THE PREVALENCE OF ASTHMA SYMPTOMS IN PRESCHOOL AND PRIMARY SCHOOL CHILDREN IN MITCHELLS PLAIN, CAPE TOWN

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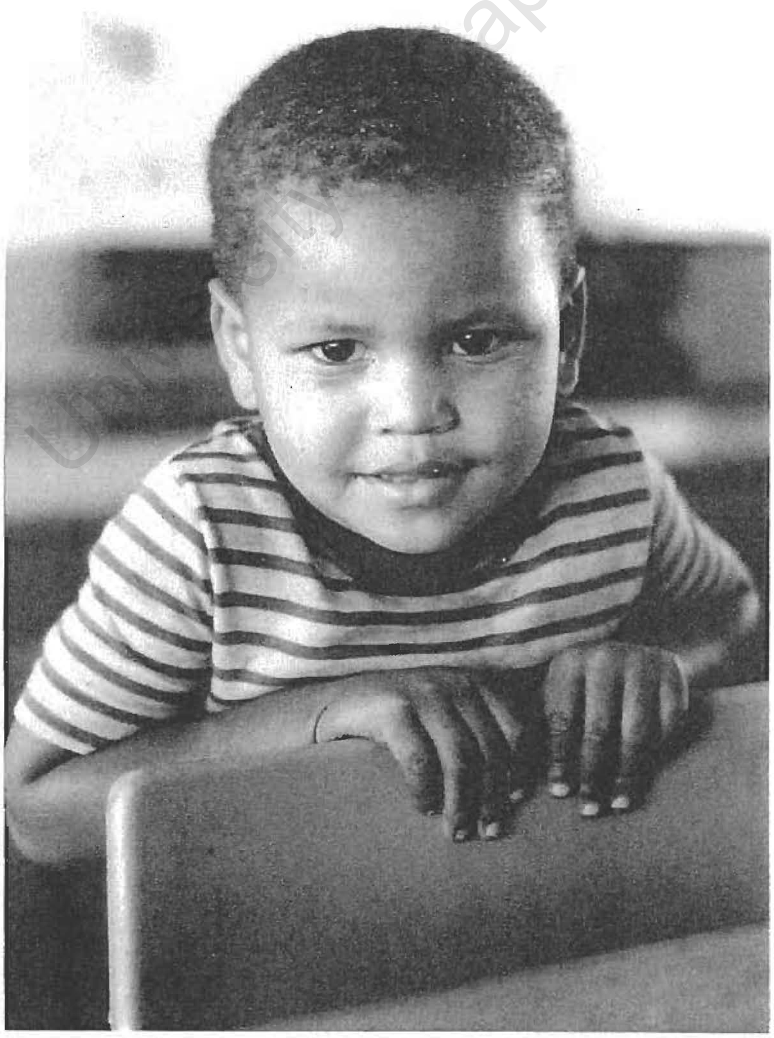
AN ESTIMATE OF THE PREVALENCE OF ASTHMA SYMPTOMS IN PRESCHOOL AND PRIMARY SCHOOL CHILDREN IN MITCHELLS PLAIN, CAPE TOWN.



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DECLARATION

I, Dr Sandrakantha Pather, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise), and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Signed by candidate

Dr S. Pather

10/9/02

Date

ABSTRACT

BACKGOUND: Childhood asthma is believed to be a serious problem both locally and internationally. This study aimed to measure the prevalence of asthma symptoms in preschool and primary school children in Mitchells Plain, Cape Town. The secular trend in symptom prevalences over time (1993-1997) was assessed in a sub-group of 7 to 9 year old children.

METHOD: A questionnaire was completed by parents of 4018 preschoolers and 9765 primary schoolers.

RESULTS: The prevalence of asthma symptoms in preschoolers was found to be high by international standards. The prevalence of recent (12 months) wheeze was 36.7%, recent night cough 28.9% and recent night waking 29.5%. The prevalence of reported asthma was 13.1%. Differences in symptom prevalences were demonstrated for age (decreasing prevalence with increasing age), gender (excess of symptoms in boys) and residential suburb (increased symptoms in children from the poorer suburb). Recent wheeze and night waking were found to be the best symptom predictors of reported asthma. Symptom prevalences decreased as numbers of older children in a household increased. The prevalence of asthma symptoms in preschool and primary school children was found to be high in comparison to reported asthma, suggesting underdiagnosis of the disease. A small increase in symptom prevalences was observed in 7-9 year olds between 1993 and 1997.

CONCLUSION: This is the first estimate of asthma symptoms in preschool children in South Africa and one of very few studies worldwide. Asthma in preschoolers in Mitchells Plain is underreported and underdiagnosed. The true prevalence of reported asthma is therefore likely to lie somewhere between the prevalence of reported asthma (13.1%) and prevalence of recent wheeze (36.7%).

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1.1 STATEMENT OF THE PROBLEM

We chose to study asthma as a research subject for a variety of reasons. Asthma is the most common chronic disease in childhood (South African Childhood Asthma Working Group 1994). Internationally, it is believed to be responsible for an increasing burden of disease (Ninan 1992, Mitchell 1983, Robertson 1991, Rona 1995). Although epidemiological studies are limited by the absence of a definitive test for asthma, studies of prevalence, asthma morbidity and mortality all indicate a local and international public health problem of considerable magnitude (Benatar 1986, Campbell 1997, Ehrlich 1994, Macintyre 2001).

The prevalence of asthma is high in developed and developing countries (Anderson 1994, Burr 1994, Luyt 1994). Current literature suggests that asthma prevalence has increased (Anderson 1994, Gergen 1988, Mitchell 1989, Ninan 1992, Peat 1994). There has been controversy as to whether the observed changes represent a true increase in asthma prevalence or whether they reflect local changes in the population e.g. an increased awareness of the disease, improved access to medical care or changes in the use of diagnostic terms from "chronic bronchitis" to "asthma" (Bauman 1993, Magnus 1997). However with the advent of standardised, internationally validated questionnaires, there is a growing body of evidence to suggest that asthma prevalence is indeed on the increase worldwide (Burney 1990, Manfreda 1993, Mitchell 1983, Peat 1994). Asthma has also been positively linked to increasing urbanisation (Silverman 1998, Van Niekerk 1979). Hence, with the current rapid urbanisation in South Africa, it is likely that we too should expect a concomitant increase in asthma prevalence.

1.2 ASTHMA MORBIDITY AND MORTALITY

In South Africa, asthma is believed to be a major cause of childhood morbidity (Ehrlich 1994). A recent local study of children aged between 7 to 9 years found a high prevalence of recent wheeze (26.8%) compared to international studies (Ehrlich 1995). Asthma is also the most common disease requiring admission to the academic Red Cross War Memorial Children's Hospital in Cape Town (Lachman 1990).

In South Africa, asthma mortality accounts for few deaths per year compared to e.g. tuberculosis (Bradshaw 1995). Its importance lies in the fact that such deaths should be preventable. A study on asthma mortality between 1962 and 1988, in so-called Coloured• and White• South Africans (Ehrlich 1994) did not show the rise in mortality that had been described in other developed countries (Campbell 1997). However, within South Africa, asthma mortality was shown to be a bigger problem in Coloured South Africans than among their White counterparts (Ehrlich 1994). Fortunately, current international literature suggests that asthma mortality may be on the decline (Sly 1994), and this may also be the case in South Africa. Data from a recent local study of fatal and near fatal asthma shows decreased mortality between 1980 and 1997 (Zar 2000). The morbidity from the disease however remains high. Macintyre et al. (2001) report more than a doubling of asthma admissions to Ga-Rankuwa Hospital on the Gauteng-NorthWest province border over the period 1986 to 1996.

• In terms of apartheid legislation repealed in 1991 all South Africans were allocated at birth to one of four legally defined groups: White (European descent), Coloured (mixed descent), Black (wholly African descent) and Asian (descent mainly from Indian subcontinent).

1.3 UNDERDIAGNOSIS OF ASTHMA

In spite of the high morbidity from asthma in South Africa, the disease is believed to be underdiagnosed and poorly treated. A previous study of children aged 7 to 9 years in Mitchells Plain, Cape Town reported a 12-month prevalence of wheeze of 27% and a cumulative prevalence of "reported asthma ever" of 10.8% (Ehrlich 1995). The authors attributed this discrepancy to be due to underdiagnosis of asthma. A total of 34% of likely asthmatics in this study who did report the diagnosis were not on current treatment and many were using inappropriate therapy. Salbutamol and theophylline syrups were the most common forms of medication used, and inhalers and anti-inflammatory medication were underused. Few children also reported ever having used a peak flow meter (Ehrlich 1995). Green et al. (1998) reviewed prescription data and confirmed that many asthmatics in South Africa received inappropriate therapy. They reported a high usage of beta-2-agonists compared to inhaled corticosteroids and found that oral rather than inhaled corticosteroids were commonly prescribed.

The underdiagnosis of asthma in a community is a major concern. An acute severe attack of asthma can be fatal. Poorly managed asthma in a child may result in considerable social and economic distress for his/her family. The sequelae of regular, severe asthmatic attacks are frequent school absences (Hill 1989, Lenney 1978, Taylor 1992), decreased physical activity and poor school functioning (Doull 1996, Fowler 1992). Parents are affected by having to take time off work to look after their sick child, family life is disrupted and siblings may even be neglected.

Asthma also poses an economic burden on the health services of a country. Mean annual cost per asthma patient is $1000 in the United States and between $85 and $884 in Australia (Lenney 1997). In South Africa, the treatment of an acute exacerbation of asthma can cost anything between R200 and R3000 daily and uncontrolled asthma is responsible for unnecessary and excessive health expenditure (Green 1998).

