this study raise several issues of relevance to the health sector, health services, and clinical practice.

Asthma is a chronic condition that is associated with significant costs to the health sector and to the children and families who are affected by asthma. These costs, and the high burden of disease experienced by children with asthma, are amenable to change through the provision of high quality primary care. Guidelines for managing asthma are widely available and are based on strong evidence, particularly in relation to pharmacological management, the provision of action plans, and delivery of asthma education. Reducing ambulatory sensitive hospitalisations is one of the Minister of Health's key targets for District Health Boards (Minister of Health, 2007), and improving access to, and the effectiveness of, 'mainstream' services is a key objective in the Māori Health Strategy (Ministry of Health, 2002a).

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 should be explicitly incorporated into funding and service delivery strategies aimed at improving the outcomes of chronic diseases and reducing ambulatory sensitive conditions.

PHOs and individual providers should review their approaches to supporting and delivering high quality asthma care.

Health professional behaviour and quality of care could be augmented in a number of ways. The role of appropriately trained nurses and pharmacists as providers of asthma care and education could be encouraged, and has shown to be effective in some studies encouraging a team-based approach to asthma care (Laurant et al., 2006) and a pharmacy demonstration project in NZ (Emmerton, Shaw, & Kheir, 2003). In addition, primary care teams should take a chronic disease approach to managing asthma and should incorporate regular review of people with asthma including regular review of medication needs, action plans, and updating caregiver's knowledge and asthma management skills.

Ensuring the care provided falls within the recommendations of evidence-based guidelines is also important. The results of this study suggest that there is significant scope to improve practices associated with the provision of self-management tools and asthma education as recommended by guidelines. The benefits of these activities has been clearly shown (Guevara, Wolf, Grum, & Clark, 2003; Toelle & Ram, 2006; Wolf, Guevara, Grum, Clark, & Cates, 2006).

Practitioners should be encouraged to increase the implementation of asthma guideline recommendations within their clinical practice. Mitchell et al. (2005) reported that the implementation of an asthma clinical pathway for children in general practice did not result in a reduction in asthma morbidity, measured by attendance at EDs and hospital admissions. However, there are a number of methodological issues that may have affected the outcomes of this clinical trial and resulted in the 'negative' findings, and efforts to improve the implementation of guidelines should not cease on the basis of this trial.

Clinical audit with feedback to individual clinicians is a useful tool for undertaking continuous quality improvement (Jamtvedt, Young, Kristoffersen, O'Brien, & Oxman, 2008). Specific reporting of audit findings by ethnicity will assist providers to reduce any identified ethnic differences in their practice. Other tools to assist clinical decision making and improve practice have been shown to be of use and could be further implemented in individual practices or across PHOs, including continuing medical education workshops and outreach educational visits to doctors' offices (O'Brien et al., 2008a; O'Brien et al., 2008b). Systematic reviews of other interventions, including the provision of electronic access to information for health professionals and on-screen reminders for aspects of care, and interventions to improve the management of asthma in primary care settings, are currently being undertaken (Gordon, Grimshaw, Eccles, Rowe, & Wyatt, 2008; Lozano et al., 2008; McGowan et al., 2008). Computerised decision-support tools to assist practitioners to align their practice with evidence-based recommendations for asthma management are also being implemented and evaluated (Adams et al., 2003; Kuilboer et al., 2006; Shegog et al., 2004; Shegog et al., 2006; Twiggs, Fifield, Jackson, Cushman, & Apter, 2004). This array of strategies should be considered when developing DHB or PHO-wide approaches to improving the management of asthma. The implementation of strategies to improve asthma management should be rigorously evaluated.

The data presented in this study was collected prior to the implementation of the primary care reforms. Data about asthma management in the PHO environment is not currently available. The primary care strategy emphasised prevention, health education, and population health; teamwork and the incorporation of other health professionals into primary care teams; and funding that was based on the PHO population's needs, with higher funding for populations with high needs and specific initiatives to increase access to care and improve the management of important conditions such as diabetes and cardiovascular disease. The primary care strategy has reduced financial barriers to care for many people. However, 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 incorporates a structured asthma education programme and the provision of action plans; 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. PHOs, as conceived in the primary care strategy, are ideally placed to lead efforts to improve the management of asthma in the communities they serve.

Finally, it is worth noting that this study's findings of ethnic disparities in asthma management are consistent with findings about ethnic disparities in disease management for other conditions, such as cardiovascular disease (Curtis, Harwood, & Riddell, 2007) and diabetes (Harwood & Tipene-Leach, 2007). The identification of ethnic differences in management across a diverse range of conditions suggests that underlying systemic issues may be important. Institutional racism has been identified as an issue in NZ (Harris et al., 2006b). The role that institutional racism and other systemic issues play in the development and maintenance of ethnic disparities in disease management should be identified and addressed.

Implications for research practice

This study provides an example of the successful application of KMR principles into epidemiological and health services research. The methods used to implement and support KMR principles in this research will be of use to others who are considering incorporating KMR into their own projects. The study also illustrates the complexity of the variable

'ethnicity' and provides information that will be of use in the on-going and contentious debate about 'ethnicity'.

The establishment of an advisory group reflected good research practice. The advantages of having an advisory group for this project were the group could provide information about the project to their communities and could have provided advice about issues arising during the implementation of the study. In practice these roles were limited by the relatively infrequent meetings. It is worthwhile considering whether this type of advisory group is useful for group members and researchers, what the expectations of advisory groups are, and how the group member's expertise and time could be utilised in more effective ways.

6.5 Unanswered questions and future research

The study design presented here is not able to attribute causation to any of the identified associations between asthma management and outcomes. However, it has identified significant associations between Māori and Pacific ethnic groups and outcomes, particularly in relation to asthma education and knowledge. The study has also demonstrated that the management of asthma, particularly in relation to asthma education and action plans, is not consistent with recommendations in evidence-based guidelines. The key consideration now is this: does the available information provide sufficient evidence to encourage a shift of focus from description to one of intervention? That is, should we continue to describe asthma management with a view to proving causation between ethnicity and outcomes or should we move to approaches that focus on improving asthma management, implementing guideline recommendations for management, and reducing ethnic differences in management? The author believes that there is sufficient evidence to allow a move to interventions to improve asthma. Should further studies be undertaken to establish causation, cohort studies will be required and ideally these should involve the prospective collection of data, with sufficient sample sizes of Māori, Pacific, and Other ethnic groups to accurately reflect these groups' experiences.