1.4 ASTHMA IN PRESCHOOLERS

This dissertation focuses on asthma in preschoolers particularly, as the natural history and prognosis of asthma are different in the preschool child compared to older children.

Childhood asthma is a heterogenous condition with atopy being strongly associated with the persistence of wheeze (Sporik 1991). About one-quarter of all children wheeze at some time in their lives with a peak incidence in the second year of life (Anderson 1986). Age of onset has been variably associated with the duration of asthma. Studies have found that early age of onset is associated with a poorer outcome (Williams 1969) or better outcome (Aberg 1990), or have shown no association (Blair 1977). Other studies have suggested that severity of symptoms at age of onset is associated with a poorer prognosis (Jenkins 1994, Park 1986).

Asthma in preschool children is poorly researched internationally. While epidemiological surveys of primary school children are plentiful, there is a dearth of epidemiological data on asthma in preschoolers. The reasons for this dearth are twofold. First, young children pose a diagnostic dilemma to the attendant doctor. In the absence of objective evidence of reversible bronchoconstriction by means of e.g. a peak flow rate, one is forced to rely on the subjective clinical history and examination. Furthermore, it has been shown that not all frequent wheezers in this age group are asthmatic (Martinez 1995). Young children may wheeze and/or cough with upper or lower respiratory tract infection (Hart 1986, Lenney 1978) and it is often difficult to distinguish asthma from bronchitis, pneumonia with wheeze or bronchiolitis.

Second, it is logistically difficult in most countries to reach a representative sample of preschoolers. In the absence of good record keeping, birth cohorts are notoriously difficult to identify and trace. Prospective studies of such groups are prone to attrition bias. They are also impractical in developing countries, where demographic data and resources are poor. Much of the information that is currently available on preschoolers is obtained retrospectively from surveys conducted on parents of older, more easily accessible schoolgoing children. These studies are limited by information bias inherent in imperfect parental recall of symptoms that their children presented with when they were much younger. One would expect that parents of severely symptomatic older children are more likely to recall earlier symptoms. A biased estimate of prevalence symptoms in younger children based on retrospective recall is thus likely. The few published data on preschoolers (Crain 1994, Haby 2001, Luyt 1993), indicate that asthma morbidity is a serious problem, and underdiagnosis of asthma is believed to be a problem in this younger group as well (Luyt 1994).

1.5 PURPOSE OF STUDY

To the best of the author's knowledge, the prevalence of asthma symptoms in preschoolers has never been studied in South Africa. This study was therefore an attempt to fill this gap in our knowledge. It is hoped that such information will be useful in influencing public health priorities in young children. This is especially relevant in South Africa, where the health system is trying to transform itself to address the major public health problems via a comprehensive public health and primary care approach.

1.6 STUDY DESIGN

A cross sectional survey was used to obtain the desired information on prevalence of asthma symptoms in preschoolers. It is widely accepted that a standardised self (or parent) reported questionnaire is the method of choice to obtain a baseline measurement of asthma prevalence in a population (Pekkanenn 1999). It is an important initial description of the magnitude of the problem as well as baseline against which local and international comparisons can be made. Important associations between variables may also be observed.

1.7 "CHAMP" - CHESTINESS AND ASTHMA IN MITCHELLS PLAIN

This study formed part of a larger project called CHAMP ("Chestiness" and Asthma in Mitchells Plain). The latter is a suburb in Cape Town, South Africa. CHAMP was an attempt to determine an effective method of delivering key asthma health messages to health care providers. As part of the project, private general practitioners were interviewed to determine what they perceived as barriers to the proper management of childhood asthma. An intervention comprising an educational kit and a programme of academic detailing was then designed and tested in an effectiveness trial. An economic evaluation of the intervention is currently being done.

Evaluation of the effectiveness of the intervention required a baseline school based survey of asthma symptoms among primary school children and their younger siblings from the community served by these general practitioners The study design of CHAMP thus permitted us to reach a subpopulation of preschoolers in this community. It was therefore an ideal opportunity to study the prevalence of asthma symptoms in these young children for the first time in this country. It also provided information on primary schoolers as a comparison group.

1.8 ASSOCIATION BETWEEN ASTHMA AND FAMILY SIZE

The study design of CHAMP allowed us to link preschoolers with older and younger children in the same household. The tendency of asthma to occur in certain families is a well described occurrence (Abdulrazzaq 1994, Davis 1981, Lewis 1998, Strachan 1989). This may be explained by a genetic predisposition to atopy (Panhuysen 1995). However environmental exposures are also implicated in the aetiopathogenesis of asthma (Woolcock 1995). The increase in asthma in many western communities (Mitchell 1983, Peat 1994) has been suggested to be due inter alia to a decrease in nuclear family size. It has been argued that the higher prevalence of atopy in children from smaller families is due to their relative isolation from the common childhood infections that they would have been exposed to in larger sibships (Martinez 1994). This is a relatively new and interesting hypothesis. It was possible to examine this within the study design.

1.9 AIMS AND OBJECTIVES OF THE STUDY

1.9.1 To determine the prevalence of asthma symptoms in a population of Cape Town children of preschool and primary school age.

1.9.2 To examine the relationship between

- prevalence of asthma symptoms
- prevalence of moderate or severe asthma (defined under Methods)

and age, sex, relationship of respondent to child and residential suburb.

1.9.3 To examine the relationship between prevalence of asthma symptoms and

- reported asthma (diagnosis)
- moderate or severe asthma (severity)

1.9.4 To examine the relationship between the prevalence of asthma symptoms and various measures of household size and birth rank, viz.

- number of older children in the household.
- number of younger children in the household.
- number of children in the household
- whether first-born child or later-born child
- whether only child or not the only child in the household.

1.9.5 To examine for any secular trend in asthma symptoms over a 4-year period by comparing their prevalences in the sub-group of children aged 7-9 years, with prevalences measured in a similar age stratum in 1993.

1.10 STRUCTURE OF THE THESIS

Chapter Two is a critical appraisal of the literature available on asthma symptoms in pre-schoolers, as well as the current literature on the associations that we chose to look at. Chapter Three is a description of the study design and methods employed. Chapter Four is a presentation of the results in a tabulated and/or graphical form. Chapter Five is a discussion of the results, their significance and relationship to available literature. Chapter Six is a presentation of the conclusions of this study. References follow and the appendix consists of a copy the self-administered questionnaire.

CHAPTER TWO

LITERATURE REVIEW

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2.1 PREVALENCE OF ASTHMA SYMPTOMS

2.1.1 Asthma symptoms in preschoolers

The purpose of this study was to determine the prevalence of asthma symptoms in preschool children in Mitchells Plain. The study design enabled us also to determine the prevalence of asthma symptoms in older schoolgoing children. We were therefore able to compare the two groups and look at interesting associations within and between them.

A review of current literature on the subject was done via a Pubmed search using the keywords "asthma", "childhood", "preschool", "prevalence" and "ISAAC". Only eight population prevalence studies on preschoolers could be found. Their findings were as follows:

In 1995, Haby et al. (2001) surveyed parents of children aged 3 to 5 years living in two cities (Lismore, n=383 and Wagga Wagga, n= 591) in Australia. They reported prevalences as follows:

Table 1: *Prevalence of asthma symptoms in Lismore, n=383, and Wagga Wagga, n=591, in Australia*

Symptom	Lismore (%)	Wagga Wagga (%)
Asthma ever	30.0	27.3
Wheeze in past 12 months	30.8	28.8
Cough in past 12 months	38.6	37.2
Recent asthma	21.7	18.1

Luyt et al. (1993) surveyed a birth cohort born between 1985 to 1989 in Leicestershire. In a questionnaire survey of parents of 1422 children, they found the following symptom prevalences and 95 % confidence intervals:

Table 2: *Asthma symptom prevalences in children aged < 5 years in Leicestershire (n = 1422)*

Symptom	Prevalence (%)	95% Confidence Interval
Formal diagnosis of Asthma	11.0	9.4; 12.6
Cumulative prevalence of wheeze i.e. "ever wheezed"	15.6	13.7; 17.5
Prevalence of recurrent cough without a cold	21.8	19.6; 23.9
Prevalence of wheeze in past 12 months	13.0	11.3; 14.8

Data from the Second National Health and Nutrition Survey (NHANES II) in the United States reported prevalences of "current asthma" and "frequent wheeze" in the past 12 months by racial categories as follows (Schwartz 1990):

Table 3: *Prevalence of asthma symptoms in the United States from NHANES II.*

Age group	12 month symptom prevalence			
	Current asthma (%)		Frequent wheeze (%)	
	Whites	Blacks	Whites	Blacks
6 months to 3 years	2.4	6.8	6.7	10.9
4 to 7 years	3.4	8.3	6.0	9.4
8 to 11 years	3.6	6.0	5.4	5.4

Other national surveys done in the United States reported similar asthma prevalences to those from the NHANES II (Halfon 1986, Taylor 1992).

A review of the diagnoses appearing on Health Insurance scripts in Manitoba, Canada (1987), reported that doctors diagnosed asthma in 10% of male and 7.6% of female children between 0 to 4 years of age (Manfreda 1993).

An older study from Birmingham, United Kingdom, reported racially categorised prevalences of asthma and wheezing combined (Morrison Smith 1976). Parents of children aged 5 to 6 years were interviewed by school health visitors in 1974-5 and the prevalence of asthma and wheezing combined was found to be 7.5% in European children and 11.4% in Black children respectively.

A household survey of 367 children under 5 years of age from Lower Hutt, New Zealand, in 1974 reported a cumulative prevalence of wheezing of 26.1% (Anyon 1979). The cumulative prevalence of asthma, wheezy bronchitis or bronchitis was 44.6%.