6.6 Conclusions

The aim of this study was to investigate the effect of ethnicity on asthma management and health service utilisation in a random, community-based sample of Auckland children from Māori, Pacific, and Other ethnic groups.

The research undertaken has been located within a kaupapa Māori methodological position and has sought to make explicit the experiences of Māori and Pacific peoples. The study has contributed to the body of knowledge about applying this methodology to quantitative epidemiological and health services research. The study is a well designed, rigorously analysed cross-sectional survey with high internal and good external validity. The findings can, therefore, be generalised to the wider community of children with asthma.

The results of the study have indicated that for many children the asthma management they experience differs from that recommended by explicit evidence-based management guidelines. This is particularly so for the aspects of management that are necessary to ensure caregivers have the knowledge and tools required to effectively manage their children's asthma – asthma education and the provision of asthma action plans.

The use of asthma medications appears to have increased in the time between the publication of previous NZ research and the collection of data for this study. Previously noted ethnic differences in asthma medications were not observed in the study. However, this may be a result of an increase in the overall use of these medications and an associated reduction in the power of the study to detect ethnic differences.

A significant proportion of participants (15%) had not received asthma education from a health professional. Significant ethnic differences in asthma education were observed, with fewer Māori and Pacific caregivers reporting exposure to a number of areas of asthma education. Significantly more Māori and Pacific caregivers reported difficulties understanding some or all of the asthma education they had been given. About one third of the total sample reported they were not given enough information during asthma education. The majority of caregivers (over 90%) found the education they received useful for managing their child's asthma.

Māori and Pacific caregivers' reports of less education in some topic areas and poorer comprehension of information were accompanied by lower levels of knowledge about asthma.

Just over 20% of caregivers reported having ever been given an action plan. A minority (10.9%) of participants had a current action plan. Among those who had ever been given a plan, over 85% of caregivers reported being given sufficient information about plans, 85%

reported the information was clear and easy to understand, and over 90% found the information useful.

The results strongly suggest there are areas where the management of children's asthma can be improved, with the aim of reducing morbidity in the community and preventing hospitalisations for asthma. A chronic disease management approach should be adopted, with: primary care team-based approaches to asthma management; the implementation of continuous quality improvement activities; and the use of a wide range of practice and provider orientated strategies to assist practitioners to align their care with evidence-based guidelines. The strategies should include recurrent clinical audit to quantify changes, monitor ethnic disparities, and identify areas for improvement. In addition, increased efforts to ensure that asthma education is delivered effectively, appropriately, and in an acceptable manner are required.

References

Adams, W. G., Fuhlbrigge, A. L., Miller, C. W., Panek, C. G., Gi, Y., Loane, K. C., et al. (2003). TLC-Asthma: an integrated information system for patient-centered monitoring, case management, and point-of-care decision support. *AMIA .. Annual Symposium Proceedings/AMIA Symposium.*, 1-5.

Ajwani, S., Blakely, T., Robson, B., Atkinson, J., & Kiro, C. (2003). Unlocking the numerator-denominator bias III: adjustment ratios by ethnicity for 1981-1999 mortality data. The New Zealand Census-Mortality Study. *New Zealand Medical Journal, 116*(1175), U456.

Allan, J. (2001). *Review of the measurement of ethnicity: classification and issues main paper* Wellington: Statistics New Zealand.

Anonymous. (1997). *Expert Panel Report 2 Guidelines for the Diagnosis and Management of Acute Asthma*: National Heart Lung and Blood Institute, National Institutes of Health

Anonymous. (1998). Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet, 351*(9111), 1225-1232.

Anonymous. (2002). Asthma Clinical Guidelines for Children and Young People: Procare, Starship Children's Hospital, Kidzfirst; University of Auckland.

Asher, I., Ellwood, P., Clayton, T., Mackay, R., Mitchell, E., Moyes, C., et al. (2004). *Is the prevalence of asthma, allergic rhinoconjunctivitis and atopic eczema symptoms in adolescents and children still increasing in New Zealand?* Paper presented at the 57th Annual Scientific Meeting Paediatric Society of New Zealand, Rotorua.

Asher, M. I., Barry, D., Clayton, T., Crane, J., D'Souza, W., Ellwood, P., et al. (2001). The burden of symptoms of asthma, allergic rhinoconjunctivitis and atopic eczema in children and adolescents in six New Zealand centres: ISAAC Phase One. *New Zealand Medical Journal., 114*(1128), 114-120.

Asher, M. I., Keil, U., Anderson, H. R., Beasley, R., Crane, J., Martinez, F., et al. (1995). International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *European Respiratory Journal, 8*(3), 483-491.

Asher, M. I., Toop, L., Mitchell, E., & Ad Hoc Paediatric Group. (1994). Asthma in children: Consensus on preventive management in New Zealand. *New Zealand Medical Journal., 107*, 108-110.

Barnes, P. J., Jonsson, B., & Klim, J. B. (1996). The costs of asthma. *European Respiratory Journal, 9*(4), 636-642.

Barry, D., Burr, M., & Limb, E. S. (1991). Prevalence of asthma among 12 year old children in New Zealand and South Wales: a comparative survey. *Thorax, 46*, 405-409.

Basagana, X., Sunyer, J., Kogevinas, M., Zock, J.-P., Duran-Tauleria, E., Jarvis, D., et al. (2004). Socioeconomic status and asthma prevalence in young adults: the European Community Respiratory Health Survey. *American Journal of Epidemiology, 160*(2), 178-188.

Beaglehole, R., Bonita, R., & Kjellstrom, T. (1993). *Basic Epidemiology*. Geneva: World Health Organisation.

Beasley, R., Ellwood, P., & Asher, I. (2003). International patterns of the prevalence of pediatric asthma the ISAAC program. *Pediatric Clinics of North America, 50*(3), 539-553.

Begg, C. B., & Mazumdar, M. (1994). Operating Characteristics of a Rank Correlation Test for Publication Bias. *Biometrics, 50*(4), 1088-1101.

Bernard-Bonnin, A. C., Stachenko, S., Bonin, D., Charette, C., & Rousseau, E. (1995). Self-management teaching programs and morbidity of pediatric asthma: a meta-analysis. *Journal of Allergy & Clinical Immunology, 95*(1 Pt 1), 34-41.

Bhogal, S., Zemek, R., & Ducharme, F. M. (2006). Written action plans for asthma in children. *Cochrane Database of Systematic Reviews, 3*, CD005306.