It is clear from the literature search that asthma is poorly researched in preschoolers. The few studies that are available differ widely in methodology. A different questionnaire was used in each of the above studies and the mode of administration was dissimilar. While self-administered questionnaires were used in the studies from Australia and Leicestershire, a telephone survey was performed in the United States. A school health visitor obtained the information in Birmingham and the study from Manitoba was an analysis of diagnoses as they appeared on doctors' claims from the Provincial Health Insurance database. As questions regarding asthma prevalence were phrased differently, they may have included different sub-groups of symptomatic individuals in their responses, e.g. "doctor-diagnosed asthma" (Leicestershire), "asthma and wheezing" (Birmingham). The above factors limit comparison between the eight studies. The problem is compounded by the fact that many of the studies were performed a number of years ago, e.g. Birmingham (1974), Canada (1987), United States (1988). Current literature suggests that asthma prevalence has changed over the years (Anderson 1994, Burney 1990, Mitchell 1983, Peat 1994) and hence reported asthma from the above-mentioned studies may not be comparable to current international prevalences of asthma. The studies from Leicestershire (1993) and Australia (1995) are thus most relevant for comparison purposes.

A standardised and validated epidemiological tool is the basis of a good population survey. The lack of such a tool for asthma measurement in preschoolers may partly explain the differences in asthma prevalences reported in these children worldwide. The Leicestershire group attempted to address this question by constructing a questionnaire based on study objectives and then piloting it to assess comprehensibility. Wherever possible questions were abstracted from previously validated questionnaires, mostly from Australia. The repeatability of questions was also assessed in an attempt to reduce information bias. The Australian group does not discuss how their questionnaire was arrived at, however questions used were similar to the ones used in Leicestershire. Repeatability was also tested in the Australian study and a strict definition of asthma was used in an attempt to improve validity of the study. It is clear therefore that these two studies are good epidemiological population surveys.

The lack of standardisation of method prevents meaningful ecological comparison of asthma symptom prevalences in preschoolers. The ISAAC Steering Committee has addressed this problem in children of schoolgoing age with the ISAAC questionnaire. The project has, however, not yet encompassed preschoolers. Our study is the first of which we are aware that has used the ISAAC questionnaire in younger children.

2.1.2 Asthma in primary schoolers

Asthma prevalence in primary schoolers is well researched internationally. Four prevalence surveys were found that measured self reported asthma in children or adolescents in South Africa. Their findings are tabulated below.

Table 4: *Self reported asthma symptoms or asthma in children or adolescents in South Africa.*

Study (year published)	Sample size Age range	Outcome measure	Prevalence (%)
Burr 1994	1180 12 years	wheeze past 12 months asthma ever	17.8 11.5
Ehrlich 1995	1955 6-10 years	wheeze past 12 months asthma ever	26.8 10.8
Nriagu 1999	367 <17 years	shortness of breath with wheeze past 12 months asthma ever	16.0 10.0
Poyser 2002	5178 13-14 years	wheezing past 12 months (video) wheezing past 12 months (written questionnaire) asthma ever	7.0 16.0 13.3

* from Ehrlich 2002

Other South African studies used tests of bronchial hyperresponsiveness to obtain asthma prevalences. Their findings are tabulated below.

Table 5: *Asthma and tests of bronchial hyperresponsiveness in South African populations*

Study (yr published)	**Population (number, age range)**	**Outcome measure**	**Prevalence (%)**
Van Niekerk 1979	Transkei (671, 6-9 yr) Gugulethu, CT (694, 6-9 yr)	≥15% ↓ in FEV1 *or* PEF after exercise	0.14 rural 3.17 urban
Vermeulen 1990	Transkei (1014, 8-16 yr)	≥20% ↓ FEV1 after histamine	14.2
Terblanche 1990	Northern suburbs, CT (1192, 6-19 yr)	>10% ↓ in FEV1 after exercise	5.1
Nagel 1992	Southern suburbs, CT (1180, 12 yr)	>15% ↓ FEV1 after exercise	4.1
Calvert 2001	Transkei (1672, 8-13 yr) Khayelitsha, CT (1632, (8-13 yr)[1]	>15% ↓ FEV1 *or* >26% ↓ FEF 25-75 after exercise	8.7 rural 14.5 urban

CT: Cape Town. FEV1: Forced expiratory volume in one second. PEF: Peak expiratory flow. FEF 25-75: Forced expiratory flow between 25 and 75 % of the forced vital capacity.

• Ehrlich 2002

The questionnaire found relatively similar 12- month prevalences of asthma ever and wheeze, with the exception of Ehrlich 1995. The recent (1990s) studies of bronchial hyperresponsiveness show wide variation in prevalences and this reflects their poor sensitivity for asthma in population studies (Pekkanen 1999).

2.2 THE ISAAC PROJECT

In spite of the large number of studies of asthma in primary schoolers internationally, their methodology and epidemiological definitions of asthma differ. The International Study of Asthma and Allergies in Childhood (ISAAC) was a response to this deficiency (ISAAC 1998). This is a unique project that has attracted worldwide participation. The aim of Phase One of the project was to develop simple methods for measuring the prevalences of childhood asthma, allergic rhinitis and atopic eczema. To enable international comparisons, the epidemiological tool designed had to be suitable for different geographical regions and languages. This tool is known as the ISAAC questionnaire. Phase One studies targeted 13 to 14 year old children who completed both written and video forms of the ISAAC questionnaire. Inclusion of 6 to 7 year old children was an optional component. A number of studies have been published. Prevalence figures for selected ISAAC studies on 6 to 7 year olds are presented in the table below. There have been no published studies on 6 to 7 year old children from any African country.

Table 6: *Prevalence of asthma symptoms in children aged 6 to 7 years from selected ISAAC studies.*

Region/Centre	**Asthma ever (%)**	**Wheeze past 12 months (%) (written)**	**Severe wheeze limiting speech (%)**
Australia	27.1	24.6	3.9
North America	14.7	17.6	3.0
Latin America	12.4	19.6	4.5
Western Europe	7.2	8.1	3.4
Asia (excluding India)	10.7	9.6	1.5
India	3.7	5.6	1.9
Northern and Eastern Europe	3.2	8.8	1.5
Global average	10.2	11.8	2.4

The ISAAC project is the largest international survey of asthma to date. The survey demonstrates large geographic variations in asthma prevalence among 6 to 7 year olds. The 12- month prevalence of wheeze ranges from 5.6% in India to 24.6% Australia. Similarly, the cumulative prevalence of asthma ranges from 3.7% in India to 27.1% in Australia. A possible problem in inferring inter-country variation in asthma from the ISAAC study is that participating centres are self- selected. These centres may regard asthma as a health priority, in which case, the presence of increased public awareness in them could bias prevalences in an upward direction. In such a case, the significance of mild wheezing may be questionable. "Intuitively, it may appear that the occurrence of frequent "speech-limiting "attacks" (Table 6), is a more reliable symptom signifying asthma. However various validation studies have shown that because of social and cultural differences in labelling of "attacks" compared to "wheeze", questions on "wheeze" validate as well or better than questions on "attacks".

An important objective of the ISAAC project is the identification of possible aetiological associations at a population level. The association between genetic factors and asthma is well known, but environmental factors are clearly important in the development and severity of asthma. Identification of these factors may provide an opportunity for preventive action.

There are no published ISAAC studies of 6 to 7 year olds in South Africa. However, the study by Ehrlich et al. on primary schoolers in Mitchells Plain was based on a modified version of the ISAAC questionnaire (Ehrlich 1995). Its results are therefore comparable with other ISAAC studies in this age group. The prevalence of wheeze in the past 12 months (26.8%) is higher than that reported in any of the ISAAC studies. It ranks closely with Australia (24.6%) where the prevalence of "asthma ever" was 27.1%. By comparison, the prevalence of "asthma ever" was 10.8% in the South African study. This indicates under-diagnosis of asthma. It is of concern that a greater proportion of children in this study were "severe" asthmatics compared to Australia. This is illustrated by a prevalence of speech limiting attacks of 3.9% in Australia compared to 9.3% in Mitchells Plain.

Although the ISAAC project has not addressed asthma in the younger age group, it has successfully developed an important worldwide network of committed asthma researchers, and it is hoped that future research will target children of preschool age.

2.3 IS THE PREVALENCE OF ASTHMA INCREASING?

The table on the following page summarises the trends of some of the studies reviewed.

Table 7: *Table showing studies where the secular trend of recent wheeze and/or asthma was examined over different lengths of time. Change shown as rate of increase per annum.*

Years	Location	Age group	% change in prevalence per annum	
			Asthma	Wheeze
1982 - 1992 (Peat)	Belmont, Australia	8 - 10 years		+1.7
1991 -1993 (Kelly)	Merceyside, UK	5 - 11 years	+2.3	
1973 - 1988 (Burr)	Cardiff, Wales	12 years	+0.4	+0.3
1964 - 1989 (Ninan)	Aberdeen, UK	8 - 13 years	+0.3	+0.4
1969 - 1982 (Mitchell)	Lower Hutt, New Zealand	11 - 13 years		+0.5

A number of studies have found increases in the prevalence of asthma or wheezing over time. It is tempting to attribute this increase to an increase in atopy and a change in environmental risk factors but the evidence for this is poor. Alternative explanations may be greater awareness, changes in diagnostic practice as well as the presence of selection or information bias. As the epidemiological definition of asthma remains contentious, diagnostic labelling is a problem in most studies. Criteria for the diagnosis of asthma are likely to have changed over the years. This is especially relevant where changes in prevalence have been measured over many years e.g. 25 years. Current doctors may more readily diagnose asthma than before owing to improved knowledge and the tendency towards earlier introduction of therapy. Greater public awareness of asthma may also account for destigmatisation of the disease. Parents may therefore be more inclined to accept the diagnosis and hence report it in a survey. All of the above factors threaten the validity of inferring real increases in asthma prevalence over time.