Bhopal, R. (1998). Spectre of racism in health and health care: lessons from history and the United States. *BMJ, 316*(7149), 1970-1973.

Blakely, T., Kiro, C., & Woodward, A. (2002). Unlocking the numerator-denominator bias. II: Adjustments to mortality rates by ethnicity and deprivation during 1991-94. The New Zealand Census-Mortality Study.[erratum appears in N Z Med J 2002 Feb 22;115(1148):87]. *New Zealand Medical Journal, 115*(1147), 43-48.

Blakely, T., Robson, B., Atkinson, J., Sporle, A., & Kiro, C. (2002). Unlocking the numerator-denominator bias. I: Adjustments ratios by ethnicity for 1991-94 mortality data. The New Zealand Census-Mortality Study. *New Zealand Medical Journal, 115*(1147), 39-43.

Blessing-Moore, J. (1996). Does asthma education change behavior? To know is not to do. *Chest, 109*(1), 9-11.

Bramley, D., & Latimer, S. (2007). The accuracy of ethnicity data in primary care. *New Zealand Medical Journal, 120*(1264), U2779.

British Guidelines on Asthma Management. (1997). British Guidelines on Asthma Management: 1995 review and position statement. *Thorax, 52*(Suppl 1), S1-S21.

Buetow, S., Richards, D., Mitchell, E., Gribben, B., Adair, V., Coster, G., et al. (2004). Attendance for general practitioner asthma care by children with moderate to severe asthma in Auckland, New Zealand. *Social Science & Medicine, 59*(9), 1831-1842.

Callister, P., Didham, R., Potter, D., & Blakely, T. (2007). Measuring ethnicity in New Zealand: developing tools for health outcomes analysis. *Ethnicity & Health, 12*(4), 299-320.

Chapple, S. (2000). *Māori socio-economic disparity*. Paper presented at the Conference Name|. Retrieved Access Date|. from URL|.

Chou, K. J., Cunningham, S. J., & Crain, E. F. (1995). Metered-dose inhalers with spacers vs nebulizers for pediatric asthma. *Archives of Pediatrics & Adolescent Medicine, 149*(2), 201-205.

Cormack, D. (2007). *The Māori Population*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

Cote, J., Cartier, A., Robichaud, P., Boutin, H., Malo, J. L., Rouleau, M., et al. (1997). Influence on asthma morbidity of asthma education programs based on self-management plans following treatment optimization. *American Journal of Respiratory & Critical Care Medicine, 155*(5), 1509-1514.

Crampton, P., Lay-Yee, R., & Davis, P. (2004). *The National Primary Medical Care Survey (NatMedCa): 2001/02. Report 2 Primary Health Care in Community-Governed Non-Profits: The work of doctors and nurses*. Wellington, New Zealand: Ministry of Health.

Crengle, S. (2000). The development of Māori primary care services *Pacific Health Dialogue, 7*(1), 48-53.

Crengle, S., Lay-Yee, R., & Davis, P. (2004). *The National Primary Medical Care Survey (NatMedCa): 2001/02. Report 3 Māori Providers: Primary Health Care Delivered by Doctors and Nurses*. Wellington, New Zealand: Ministry of Health.

Curtis, E., Harwood, M., & Riddell, T. (2007). Cardiovascular disease. In B. Robson & R. Harris (Eds.), *Hauora: Māori Standards of Health IV. A study of the years 2000-2005*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

D'Souza, W., Crane, J., Burgess, C., Te Karu, H., Fox, C., Harper, N., et al. (1994). Community based asthma care: trial of a 'credit card' asthma self-management plan. *European Respiratory Journal., 7*, 1260-1265.

D'Souza, W., Te Karu, H., Fox, C., Harper, M., Gemmell, T., Ngatuere, M., et al. (1998). Long-term reduction in asthma morbidity following an asthma self-management programme. *Eur Respir J, 11*(3), 611-616.

D'Souza, W. J., Slater, T., Fox, C., Fox, B., Te Karu, H., Gemmell, T., et al. (2000). Asthma morbidity 6 yrs after an effective asthma self-management programme in a Maori community. *European Respiratory Journal, 15*(3), 464-469.

Davis, P., Lay-Yee, R., Sinclair, O., & Gribben, B. (1997). Maori / non-Maori Patterns of Contact, Expressed Morbidity and Resource Use in General Practice: Data from the Waikato Medical Care survey 1991-2. *New Zealand Medical Journal, 100*, 390-392.

Davis, P., McLeod, K., Ransom, M., & Ongley, P. (1997). *The New Zealand Socioeconomic Index of Occupational Status (NZSEI): Research Report No 2.* Wellington: Statistics New Zealand.

Declaration of Alma-Ata. (1978, 6-12 September 1978). *Declaration of Alma-Ata.* Paper presented at the International Conference on Primary Health Care, Alma-Ata, USSR.

Department of Statistics. (1990). *Area census unit maps*. Wellington.

Dewar, A. L., Stewart, A., Cogswell, J. J., & Connett, G. J. (1999). A randomised controlled trial to assess the relative benefits of large volume spacers and nebulisers to treat acute asthma in hospital. *Archives of Disease in Childhood, 80*(5), 421-423.

Duran-Tauleria, E., Rona, R. J., Chinn, S., & Burney, P. (1996). Influence of ethnic group on asthma treatment in children in 1990-1: national cross sectional study. *BMJ, 313*(7050), 148-152.

Durie, M. (1994). *Whaiora: Māori Health Development*: Oxford University Press.

Ellison-Loschmann, E. (2004). *Asthma in Māori*. Wellington: Centre for Public Health Research, Massey University.

Ellison-Loschmann, E., & Pearce, N. (2000). He Mate Huango: an update on Maori asthma. *Pacific Health Dialog., 7*(1), 82-93.

Elster, A., Jarosik, J., VanGeest, J., & Fleming, M. (2003). Racial and ethnic disparities in health care for adolescents: a systematic review of the literature. *Archives of Pediatrics & Adolescent Medicine, 157*(9), 867-874.

Emmerton, L., Shaw, J., & Kheir, N. (2003). Asthma management by New Zealand pharmacists: a pharmaceutical care demonstration project. *Journal of Clinical Pharmacy & Therapeutics, 28*(5), 395-402.

Finkelstein, J. A., Brown, R. W., Schneider, L. C., Weiss, S. T., Quintana, J. M., Goldmann, D. A., et al. (1995). Quality of care for preschool children with asthma: the role of social factors and practice setting. *Pediatrics, 95*(3), 389-394.