Even studies of bronchial hyperresponsiveness over time show conflicting results. Some studies show decreasing bronchial hyperresponsiveness over time (Panhuysen 1997), while others show an increase in bronchial hyperresponsiveness (Burr 1989) or an increase in selected groups only e.g. among atopics (Peat 1994) or an urbanising population (Richter 2000).

Previous studies all acknowledge the above shortcomings. Thus evidence for a true increase in asthma prevalence is poor. With the advent of the ISAAC project, we can look forward to an internationally standardised and validated observation of secular trends in various study populations over time.

2.4 ASTHMA SYMPTOM PREVALENCES vs AGE AND SEX

"Childhood asthma usually begins before the age of 5 years (Dodge 1996). While many young children wheeze (Lenney 1978, Martinez 1995), those children whose symptoms either develop or persist through 3 to 4 years of age are more likely to have asthma (Dodge 1996). It follows therefore that asthma prevalence should increase with age in preschool children. Conversely, the prevalence of asthma in primary schoolers is believed to decrease with increasing age (Martin 1980) . While approximately half of all childhood asthmatics will outgrow their disease by adulthood, early age (Blair 1977) and severity at onset (Jenkins 1994, Park 1986) are noted to be predictors of the duration of asthma."

Sex differences in asthma are well documented. Asthma has been shown to be more common in both preschool (Luyt 1994, Schwartz 1990) and primary school boys (Clifford 1989, Ehrlich 1995, Strachan 1994). The sex ratio is believed to be 1.5-2.0 boys to 1 girl. A number of theories have attempted to explain this difference. Dysanaptic lung growth (i.e. unequal growth rates of airways and lung parenchyma) is believed to be the cause of a lower bronchi diameter to lung volume ratio in males (Pagtakhan 1984). In addition, boys have been noted to have higher prevalences of atopy (Anderson 1986, Berlier 1997) and bronchial hyperreactivity (Sears 1998). The surge in female sex hormones in adolescence is believed to be responsible for a reversal of the asthma prevalence ratio in this age group while the sex difference in asthma in adulthood is equivocal (Weiss 1995). Environmental factors may play a role in modifying the effect of female hormones in adulthood.

2.5 IS THERE AN ASSOCIATION BETWEEN SOCIO-ECONOMIC STATUS AND ASTHMA?

Various environmental factors are believed to be associated with asthma severity. Some of them are smoking, residence in an urban versus rural environment, dampness of the home, air pollution, socio-economic status (SES), season, altitude and infections. The effect of SES on the prevalence of asthma is not clear. Different studies yield conflicting results (Burr 1997, Goh 1996, Halfon 1993, Schwartz 1990, Strachan 1994). A problem in epidemiological research is the definition of the variable "socio-economic status". The studies reviewed used family income and/or housing to represent SES.

A national survey from the United States reported that the prevalence of asthma and wheeze decreased as the family income increased from less than $9100 per annum to greater than $27 300 per annum (Schwartz 1990). Another study from California showed the difference in asthma prevalence between poorer children and their more affluent counterparts was greatest in children under 6 years of age (Halfon 1986).

A study from Singapore (Goh 1996) of 6 to 7 year olds, reported the opposite finding i.e. wheezing and rhinitis increased with increasing socio-economic status (based on housing and total family income). An ISAAC study by Poyser (2002) reported that adolescents living in affluent areas of Cape Town reported more asthma symptoms in the previous 12 months than there poorer counterparts. It is believed that a higher socio-economic status may in some way be linked to a higher incidence of asthma whereas lower socio-economic status is linked to a higher morbidity from asthma (Schwartz 1990). This was confirmed by the Cape Town study where among all subjects with asthma symptoms, poorer adolescents reported more frequent asthma symptoms than their more affluent counterparts.

Morbidity from asthma is also reflected in studies of hospital admissions. Poor children have been observed to have longer hospitalisations for asthma than affluent children (Mitchell 1989). This may reflect the limited access that poorer children have to good medical care because of its cost. The use of medication, especially prophylactic drugs is also lower in poorer families (Burr 1997, Weinberg 1994). Other implicated factors may be higher exposures to environmental tobacco smoke (Burr 1989, Leeder 1976) and poor housing conditions and dampness which encourage the growth of moulds and house-dust mite. The use of certain fuels for home heating and/or cooking (Becklake 1997, Luyt 1994) may also be implicated.

Another effect of limited access to medical care is that poorer children either remain undiagnosed or poorly treated. Inadequate parental knowledge may also be a contributory factor. It has been shown in Cape Town that residence in the relatively more affluent suburbs of Mitchells Plain is associated with an overall good asthma knowledge (Moosa 1996). For example, ill-informed parents may be more likely to expose their asthmatic child to environmental tobacco smoke than their better- informed counterparts (Leeder 1976).

In the South African setting, as in many other societies, socio-economic status is inextricably related to race. Studies on mortality by race reflect higher death rates in Coloureds as compared to Whites (Benatar 1986, Ehrlich 1994). Such studies may however be confounded by many other factors related to environmental exposures, e.g. smoking and air pollution, that make interpretation difficult. Our study was therefore an opportunity to examine asthma by socio-economic status in a single race group.

2.6 PREDICTORS OF REPORTED ASTHMA IN CHILDREN

Reported asthma reflects the level of perceived or diagnosed asthma in a population. It is not an objective measure for epidemiological comparison as the criteria for asthma diagnosis vary between populations. The level of awareness among doctors and the public will influence the prevalence of reported asthma. Although underdiagnosis of asthma was reported in both preschoolers (Luyt 1994) and primary schoolers (Abukteish 1996, Bauman 1992, Clifford 1989, Silverman 1998, Speight 1983), many of the studies reviewed observed that children with recurrent symptoms were more likely to report asthma (Ehrlich 1994, Luyt 1993, Robertson 1991). Two of these studies looked at the predictors of reported asthma. The first, on preschoolers, found that increasing age, numbers of attacks per year, severity of shortness of breath as well as precipitants other than colds were all highly predictive of reported asthma (Luyt 1993). The second study found that in children aged between 3 months and 11 years, increasing age, male sex, younger maternal age, residence in the central city and a low family income were all strong predictors of reported asthma (Schwartz 1990).

One study looked at factors which predicted whether a parent recognised asthma in his/her child (Ehrlich 1998). In this study, from an initial self-administered questionnaire, children were identified as asthmatic if they satisfied the following criteria:

- parent reported asthma + at least one symptom in the previous 12 months or
- affirmative responses to 4 or more symptom questions referring to the past 12 months. For this purpose, frequent wheezing was given the weight of 2 symptoms.

Children identified as asthmatic on the above criteria were then divided into a "recognised" and "unrecognised" group by their response to the question "has your child ever had asthma?"

on a second interviewer-administered questionnaire. In this study, the parents of only 53% of 242 asthmatics (as defined above) recognised and appropriately reported the presence of asthma. Increasing age of the child, the respondent being the mother, personal history or family history of atopy and attendance at a usual private doctor were all found to be strong predictors of asthma recognition. Children belonging to the "unrecognised group" were found to have higher prevalences of asthma symptoms than the "recognised" group and this was believed to be due to a treatment effect. In other words, if a child was recognised to be asthmatic, he/she was more likely to be on appropriate therapy and was therefore less symptomatic.

Although the presence of asthma symptoms and increasing age were identified by most studies as predictive of asthma, the range of factors looked at as possible predictors of asthma differred between the studies. This limits comparison between the studies.

2.7 ASTHMA AND FAMILY SIZE AND THE "INFECTION" HYPOTHESIS

Many studies have looked at the association between family size, birth order and asthma. In 1990 and 1991, Rona et al. (1997) showed that in children between the ages of 5 to 11 years in England and Scotland, family size i.e. 3+ siblings compared to 0 siblings (odds ratio=0.5 and 95% CI 0.4 to 0.6) but not birth order was highly associated with asthma or persistent wheezing. In a large population sample in the UK, Strachan (1989) demonstrated an inverse relationship between the prevalence of allergic rhinitis and the number of older siblings. The association was less strong for number of younger siblings. Von Mutius et al. (1994) observed in East and West German children that the prevalence of atopy as assessed by the presence of a positive skin test to an aeroallergen was inversely related to the number of siblings in a household i.e. family size. The Wellington Asthma Research Group found a similar effect in 708 children between the ages of 8 to 13 years in New Zealand (Crane 1994). They observed that the prevalence of wheezing in the past year declined with an increasing number of older siblings and to a lesser extent with increasing numbers of younger siblings.

The protective effect of siblings on the development of atopy is postulated to be due to the programming of the immune system by repeated infections in early life ("infection" hypothesis") (Martinez 1994). Young children from large families are believed to have high exposures to infections early on in life which favours the response of the T-helper cell 1 (Martinez 1994). The T-helper cell 2 response that is responsible for IgE mediated allergic conditions is in turn down regulated. This forms the basis of protection from allergic disease.

Viral infections including airborne respiratory viruses (Martinez 1994) and childhood exanthems e.g measles (Shaheen 1996) were initially thought to be important early childhood exposures responsible for the prevention of atopy. The results of newer studies on viral infections are however inconclusive (Alm 1999, Lewis 1998). There is increasing evidence that exposure to bacteria, especially those spread by the oro-faecal route e.g. Hepatitis A protects against atopy (Matricardi 2000).