Flores, G., Abreu, M., Chaisson, C. E., & Sun, D. (2003). Keeping children out of hospitals: parents' and physicians' perspectives on how pediatric hospitalizations for ambulatory care-sensitive conditions can be avoided. *Pediatrics, 112*(5), 1021-1030.

Galbraith, C., Jenkin, G., Davis, P., & Coope, P. (2003). *New Zealand Socioeconomic Index 1996: Users' Guide*. Wellington: Statstics New Zealand.

Garrett, J., Fenwick, J. M., Taylor, G., Mitchell, E., & Rea, H. (1994). Peak expiratory flow meters (PEFMs)--who uses them and how and does education affect the pattern of utilisation? *Australian & New Zealand Journal of Medicine., 24*(5), 521-529.

Garrett, J., Fenwick, J. M., Taylor, G., Mitchell, E., Stewart, J., & Rea, H. (1994). Prospective controlled evaluation of the effect of a community based asthma education centre in a multiracial working class neighbourhood. *Thorax., 49*(10), 976-983.

Garrett, J., Mulder, J., & Wong-Toi, H. (1989). Reasons for racial differences in A & E attendance rates for asthma. *New Zealand Medical Journal., 102*(864), 121-124.

Garrett, J., Williams, S., Wong, C., & Holdaway, D. (1997a). Application of asthma action plans to childhood asthma: a national survey. *New Zealand Medical Journal, 110*(1050), 308-310.

Garrett, J., Williams, S., Wong, C., & Holdaway, M. D. (1997b). Application of asthma action plans to childhood asthma: a national survey. *New Zealand Medical Journal., 110*, 308-310.

Garrett, J. E., Mulder, J., & Wong-Toi, H. (1988). Characteristics of asthmatics using an urban accident and emergency department. *New Zealand Medical Journal., 101*(847 Pt 1), 359-361.

Gergen, P. J. (2001). Understanding the economic burden of asthma. *Journal of Allergy and Clinical Immunology, 107*(5, Part 2), S445-S448.

Gibson, P., Powell, H., Coughlan, J., Wilson, A., Abramson, M., Haywood, P., et al. (2006a). Self-management education and regular practitioner review for adults with asthma. *The Cochrane Database of Systematic Reviews*(3).

Gibson, P. G., Powell, H., Coughlan, J., Wilson, A. J., Hensley, M. J., Abramson, M., et al. (2006b). Limited (information only) patient education programs for adults with asthma. *Cochrane Database of Systematic Reviews, 3*.

Gillies, J., Barry, D., Crane, J., Jones, D., Maclennan, L., Pearce, N., et al. (1996). A community trial of a written self management plan for children with asthma. *New Zealand Medical Journal., 109*, 30-33.

Global Initiative for Asthma. (2005). *Pocket Guide for Asthma Management and Prevention in Children*.

Goodman, A. H. (2000). Why Genes Don't count (for Racial Differences in Health). *American Journal of Public Health, 90*(11), 1699-1702.

Gordon, R. B., Grimshaw, J. M., Eccles, M., Rowe, R. E., & Wyatt, J. C. (2008). On-screen computer reminders: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*(3).

Graham, D., Leversha, A., & Vogel, A. (2001). *The Top 10 Report: Top 10 issues affecting the health and wellbeing of children and young people in Auckland and Waikato*. Hamilton: Waikato District Health Board.

Greenland, S. (1998). Meta-analysis. In K. J. Rothman & S. Greenland (Eds.), *Modern Epidemiology* (Second edition ed.). Philadelphia: Lippincott - Raven.

Gribben, B. (1992). Do Access Factors Affect Utilisation of General Practitioner Services in South Auckland? *New Zealand Medical Journal, 105*, 453-455.

Guevara, J. P., Wolf, F. M., Grum, C. M., & Clark, N. M. (2003). Effects of educational interventions for self management of asthma in children and adolescents: systematic review and meta-analysis. *BMJ, 326*(7402), 1308-1309.

Hamman, R. F., Halil, T., & Holland, W. W. (1975). Asthma in schoolchildren. Demographic associations and peak expiratory flow rates compared in children with bronchitis. *British Journal of Preventive & Social Medicine., 29*(4), 228-238.

Harlow, S. D., & Linet, M. S. (1989). Agreement between questionnaire data and medical records. The evidence for accuracy of recall.[see comment]. *American Journal of Epidemiology, 129*(2), 233-248.

Harris, R. (2003). *Obstructive sleep apnoea syndrome: Symptoms and risk factors among Māori and*

non-Māori adults in Aotearoa. Unpublished MPH thesis, University of Otago, Dunedin.

Harris, R., Purdie, G., Robson, B., Wright, C., Zhang, J., & Baker, M. (2007). *Appendix 3: Estimating Māori Hospitalisations and Cancer Registrations*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

Harris, R., Tobias, M., Jeffreys, M., Waldegrave, K., Karlsen, S., & Nazroo, J. (2006a). Effects of self-reported racial discrimination and deprivation on Maori health and inequalities in New Zealand: cross-sectional study. *Lancet, 367*(9527), 2005-2009.

Harris, R., Tobias, M., Jeffreys, M., Waldegrave, K., Karlsen, S., & Nazroo, J. (2006b). Racism and health: the relationship between experience of racial discrimination and health in New Zealand. *Social Science & Medicine, 63*(6), 1428-1441.

Harwood, M., & Tipene-Leach, D. (2007). Diabetes. In B. Robson & R. Harris (Eds.), *Hauora: Māori Standards of Health IV. A study of the years 2000-2005*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

Health Utilisation Research, A. (2006). Ethnicity data and primary care in New Zealand: lessons from the Health Utilisation Research Alliance (HURA) study. *New Zealand Medical Journal, 119*(1231), U1917.

Hennekens, C., & Buring, J. (1987). *Epidemiology in Medicine*. Boston / Toronto: Little, Brown and Company.

Holt, S., & Beasley, R. (2002). *The Burden of Asthma in New Zealand*. Wellington: Asthma and Respiratory Foundation of New Zealand (Inc.) and Medical Research Institute of New Zealand.

Inkelas, M., Garro, N., McQuaid, E. L., & Ortega, A. N. (2008). Race/ethnicity, language, and asthma care: findings from a 4-state survey. *Annals of Allergy, Asthma, & Immunology, 100*(2), 120-127.

Institute of Medicine. (2003). *Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare*. Washington, D.C.: The National Academies Press.

International Research Institute for Māori and Indigenous Education (IRI), & Te Rōpū Rangahau A Eru Pōmare. (2000). *Māori research development: Kaupapa Māori principles and practices - a literature review.* Auckland: University of Auckland.

Jackson, G., & Tobias, M. (2001). Potentially avoidable hospitalisations in New Zealand, 1989-98. *Australian & New Zealand Journal of Public Health, 25*(3), 212-221.

Jamtvedt, G., Young, J. M., Kristoffersen, D. T., O'Brien, M. A., & Oxman, A. D. (2008). Audit and feedback: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*(3).

Jones, C. P. (2000). Levels of Racism: A Theoretic Framework and a Gardener's Tale. *American Journal of Public Health, 90*(8), 1212-1215.

Jones, C. P. (2001). Invited Commentary: "Race", Racism, and the Practice of Epidemiology. *American Journal of Epidemiology., 154*(4), 299-304.

Joseph, C. L., Havstad, S. L., Ownby, D. R., Johnson, C. C., & Tilley, B. C. (1998). Racial differences in emergency department use persist despite allergist visits and prescriptions filled for antiinflammatory medications. *Journal of Allergy & Clinical Immunology, 101*(4 Pt 1), 484-490.

Juniper, E. F. (1997). How important is quality of life in pediatric asthma? *Pediatric Pulmonology - Supplement, 15*, 17-21.

Kamps, A. W., & Brand, P. L. (2001). Education, self-management and home peak flow monitoring in childhood asthma. *Paediatric Respiratory Reviews, 2*(2), 165-169.

Kamps, A. W., Roorda, R. J., & Brand, P. L. (2001). Peak flow diaries in childhood asthma are unreliable.[see comment]. *Thorax, 56*(3), 180-182.

Karlsen, S., & Nazroo, J. Y. (2002). Relation between racial discrimination, social class, and health among ethnic minority groups. *American Journal of Public Health., 92*(4), 624-631.

Karnick, P., Margellos-Anast, H., Seals, G., Whitman, S., Aljadeff, G., & Johnson, D. (2007). The pediatric asthma intervention: a comprehensive cost-effective approach to asthma management in a disadvantaged inner-city community. *Journal of Asthma, 44*(1), 39-44.

Kljakovic, M. (1994). A comparison of the respiratory care given to asthmatic and nonasthmatic children in a general practice. *New Zealand Medical Journal., 107*, 240-242.

Kljakovic, M., & McLeod, D. (1997). Management of acute asthma: gaps between opinion and recorded action by general practitioners. *International Journal for Quality in Health Care, 9*(6), 405-412.

Kljakovic, M., & Salmond, C. (1996). The pattern of consultations for asthma in a general practice over five years. *New Zealand Medical Journal., 109*, 48-50.

Kolbe, J. (1999). Asthma education, action plans, psychosocial issues and adherence. *Canadian Respiratory Journal, 6*(3), 273-280.

Krieger, N. (2000). Discrimination and Health. In L. Berkman & I. Kawachi (Eds.), *Social Epidemiology* (pp. 36-75). New York: Oxford University Press.

Krieger, N., Rowley, D. L., Herman, A. A., Avery, B., & Phillips, M. T. (1993). Racism, sexism, and social class: implications for studies of health, disease, and well-being. *American Journal of Preventive Medicine, 9*(6 Suppl), 82-122.

Krieger, N., & Sidney, S. (1996). Racial discrimination and blood pressure: the CARDIA Study of young black and white adults. *American Journal of Public Health, 86*(10), 1370-1378.

Krishnan, J. A., Diette, G. B., Skinner, E. A., Clark, B. D., Steinwachs, D., & Wu, A. W. (2001). Race and sex differences in consistency of care with national asthma guidelines in managed care organizations. *Archives of Internal Medicine, 161*(13), 1660-1668.

Kuilboer, M. M., van Wijk, M. A., Mosseveld, M., van der Does, E., de Jongste, J. C., Overbeek, S. E., et al. (2006). Computed critiquing integrated into daily clinical

practice affects physicians' behavior--a randomized clinical trial with AsthmaCritic. *Methods of Information in Medicine, 45*(4), 447-454.

Laurant, M., Reeves, D., Hermens, R., Braspenning, J., Grol, R., & Sibbald, B. (2006). Substitution of doctors by nurses in primary care. *Cochrane Database of Systematic Reviews, 3*.

LaVeist, T. A. (2000). On the study of race, racism, and health: a shift from description to explanation.[comment]. *International Journal of Health Services., 30*(1), 217-219.

LaVeist, T. A., Bowie, J. V., & Cooley-Quille, M. (2000). Minority health status in adulthood: the middle years of life. *Health Care Financing Review., 21*(4), 9-21.

Lenney, W. (1997). The burden of pediatric asthma. *Pediatric Pulmonology - Supplement, 15*, 13-16.

Lethaby, A. (2005, 20 December 2005). Grading for evidence-based guidelines: a simple system for a complex task? Retrieved 17 August 2006, 2006, from http://www.nzgg.org.nz/index.cfm?fuseaction=evidence&fusesubaction=article&documentid=10&articleID=209

Leversha, A. M., Campanella, S. G., Aickin, R. P., & Asher, M. I. (2000). Costs and effectiveness of spacer versus nebulizer in young children with moderate and severe acute asthma. *Journal of Pediatrics, 136*(4), 497-502.

Lieu, T. A., Lozano, P., Finkelstein, J. A., Chi, F. W., Jensvold, N. G., Capra, A. M., et al. (2002). Racial/ethnic variation in asthma status and management practices among children in managed Medicaid. *Pediatrics, 109*(5), 857-865.

Linet, M. S., Harlow, S. D., McLaughlin, J. K., & McCaffrey, L. D. (1989). A comparison of interview data and medical records for previous medical conditions and surgery. *Journal of Clinical Epidemiology, 42*(12), 1207-1213.

Loring, B. (2007). *Avoiding inaction in the face of need: how a publicly funded human papillomavirus vaccine could be implemented in Aotearoa/New Zealand to avoid Māori:non-Māori immunisation inequalities.* Unpublished MPH Dissertation, University of Auckland, Auckland.

Lozano, P., Schaefer, J. K., Finkelstein, J. A., Stout, J., Wagner, E. H., & Weiss, K. B. (2008). Interventions to improve the management of asthma in primary care settings. *Cochrane Database of Systematic Reviews*(3).