A review of the literature on the "sibling effect" is contradictory and suggests that the association is as yet incompletely worked out. First, the "infection" hypothesis has been expanded to be called the "hygiene" hypothesis and certain environmental exposures related to "westernisation" of society have been linked to the increase in atopic disease. These include : vaccination in early life (Lewis 1998), antibiotic use in early childhood (Wickens 1999), life away from a farm environment (Von Ehrenstein 2000), day-care attendance (Rusconi 1999) and decrease in breastfeeding (Infante-Rivard 2001). Of the above factors, only breastfeeding has clearly been shown to be protective of asthma (Infante-Rivard 2001, Nystad 1999, Rusconi 1999), while studies on all of the other above variables show conflicting results. Nevertheless, as all of these exposures have changed simultaneously with a decrease in nuclear family size, they may be responsible for confounding in the "sibling effect".

Second, the "infection" hypothesis contradicts the long held belief that respiratory infection in early childhood might cause changes in the lung that result in asthma (Weiss 1985). Asthma was shown to be higher in children with lower respiratory tract infection, otitis media, mumps and croup in the first year of life (Nafstad 2000). The "infection" hypothesis fails to explain why children from larger sibships develop less atopic disease when they are more likely to be exposed to more childhood respiratory illness.

In addition, there are newer theories that suggest the "sibling effect" may not only be as a result of the "infection" hypothesis but may already be apparent at birth. These theories include: "in-utero programming" and the effect of hormones. A recent study showed that cord-blood IgE decreased with age of the child in families due to maternal exposure to allergens (Karmaus 2001, Warner 1996). Progesterone has also been shown to favour the T helper cell 2 response (Piccini 1995).

The "infection" hypothesis may therefore only partly explain the increase in atopic disease in young children from nuclear familes. Alternative aetiological hypotheses e.g. the "hygiene" hypothesis and foetal exposures need to be considered.

CHAPTER THREE

METHODS

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3.1 STUDY SETTING

The study setting was Mitchells Plain, a lower socio-economic class housing development begun in the 1970s for people classified as "Coloured" by apartheid legislation. It lies at the south-east rim of the Cape Peninsula, approximately 20 km from Cape Town. Mitchells Plain consists of nine municipally defined suburbs viz. Mandalay, Westridge, Portlands, Rocklands, Woodlands, Lentegeur, Beacon Valley, Eastridge and Tafelsig.

3.2 STUDY DESIGN

This was a cross sectional prevalence study

3.3 STUDY POPULATION

The population of Mitchells Plain in 1990 was approximately 210 000 people of whom 55 000 were between 2 to 11 years of age (Population Census 1991). The mean household income was reported in the 1990 census as R19 600, with a range of R15 012 to R25 537 across the suburbs[•]. Housing is typical of a lower class housing development, consisting mainly of poor quality free-standing homes with gardens in the higher earning suburbs to poor quality double-storey flats in the lower earning suburbs. Unemployment is high, with only 40% of the population reporting being "economically active" at the 1990 census.

[•] In 1990, 1US$=R3.00 approximately. In 2002, 1US$=R10.00 approximately.

Mitchells Plain was chosen as the study population because previous South African studies have shown it to be an area with a high prevalence of childhood asthma. In 1990, Lachman et al. observed that the children from Mitchells Plain made up the highest proportion of referrals to the outpatients department of Red Cross War Memorial Hospital (the local teaching hospital). In 1994, "Coloured" children made up 83% of all asthma admissions to the same hospital compared to 61% of bronchiolitis and 51% of pneumonia admissions (Ehrlich 1994). In 1995, Ehrlich et al. reported a high 12-month prevalence of wheeze (26.8%) by international standards in 7-8 year olds and a low prevalence of reported asthma (10.8%). They suggested that there was a problem of underdiagnosis of asthma in this population. Against this backdrop, Mitchells Plain was considered to be an appropriate study population for CHAMP (see Section 1.7, page 21). The baseline survey included both the younger (2-6 years) and older (7-12 years) age groups.

3.4 STRUCTURE OF THE STUDY

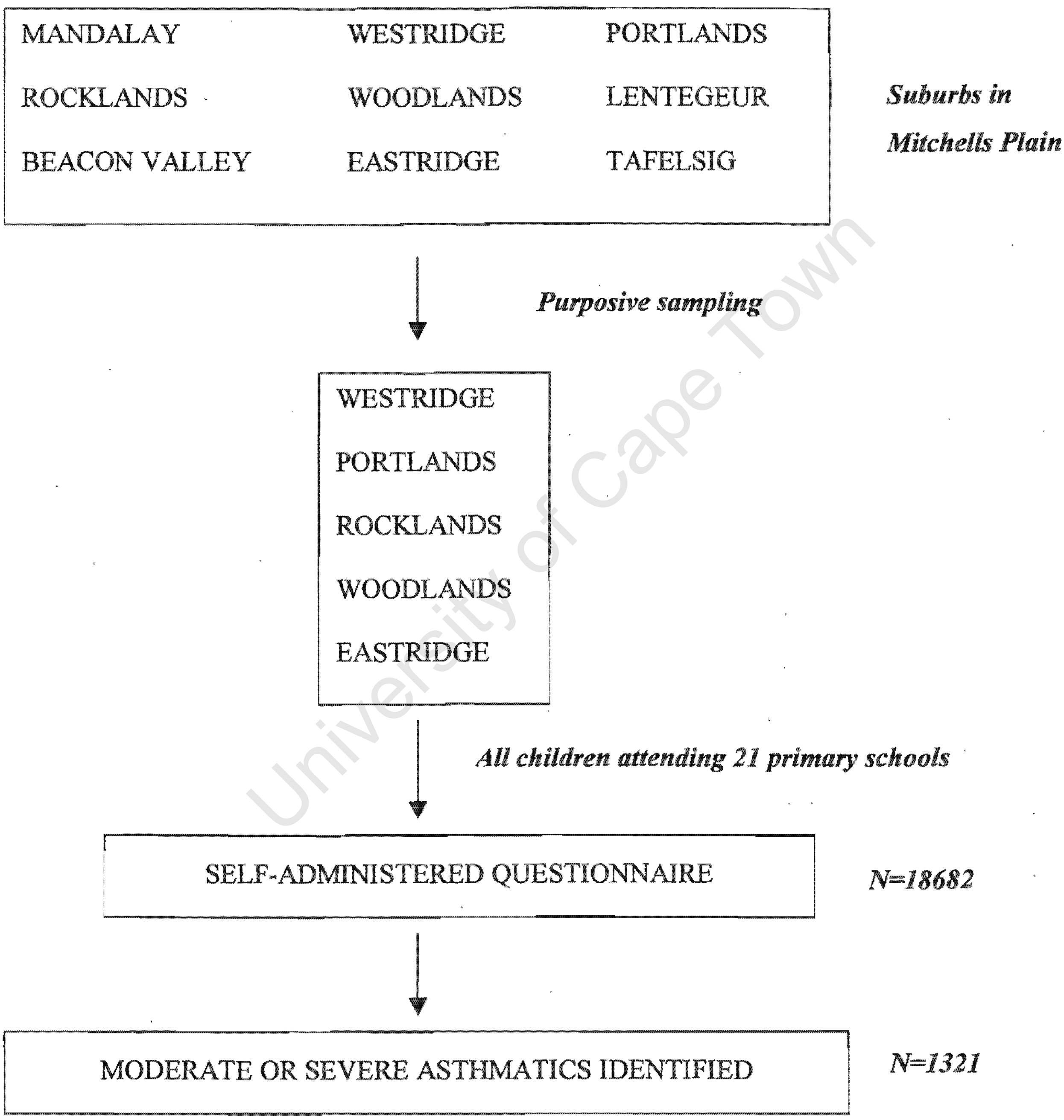
3.4.1 Effectiveness trial (not reported in this thesis)

This prevalence survey formed a part of an effectiveness trial of an intervention of academic detailing among general practitioners in Mitchells Plain. The study was a cluster randomised trial incorporating a multi-step process illustrated in the flow diagram of the sampling method (see section 3.4.2). A baseline cross sectional asthma symptom survey of all children attending selected schools and their younger siblings was performed. This survey was used to identify all children who were likely to be "moderate or severe" asthmatics. General practitioners of these children were chosen as the study subjects. Half of the group of general practitioners were randomised to be visited by an academic detailer and given an intervention kit that was designed specifically for the purposes of this trial (intervention group). The other half of the general practitioners were simply posted a similar intervention kit (control group). Outcomes were measured in the children identified as moderate or severe asthmatics. Twelve months later, an asthma symptom survey identical to the baseline survey was performed. The difference in symptoms between the children served by the two groups of general practitioners (intervention and control) was examined, to test the effectiveness of the intervention.

3.4.2 Sampling Method

The nine municipally defined suburbs of Mitchells Plain were graded according to an average index of annual household income. (Population Census 1991). This was used as a proxy measure for socio-economic status. For the purpose of the intervention trial, the four suburbs with the "highest" income index were chosen. For purposes of this prevalence study, one "low" income suburb was added. All children attending the 21 primary schools in the five selected areas were surveyed during the second two weeks of October 1997 (spring months). The study was referred to as "a survey of breathing problems in children" and questionnaires were available in English and Afrikaans versions according to individual preference. The sampling method is illustrated in the flow diagram on the following page.

FLOW DIAGRAM SHOWING SAMPLING METHOD



3.4.3 Sample size calculation

For the purposes of the baseline prevalence survey, the sample size calculations based on the estimated 12-month prevalence of wheeze are given below.

In 1990, Luyt et al. reported an overall prevalence of recent wheeze in children under 5 years of age in Leicestershire as 13%. Assuming a similar prevalence in our study population, we required 695 children in the younger age group i.e. 2 to 6 years, to achieve a precision of +/- 2.5%.