Mak, H., Johnston, P., Abbey, H., & Talamo, R. C. (1982). Prevalence of asthma and health service utilization of asthmatic children in an inner city. *Journal of Allergy & Clinical Immunology., 70*(5), 367-372.

Malcolm, L. (1996). Inequities in access to and utilisation of primary medical care services for Maori and low income New Zealanders.[see comment]. *New Zealand Medical Journal, 109*(1030), 356-358.

Marmot, M. (1999). Introduction. In M. Marmot & R. Wilkinson (Eds.), *Social Determinants of Health*. Oxford: Oxford University Press.

Marshall, R. J., Zhang, Z., Broad, J. B., & Wells, S. (2007). Agreement between ethnicity recorded in two New Zealand health databases: effects of discordance on cardiovascular outcome measures (PREDICT CVD3). *Australian & New Zealand Journal of Public Health, 31*(3), 211-216.

Matthews, B., Dickinson, A., & Cram, F. (1998). Establishment and Evaluation of a Preschool Asthma Programme: A Pilot Study. *Nursing Praxis in New Zealand, 13*(3), 25-34.

McGowan, J. L., McAuley, L. M., Dawes, M., Grad, R., Hannes, K., Judd, M., et al. (2008). Electronic access to health information and/or knowledge by health professionals to improve practice and patient care. *Cochrane Database of Systematic Reviews*(3).

McMullen, A. H., Yoos, H. L., & Kitzman, H. (2002). Peak flow meters in childhood asthma: parent report of use and perceived usefulness. *Journal of Pediatric Health Care, 16*(2), 67-72.

McNally, A. J., Frampton, C., Garrett, J., & Pattemore, P. (2004). Application of asthma action plans to childhood asthma: national survey repeated. *New Zealand Medical Journal, 117*(1196), U932.

McNaughton, S., Smith, L., Rea, H., Asher, I., Mitchell, E., Mulder, J., et al. (1993). The Management of Childhood Asthma: Attendance and School Performance. *New Zealand Journal of Educational Studies, 28*(2), 155-164.

Meningococcal Disease Case Control Study Project Group. (1996). *Investigation of risk factors for meningococcal disease in Auckland - a pilot case control study. Draft study protocol.* Auckland.

Mielck, A., Reitmeir, P., & Wjst, M. (1996). Severity of childhood asthma by socioeconomic status. *International Journal of Epidemiology., 25*(2), 388-393.

Milton, B., Whitehead, M., Holland, P., & Hamilton, V. (2004). The social and economic consequences of childhood asthma across the lifecourse: A systematic review. *Child: Care, Health & Development, 30*(6), 711-728.

Minister of Health. (2001). *The Primary Health Care Strategy*. Wellington: Ministry of Health.

Minister of Health. (2007). *Health Targets: Moving towards healthier futures 2007/08.*

. Wellington: Ministry of Health.

Ministry of Health. (1999). *Taking the Pulse: The 1996/97 New Zealand Health Survey*. Wellington: Ministry of Health.

Ministry of Health. (2000). *The New Zealand Health Strategy*. Wellington: Ministry of Health.

Ministry of Health. (2001). *Monitoring Ethnic Inequalities in Health.* Wellington: Minisitry of Health.

Ministry of Health. (2002a). *He Korowai Oranga: Mäori Health Strategy*. Wellington: Ministry of Health.

Ministry of Health. (2002b). *Reducing inequalities in health*. Wellington: Ministry of Health.

Ministry of Health. (2004). *Ethnicity Data Protocols for the Health and Disability Sector.* . Wellington: Ministry of Health.

Ministry of Health, & University of Otago. (2005). *Decades of Disparity II: Socioeconomic mortality trends in New Zealand, 1981-1999*. Wellington: Ministry of Health.

Ministry of Health, & University of Otago. (2006). *Decades of Disparity III: Ethnic and socioeconomic inequalities in mortality, New Zealand 1981–1999*. Wellington: Ministry of Health.

Ministry of Health and Ministry of Pacific Island Affairs. (2004). *Tupu Ola Moui: Pacific Health Chart Book 2004*. Wellington: Ministry of Health.

Mitchell, E. (1991). Racial inequalities in childhood asthma. *Social Science and Medicine, 32*(7), 831-836.

Mitchell, E., & Ad Hoc Paediatric Group. (1992). Consensus on acute asthma management in children. *New Zealand Medical Journal., 105*, 353-355.

Mitchell, E. A., & Borman, B. (1986). Demographic characteristics of asthma admissions to hospitals. *New Zealand Medical Journal, 99*(807), 576-579.

Mitchell, E. A., & Cutler, D. R. (1984). Paediatric admissions to Auckland Hospital for asthma from 1970-1980. *New Zealand Medical Journal, 97*(749), 67-70.

Mitchell, E. A., Didsbury, P. B., Kruithof, N., Robinson, E., Milmine, M., Barry, M., et al. (2005). A randomized controlled trial of an asthma clinical pathway for children in general practice. *Acta Paediatrica, 94*(2), 226-233.

Mitchell, E. A., & Quested, C. (1988). Why are Polynesian children admitted to hospital for asthma more frequently than European children? *New Zealand Medical Journal, 101*(849), 446-448.

Mitchell, E. A., Stewart, A. W., Rea, H. H., McNaughton, S., Taylor, G., Smith, L. T., et al. (1997). Measuring morbidity from asthma in children. *New Zealand Medical Journal., 110*(1036), 3-6.

Moala, A., & Pearce, N. (2001). Asthma in Pacificans in New Zealand and in the South Pacific. *Pacific Health Dialog., 8*(1), 183-187.

Moonie, S. A., Sterling, D. A., Figgs, L., & Castro, M. (2006). Asthma Status and Severity Affects Missed School Days. *Journal of School Health, 76*(1), 18-24.

Moudgil, H., & Honeybourne, D. (1998). Differences in asthma management between white European and Indian subcontinent ethnic groups living in socioeconomically deprived areas in the Birmingham (UK) conurbation. *Thorax, 53*(6), 490-494.

Nelson, D. A., Johnson, C. C., Divine, G. W., Strauchman, C., Joseph, C. L., & Ownby, D. R. (1997). Ethnic differences in the prevalence of asthma in middle class children. *Annals of Allergy, Asthma, & Immunology., 78*(1), 21-26.

Netuveli, G., Hurwitz, B., Levy, M., Fletcher, M., Barnes, G., Durham, S. R., et al. (2005). Ethnic variations in UK asthma frequency, morbidity, and health-service use: a systematic review and meta-analysis. *Lancet, 365*(9456), 312-317.