Ehrlich et al. reported the 12-month prevalence of wheeze in 7 to 8 year olds in this population in 1995 to be 27%. Assuming a similar prevalence in our study population in 1997, we required 1211 children in the older age group, i.e. 7 to 12 years, to achieve a precision of +/- 2.5%.

3.4.4 Prevalence study

The oldest schoolgoing child of each family was identified by the class teacher and given sufficient questionnaires for himself/herself and all younger siblings in the household. The child was instructed to hand the questionnaires to its parent or caregiver for completion. Over the next two weeks, children were encouraged daily by the class teacher to return the completed questionnaires.

Although the primary research objective of this study was to determine the prevalence of asthma in preschoolers, primary schoolers were targeted to convey questionnaires to caregivers for a number of reasons. First, in our setting, birth registry details are poor and incomplete, formal crèche records are absent and young families are highly mobile in respect of place of abode. Hence it is logistically impractical to identify and/or trace a birth cohort from the local maternity clinic to derive a true population prevalence rate. Older schoolgoing siblings are therefore the only practical method of which we are aware to gain access to pre-school children in our setting. Second, school attendance rates are generally good among primary schoolers and as they are well motivated to dutifully execute instructions from their teachers, they are reliable "messengers" to their caregivers. The oldest schoolgoing sibling was chosen to avoid problems of duplication of questionnaires for younger siblings, and it was presumed that the oldest child would be the most reliable to perform the duty of handing the questionnaires to his/her caregiver.

The use of the schoolgoing sibling in families as a "messenger" precluded the inclusion of first-born preschoolers in the study population. This may have introduced selection bias into the study.

" Although some of the schools had formal preschool classes, we were only able to reach 29 first-born children between the ages of 2 to 6 years. No analysis was thus done between first-born preschoolers and those with siblings because the numbers were too small to be representative of the population."

The question "How many babies and children younger than 18 years of age live in this house?" was used to calculate the variables "number of younger children in the household" and "number of older children in the household". As many households in Mitchells Plain may house more than one nuclear family, it was impossible to differentiate biological siblings from non-siblings of the index child. The "infection" hypothesis however, refers to children sharing the same household environment, hence we chose to measure all children younger or older than the index child in the household. The index child i.e. the child who was given the questionnaire was identified by an identification number consisting of nine or fewer digits. Other children were identified by longer identification numbers (i.e. ten digit numbers). The age of this child was then linked to all the identification numbers to create a new variable called "test_age". The rank of the child (i.e. whether younger or older than the index child) was determined by subtracting "age" from "test_age". If the difference was positive, it indicated a younger child (rank 1) and if the difference was negative, it indicated an older child (rank 2). If the difference was zero, it was the index child (rank 0). An example is shown below.

ID Number	**Age**	**Test_age**	**Rank**	**Position in family**
01040708	9	9	0	index child
0104070801	4	9	1	younger sibling
0104070802	1	9	1	younger sibling
0104070803	11	9	2	older sibling

3.5 QUESTIONNAIRE DESIGN

3.5.1 The definition of asthma

In clinical practice, asthma is diagnosed by physicians on the basis of history, physical examination and evidence of reversible bronchoconstriction over a period of time. This requires repeated contact between a doctor and his/her patient. This is impractical in the setting of large prevalence surveys where high response rates need to be achieved. Furthermore doctors' diagnostic practices differ ecologically. Many prevalence surveys therefore make use of standardised questionnaires of self (or parent) reported asthma symptoms rather than doctor-diagnosed asthma. We made use of the internationally standardised and now much used ISAAC questionnaire (ISAAC 1998). This questionnaire has been validated internationally and takes account of the variable nature of asthma by incorporating questions on 12-month period prevalence and lifelong prevalence of "asthma ever". An additional advantage was that the same questionnaire was previously used on older children in the study population (Ehrlich 1995).

3.5.2 Tests of Bronchial Hyperresponsiveness

A possible criticism of the above approach is the lack of objective evidence of asthma e.g. bronchial hyperresponsiveness (BHR) testing (Toelle 1992). While BHR tests are objective, they are not necessarily valid estimates of asthma. The validity of a test for a prevalence survey is best assessed by the Youden's index (sensitivity and specificity - 1) (Pekkanen 1999). BHR has been shown by Pekkanen to have a similar or better specificity for doctor-diagnosed asthma in children compared to a symptom questionnaire. However it has a lower sensitivity 0.54 (0.48-0.67) compared to a symptom questionnaire which has a sensitivity of 0.85 (0.73-0.93). A symptom questionnaire therefore has a better Youden index than BHR testing and is thus a better tool for a prevalence survey. We therefore chose to use a standardised symptom questionnaire, the ISAAC questionnaire.

The English version of the questionnaire can be found in Appendix 1. A modified version of the ISAAC questionnaire on asthma in childhood was used as the self-administered questionnaire. This questionnaire was validated in its original form internationally (ISAAC 1998) and used in a modified and translated form locally in the same setting in 7 to 9 year olds in 1993 (Ehrlich 1995). Further modifications were based on results from the 1993 study.

The first section of the questionnaire comprised questions on socio-economic variables. The second section comprised questions on symptoms. Asthma symptoms and the frequency of their occurrence was measured over the previous 12 months were elicited, as well as the lifetime history "ever" of asthma.

Based on reliability data from the 1993 study (Ehrlich 1995), only three symptom questions viz. wheeze, night waking in previous 12 months and "asthma ever" were included in the self-administered questionnaire. Kappa scores were determined from a self-administered questionnaire followed 6 weeks to 3 months later by an interviewer-administered questionnaire. The Kappa scores were as follows:

- wheeze (4+ vs 4 or fewer episodes) kappa = 0.44
- tight chest kappa = 0.46
- sleep disturbance kappa = 0.56
- asthma ever kappa = 0.70

Repeatability was assessed according to the Landis and Koch scale. According to this scale of measurement, these questions had moderate repeatability. The question on "asthma ever" had substantial repeatability. The symptoms wheeze and tight chest were believed to be interchangeable terms in this population and hence they were combined into one question. Despite the symptom night cough having only a fair reliability in 1993 (kappa = 0.37), it was included as a question to accommodate the younger children i.e. 2 to 6 years. These children are believed to frequently present with recurrent cough instead of wheeze as a symptom of asthma (Brooke 1998, Luyt 1993). It is postulated that these children have a variant of asthma where the symptom of airway obstruction is cough rather than wheeze (Brooke 1998). The occurrence of the cough at night is in accordance with the circadian rhythm of airways obstruction.

Because many young children are known to wheeze occasionally in response to viral infections, frequency questions were included as more specific indicators of asthma. These questions were also used to identify a sub-group of children with moderate or severe symptoms for the effectiveness trial part of this project. Additional questions on attendance at a private doctor and measures of household size were part of the questionnaire.

3.6 THE BASIS OF THE SYMPTOM SCORE USED TO IDENTIFY MODERATE OR SEVERE ASTHMATICS

Assessment of asthma severity is a clinical process which usually requires repeated contact between a doctor and his/her patient over a period of time. As this is impractical in an epidemiological study, large prevalence surveys usually rely on symptom scores to identify more severe sub-groups within a study population. We made use of The South African Consensus Guidelines (South African Childhood Asthma Working Group 1994) and the 1995 British Guidelines on Asthma Management (GINA Guidelines) (British Thoracic Society 1997) in the development of a representative symptom score to identify a sub-group of moderate or severe asthmatics.

The South African Consensus guidelines propose a three point severity grading of childhood asthma (mild, moderate and severe) based on attack frequency, nocturnal symptoms, frequent hospital admissions and peak flow rate. The GINA severity grading system is similar, except that activity limitation and current drug therapy are added for severity grading. Intermittent asthma is added as a fourth severity category.

The symptom score used was based on questions relating to frequency of asthma symptoms. Measures of peak flow rate and information on drug therapy were omitted from the symptom score for the following reasons. First, although peak flow rate is an objective measure of asthma severity, children under six years of age are unable to reliably execute a peak flow manouevre. It was also not logistically feasible to include this test in the survey of older children. A question on drug therapy was not used because childhood asthma is known to be underdiagnosed in this population (Ehrlich 1995), and responses to such a question would thus be poorly representative of severity.

The three frequency questions were each allocated a score ranging from 0 to 3 according to frequency of episodes in the previous 12 months i.e.

- 0 episodes = 0
- 1 – 2 episodes = 1
- 3 episodes = 2
- 4+ episodes = 3

The score obtained for all three frequency questions in respect of wheeze, night cough and night waking in all symptomatic children was added to give a total score. The maximum score attainable was thus nine points and the minimum score attainable was 1 point. Children with the highest symptom scores were included until the desired sample size for the separate effectiveness trial was obtained. These children were referred to as moderate or severe asthmatics (MSA).

3.7 DATA ANALYSIS

Data collected were analysed using the SAS statistical software package. Univariate analyses were performed to obtain symptom prevalences as proportions, with 95% confidence intervals. Bivariate analyses were done to analyse the symptom prevalences by age, sex, respondent, place, reported asthma and moderate or severe asthma. Differences were evaluated statistically using the X^2 test statistic. A p value of less than 0.05 was interpreted as statistically significant. For ordinal variables, the X^2 trend test was performed using the Epi Info statistical software package. Multivariate logistic regression analysis was done to identify predictors of reported asthma.

3.8 ETHICAL CONSIDERATIONS

The study was approved by the Ethics and Research Committee of the Faculty of Health Sciences, University of Cape Town. The Department of Education of Western Cape granted permission for the study to be conducted in its schools. The study was explained and co-operation requested in separate meetings held with principals and teachers of the 21 selected schools.