Neville, R. G., Bryce, F. P., Robertson, F. M., Crombie, I. K., & Clark, R. A. (1992). Diagnosis and treatment of asthma in children: usefulness of a review of medical records. *British Journal of General Practice, 42*(365), 501-503.

New Zealand Guidelines Group. (2002). *The diagnosis and treatment of adult asthma: best practice evidence-based guideline*.

New Zealand Health Information Service. (1996). *Recording patient information: Ethnicity.* Retrieved. from.

O'Brien, M. A., Freemantle, N., Oxman, A. D., Wolf, F., Davis, D. A., & Herrin, J. (2008a). Continuing education meetings and workshops: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*(3).

O'Brien, M. A., Rogers, S., Jamtvedt, G., Oxman, A. D., Odgaard-Jensen, J., Kristoffersen, D. T., et al. (2008b). Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews*(3).

Orange, C. (1987). *The Treaty of Waitangi* (First ed.). Wellington, New Zealand: Allen and Unwin in association with Port Nicholson Press.

Ortega, A. N., Gergen, P. J., Paltiel, A. D., Bauchner, H., Belanger, K. D., & Leaderer, B. P. (2002). Impact of site of care, race, and Hispanic ethnicity on medication use for childhood asthma. *Pediatrics, 109*(1), E1.

Paediatric Society of New Zealand. (2005). *Management of Asthma in Children aged 1-15 years: Best Practice Evidence Based Guideline.*

Pattemore, P. K., Ellison-Loschmann, L., Asher, M. I., Barry, D. M., Clayton, T. O., Crane, J., et al. (2004). Asthma prevalence in European, Maori, and Pacific children in New Zealand: ISAAC study. *Pediatric Pulmonology, 37*(5), 433-442.

Pless, C. E., & Pless, I. B. (1995). How well they remember. The accuracy of parent reports. *Archives of Pediatrics & Adolescent Medicine., 149*(5), 553-558.

Pōmare, E., Keefe-Ormsby, V., Ormsby, C., Pearce, N., Reid, P., Robson, B., et al. (1995). *Hauora: Maori Standards of Health III*.

Pōmare, E., Tutengaehe, H., Ramsden, I., Hight, M., Pearce, N., & Ormsby, V. (1991). He Mate Huango: Maori Asthma Review. Report to the Minister of Maori Affairs.

Pōmare, E., Tutengaehe, H., Ramsden, I., Hight, M., Pearce, N., & Ormsby, V. (1992). Asthma in Maori people. *New Zealand Medical Journal., 105*(946), 469-470.

Poulos, L. M., Toelle, B. G., & Marks, G. B. (2005). The burden of asthma in children: An Australian perspective. *Paediatric Respiratory Reviews, 6*(1), 20-27.

Ratima, M. M., Fox, C., Fox, B., Te Karu, H., Gemmell, T., Slater, T., et al. (1999). Long-term benefits for Maori of an asthma self-management program in a Maori community which takes a partnership approach. *Australian & New Zealand Journal of Public Health, 23*(6), 601-605.

Raymont, A., Lay-Yee, R., Davis, P., & Scott, A. (2004). *The National Primary Medical Care Survey (NatMedCa): 2001/02. Report 1 Family Doctors: Methodology and description of the activity of private GPs*. Wellington, New Zealand: Ministry of Health.

Reid, P. (2001). *Kaupapa Mäori Research*. Paper presented at the Conference Name|. Retrieved Access Date|. from URL|.

Reid, P., Robson, B., & Jones, C. P. (2000). Disparities in health: common myths and uncommon truths. *Pacific Health Dialogue, 7*(1), 38-47.

Riddell, T. (2005). Heart failure hospitalisations and deaths in New Zealand: patterns by deprivation and ethnicity. *New Zealand Medical Journal, 118*(1208), U1254.

Robson, B. (2002). *Mana Whakamārama - Equal Explanatory Power: Māori and non-Māori sample size in national health surveys*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

Robson, B., Cormack, D., & Cram, F. (2007). *Social and Economic Indicators*. Wellington: Te Rōpū Rangahau Hauora a Eru Pōmare.

Robson, B., & Harris, R. (2007). *Hauora: Māori Standards of Health IV. A study of the years 2000-2005*. Wellington: Te Rōpū Rangahau a Eru Pōmare.

Robson, B., & Reid, P. (2001). *Ethnicity Matters: Māori Perspectives*. Wellington: Statistics New Zealand.

Salmond, C., Crampton, P., & Sutton, F. (1998). *NZDep96: Index of Deprivation*. Wellington: Health Services Research Centre

Victoria University of Wellington.

Schmier, J. K., Chan, K. S., & Leidy, N. K. (1998). The impact of asthma on health-related quality of life. *Journal of Asthma, 35*(7), 585-597.

Schmier, J. K., Manjunath, R., Halpern, M. T., Jones, M. L., Thompson, K., & Diette, G. B. (2007). The impact of inadequately controlled asthma in urban children on quality of life and productivity. *Annals of Allergy, Asthma, & Immunology, 98*(3), 245-251.

Scottish Intercollegiate Guideline Network. (2001, May 2004). SIGN 50: A guideline developers' handbook. Retrieved 17 August 2006, 2006, from http://www.sign.ac.uk/guidelines/fulltext/50/index.html

Scottish Intercollegiate Guideline Network. (2003). British Guideline on the Management of Asthma. *Thorax, 58*(Suppl I).

Shaw, R., Woodman, K., Crane, J., Moyes, C., Kennedy, J., & Pearce, N. (1994). Risk factors for asthma symptoms in Kawerau children. *New Zealand Medical Journal., 107*(987), 387-391.

Shegog, R., Bartholomew, L. K., Czyzewski, D. I., Sockrider, M. M., Craver, J., Pilney, S., et al. (2004). Development of an expert system knowledge base: a novel approach to promote guideline congruent asthma care. *Journal of Asthma, 41*(4), 385-402.

Shegog, R., Bartholomew, L. K., Sockrider, M. M., Czyzewski, D. I., Pilney, S., Mullen, P. D., et al. (2006). Computer-based decision support for pediatric asthma management: description and feasibility of the Stop Asthma Clinical System. *Health Informatics Journal, 12*(4), 259-273.