The voluntary nature of the study was described to caregivers in a covering letter that was attached to the self-administered questionnaire. They were also advised of the complete confidentiality of the study and that all completed questionnaires should be returned in sealed envelopes. Written consent for the questionnaire was obtained in an addendum to this questionnaire.

3.9 DISSEMINATION OF RESULTS

A manuscript will be prepared for publication. The results will be disseminated to all interested parties with a view to informing programme or intervention planning to improve the diagnosis and management of childhood asthma.

CHAPTER FOUR

SUMMARY OF RESULTS

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4.1 RESPONSE RATE

Of the 18 682 questionnaires handed out, 18 041 were returned. This gives a good response rate of 96.5%. Of these, 1016 were excluded owing to faulty identification data. The final sample for whom age was available was 17 025 children. As the sample was stratified by age for the statistical analyses, only these children were included in the final sample.

4.2 DEMOGRAPHIC PROFILE OF SAMPLE

The age distribution of the children reached was as follows (Table 8).

Table 8: *Frequency distribution of sample by age group.*

Age group (years)	N	%
0 - < 2	454	2.70
2 – 6	4018	24.00
7 – 12	9765	57.00
13 – 14	2222	13.00
15+	566	3.30

This project was a prevalence study of asthma symptoms in children of preschool and primary school age. We therefore chose to perform further analyses on these two groups only i.e. 2 to 6 years and 7 to 12 years.

The distribution by sex was approximately equal for children of preschool and primary school age (Table 9).

Table 9: *Frequency distribution by sex of preschoolers and primary schoolers in sample.*

Age group (years)	**Frequency (%)**		
	Female	**Male**	**Total**
2 – 6	2001 (49.8)	2014 (50.2)	4015
7 – 12	4923 (50.5)	4832 (49.5)	9755
Total	6924 (50.3)	6846 (49.7)	13 770

Table 10 summarises the distribution of preschoolers and primary schoolers by residential suburb in descending order of a measure of the household income status of the suburb. It demonstrates that the majority of children were from households in areas with a similar income index. As the income index differential across the sample was very small, further analyses were performed by comparing Tafelsig and Westridge i.e. the two suburbs at the opposite ends of the scale. Mandalay was not used as there were too few subjects from this suburb.

Table 10: *Distribution of preschool and primary school age children in the sample by residential suburb in Mitchells Plain including a measure of household income distribution in the suburb.*

		Number of children (% of total)	
Suburb	**Income measure(%)[1]**	**2-6 years**	**7-12 years**
Mandalay	74.5%	19 (0.5%)	29 (0.3%)
Westridge	86.5%	387 (9.6%)	1018 (10.4%)
Portlands	87.6%	391 (9.7%)	901 (9.2%)
Rocklands	92.1%	536 (13.4%)	1377 (14.1%)
Woodlands	92.1%	436 (10.9%)	1112 (11.5%)
Lentegeur	92.4%	1163 (28.9%)	2721 (27.9%)
Beacon Valley	93.4%	78 (1.9%)	194 (1.9%)
Eastridge	94.6%	161 (4.0%)	450 (4.7%)
Tafelsig	96.2%	338 (8.5%)	837 (8.6%)
Other[2]	-	456 (11.4%)	967 (9.9%)
Total		**4012 (100%)**	**9747 (100%)**

[1] Income measure = % of population living in the suburb who earn < R15 000 per annum as at 1991 census.

[2] Suburbs outside of Mitchells Plain.

4.3 ASTHMA SYMPTOM PREVALENCES AND EFFECT OF AGE

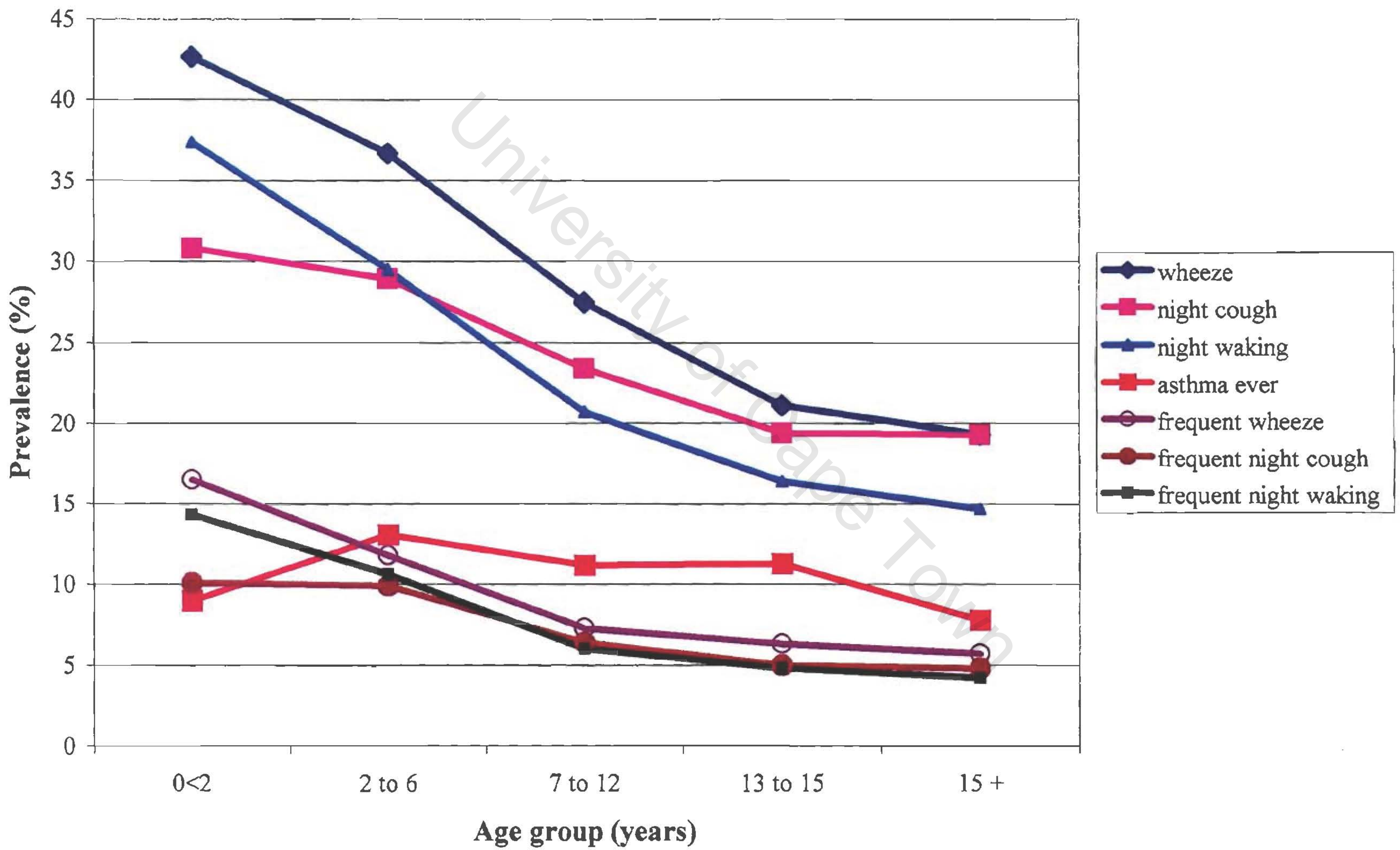
The prevalence of asthma symptoms by age is represented in Table 11 and on Figure 1 on the following page. There was a significant decreasing trend for all symptom prevalences by age (X^2 trend; $p < 0.05$). The prevalences of recent wheeze, night cough and night waking was found to be high. In all age groups, they were considerably higher than the prevalence of reported asthma. The prevalences of frequent wheeze, night cough and night waking were, however, closer to that of reported asthma.

Table 11: *Age trend of asthma symptom prevalences in children in Mitchells Plain (n= 17 025)*

Symptom (%)	**Age Group (years)**				
	0 < 2	**2 to 6**	**7 to 12**	**13 to 15**	**15+**
Wheeze past 12 months	42.7	36.7	27.5	21.1	19.3
Night cough past 12 months	30.8	28.9	23.4	19.4	19.3
Night waking past 12 months	37.4	29.5	20.7	16.4	14.7
Asthma ever	9	13.1	11.2	11.3	7.8
Frequent[1] wheeze	16.5	11.8	7.3	6.3	5.7
Frequent[1] night cough	10.1	9.9	6.4	5	4.8
Frequent[1] night waking	14.3	10.6	6	4.8	4.2

[1] frequent refers to 4+ episodes in past 12 months

Figure 1: Age trend of asthma symptom prevalences in children in Mitchells Plain



4.4 ASSOCIATION OF HAVING A USUAL PRIVATE DOCTOR WITH AGE

As attendance at a doctor may be linked to the diagnosis of asthma, the association between having a usual private doctor and the diagnosis of asthma was examined. The likelihood of having a usual private doctor decreased by age group (see Table 12). This may mean that as children grew older, they were less likely to attend a doctor and hence less likely to be diagnosed as asthmatic. Conversely, older children are less likely to be asthmatic and hence are less likely to attend a doctor regularly. As asthma symptom prevalences decreased by age, we think that the latter explanation is more likely.

Table 12: *Prevalence of having a usual private doctor by age group in children in Mitchells Plain.*

Age Group (years)	n	Prevalence	95% confidence interval
0-2	454	31.9	27.6-36.2
2-6	4018	28.7	27.3-29.1
7-12	9765	23.4	22.6-24.2
13-14	2222	18.5	16.9-20.1
15+	566	17.1	13.9-20.2

*chi-square for trend = 117.05; p = 0.32

4.5 ASSOCIATION OF SEX WITH ASTHMA SYMPTOM PREVALENCES

This is shown on Tables 13 and 14 and Figures 2 and 3 for preschoolers and primary schoolers respectively on the following two pages. In preschoolers, boys had significantly higher prevalences of most symptoms. Differences for night cough, night waking and frequent night waking were not statistically significant. In primary schoolers, although boys had higher prevalences of most symptoms, only the prevalence of night cough differed significantly between boys and girls. The differences in symptom prevalences between boys and girls was also much smaller in primary schoolers compared to those in preschoolers.