Shields, A. E., Comstock, C., & Weiss, K. B. (2004). Variations in asthma care by race/ethnicity among children enrolled in a state Medicaid program. *Pediatrics, 113*(3 Pt 1), 496-504.

Sly, P. D., & Flack, F. (2001). Is home monitoring of lung function worthwhile for children with asthma? *Western Journal of Medicine, 175*(5), 344-345.

Smartt, P., Marshall, R. J., Kjellstrom, T., & Dyall, L. (2002). Reporting comparisons between Maori and non-Maori populations.[see comment]. *New Zealand Medical Journal, 115*(1151), 167-169.

Smith, G. H. (1997). *The development of Kaupapa Mäori: Theory and praxis.* Unpublished PhD, University of Auckland, Auckland.

Smith, L. T. (1999). *Decolonising methodologies. Research and Indigenous peoples*. London & New York and Dunedin Zed Books and University of Otago Press.

Speight, A. N., Lee, D. A., & Hey, E. N. (1983). Underdiagnosis and undertreatment of asthma in childhood. *British Medical Journal Clinical Research Ed.. 286*(6373), 1253-1256.

Starfield, B. (1998). *Primary Care: Balancing Health Needs, Services, and Technology*. New York: Oxford University Press.

Statistics New Zealand. (1993). *New Zealand Standard Classification of Ethnicity*
Wellington: Statistics New Zealand.

Steinwachs, D. M., Wu, A. W., & Skinner, E. A. (1994). How will outcomes management work? *Health Affairs, 13*(4), 153-162.

Stewart, A. W., Asher, M. I., Clayton, T. O., Crane, J., D'Souza, W., Ellwood, P. E., et al. (1997). The effect of season-of-response to ISAAC questions about asthma, rhinitis and eczema in children. *International Journal of Epidemiology., 26*(1), 126-136.

Taras, H., & Potts-Datema, W. (2005). Childhood Asthma and Student Performance at School. *Journal of School Health, 75*(8), 296.

Taylor, G. H., Rea, H. H., McNaughton, S., Smith, L., Mulder, J., Asher, M. I., et al. (1991). A tool for measuring the asthma self-management competency of families. *Journal of Psychosomatic Research., 35*(4-5), 483-491.

Te Rōpū Rangahau a Eru Pōmare. (2000). Counting for Nothing: Understanding the issues in monitoring disparities in health. *Social Policy Journal of New Zealand*(14), 1-16.

Thomas, D. R. (2001). Assessing ethnicity in New Zealand health research. *New Zealand Medical Journal, 114*(1127), 86-88.

Thompson, R., Dixon, F., Watt, J., Crane, J., Beasley, R., & Burgess, C. (1993). Prescribing for childhood asthma in the Wellington area: comparison with international guidelines. *New Zealand Medical Journal., 106*(81-83).

Tobias, M., & Yeh, L.-C. (2006). Do all ethnic groups in New Zealand exhibit socio-economic mortality gradients? *Australian & New Zealand Journal of Public Health, 30*(4), 343 - 349.

Toelle, B. G., & Ram, F. S. F. (2006). Written individualised management plans for asthma in children and adults. *Cochrane Database of Systematic Reviews, 3*.

Toren, K., Brisman, J., & Jarvholm, B. (1993). Asthma and asthma-like symptoms in adults assessed by questionnaires. A literature review.[see comment]. *Chest, 104*(2), 600-608.

Towns, A. J. (1993). *Family Therapy and Childhood Asthma: Influencing the Social Constructions of Chronicity.* Unpublished PhD, University of Auckland, Auckland.

Twiggs, J. E., Fifield, J., Jackson, E., Cushman, R., & Apter, A. (2004). Treating asthma by the guidelines: developing a medication management information system for use in primary care. *Disease Management, 7*(3), 244-260.

United Nations General Assembly. (1948). Universal Declaration of Human Rights: United Nations.

United Nations General Assembly. (1959). Declaration of the Rights of the Child: Office of the Commissioner for Human Rights.

United Nations General Assembly. (2008). Declaration on the Rights of Indigenous Peoples: United Nations.

Upton, S. (1991). *Your Health and the Public Health*. Wellington: Ministry of Health.

von Mutius, E. (2000). The burden of childhood asthma. *Archives of Disease in Childhood., 82*(Suppl 2), II2-5.

Wairarapa Maori Executive, & The Wellington Asthma Research Group. (1992). *Te Reo o te Ora: the Wairarapa Maori Asthma Project*.

Walker, R. (1990). *Ka Whawhai Tonu Matou: Struggle Without End*: Penguin Books.

Warner, J. O. (1992). Asthma: A follow up statement from an international
paediatric asthma consensus group. *Archives of Disease in Childhood, 67*(2), 240-248.

Wickens, K., Crane, J., Kemp, T., Lewis, S., D'Souza, W., Sawyer, G., et al. (2001). A case-control study of risk factors for asthma in New Zealand children. *Australian & New Zealand Journal of Public Health, 25*(1), 44-49.

Wickens, K., Fitzharris, P., & Crane, J. (1998). Increasing asthma prevalence in New Zealand: understanding the causes. *The New Zealand Public Health Report, 5*(3), 17-20.

Williams, D. R. (1997). Race and Health: Basic Questions, Emerging Directions. *Annals of Epidemiology, 7*(5), 322-333.

Williams, D. R. (1999a). The monitoring of racial/ethnic status in the USA: data quality issues. *Ethnicity & Health, 4*(3), 121-137.

Williams, D. R. (1999b). Race, socioeconomic status, and health. The added effects of racism and discrimination. *Annals of the New York Academy of Sciences., 896*, 173-188.

Wolf, F. M., Guevara, J. P., Grum, C. M., Clark, N. M., & Cates, C. J. (2006). Educational interventions for asthma in children. *Cochrane Database of Systematic Reviews, 3*.

Woodward, A., & Kawachi, I. (2000). Why reduce health inequalities? *Journal of Epidemiology & Community Health, 54*(12), 923-929.

Yeatts, K., Davis, K. J., Sotir, M., Herget, C., & Shy, C. (2003). Who gets diagnosed with asthma? Frequent wheeze among adolescents with and without a diagnosis of asthma. *Pediatrics., 111*(5 Pt 1), 1046-1054.

Zoratti, E. M., Havstad, S., Rodriguez, J., Robens-Paradise, Y., Lafata, J. E., & McCarthy, B. (1998). Health service use by African Americans and Caucasians with asthma in a managed care setting. *American Journal of Respiratory & Critical Care Medicine, 158*(2), 371-377.