Table 13: ***Prevalence of asthma symptoms by sex in preschoolers in Mitchells Plain (n= 4018)***

Symptom	Male	Female	Difference (Male - Female)	P value for difference
Wheeze past 12 months	38.5	34.9	3.6	0.02
Night cough past 12 months	30.3	27.7	2.6	0.07
Night waking past 12 months	31.5	27.3	4.2	0.00
Asthma ever	15.2	10.9	4.3	0.00
Frequent[1] wheeze	12.6	10.9	1.7	0.00
Frequent[1] night cough	10.5	9.3	1.2	0.08
Frequent[1] night waking	11.7	9.5	2.2	0.10

[1]frequent refers to 4+ episodes in past 12 months

Figure 2: Prevalence of asthma symptoms by sex in preschoolers in Mitchells Plain (n=4018)

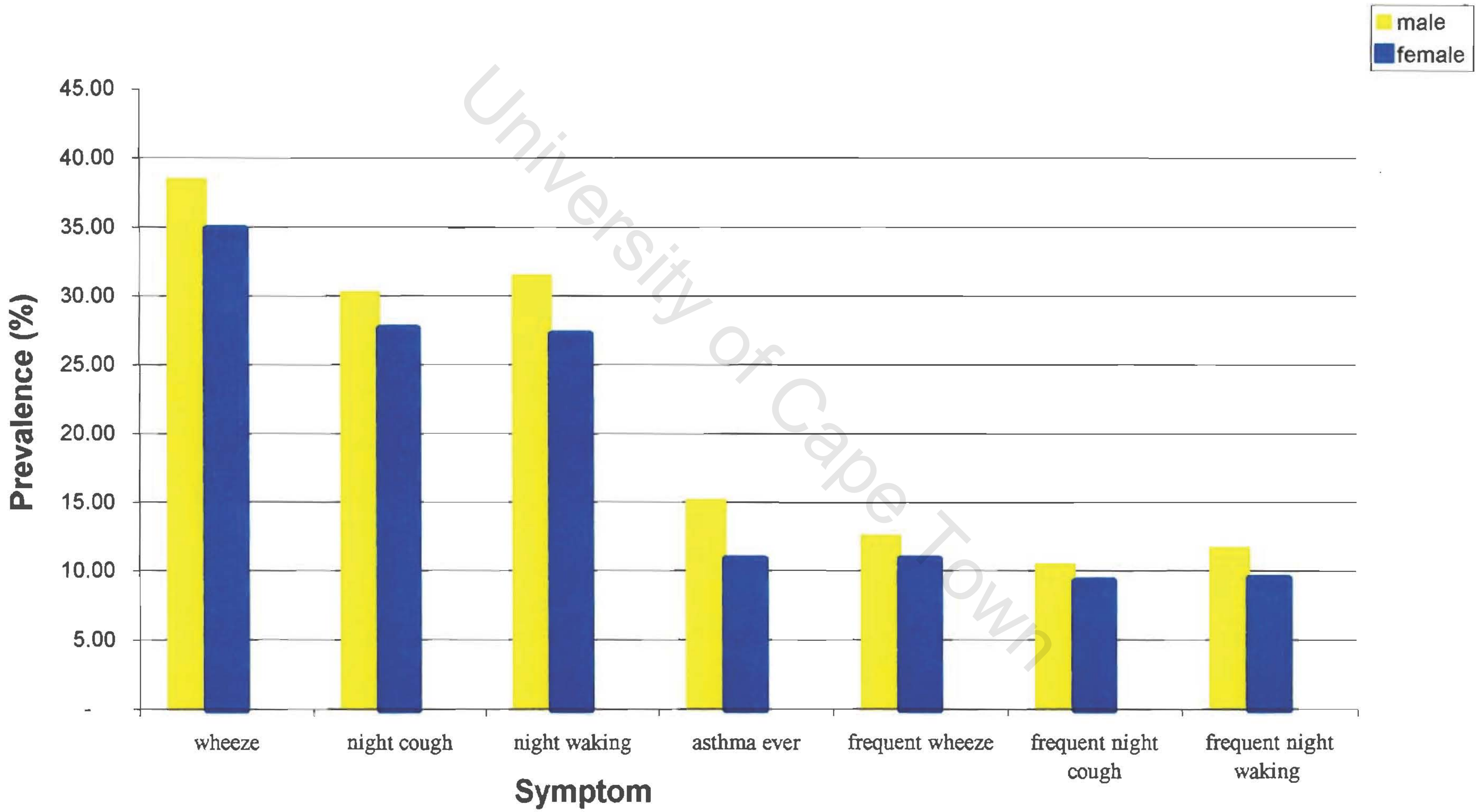


Table 14: *Prevalence of asthma symptoms by sex in primary schoolers in Mitchells Plain (n= 9765)*

Symptom	Male	Female	Difference (Male - Female)	P value for difference
Wheeze past 12 months	28.3	26.7	1.6	0.08
Night cough past 12 months	24.4	22.5	1.9	0.03
Night waking past 12 months	21.3	20.2	1.1	0.18
Asthma ever	11.7	10.7	1.0	0.14
Frequent[1] wheeze	7.5	7.2	0.3	0.38
Frequent[1] night cough	6.8	5.9	0.9	0.07
Frequent[1] night waking	5.8	6.3	-0.5	0.10

[1]frequent refers to 4+ episodes in past 12 months

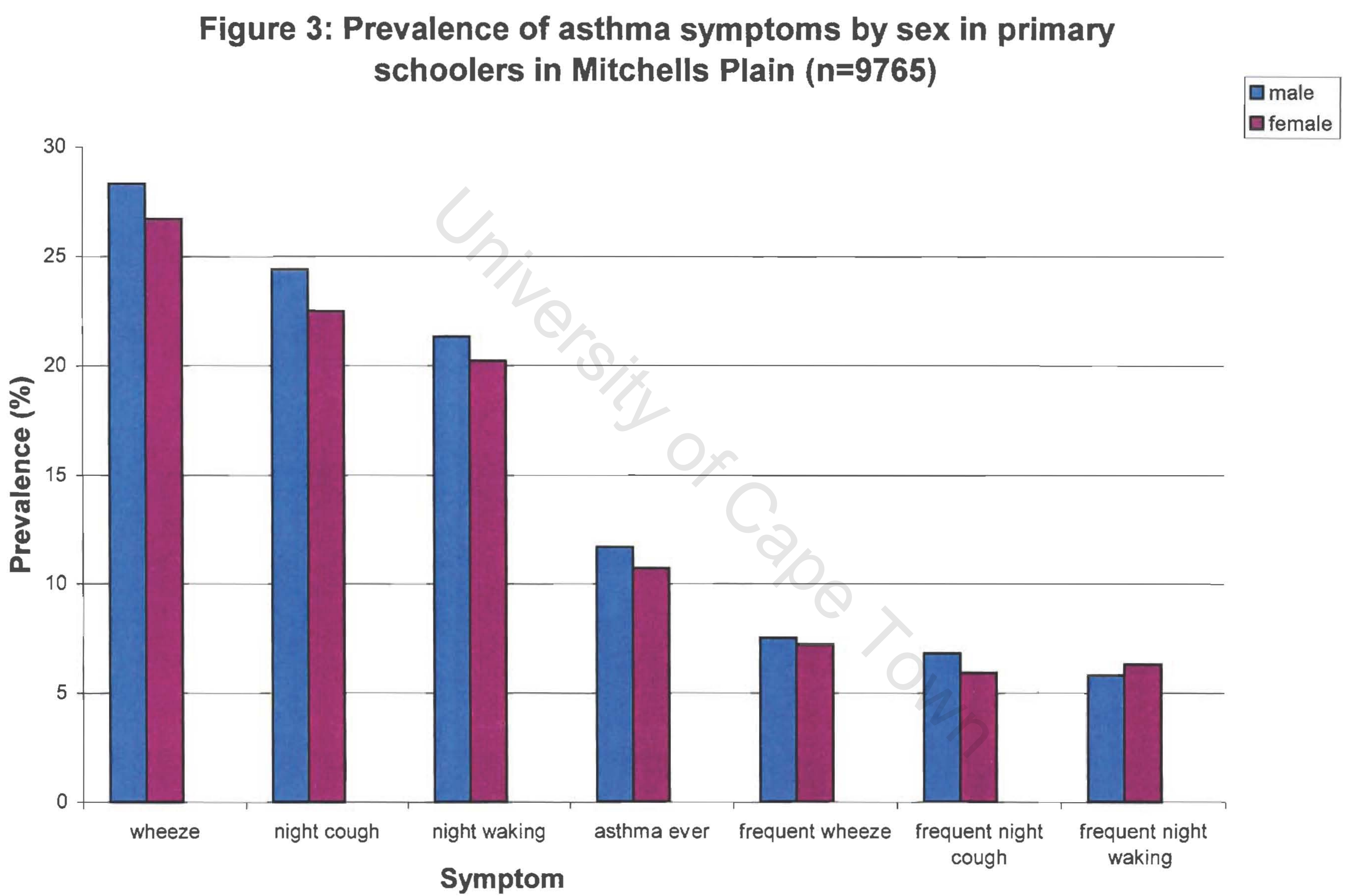


Figure 3: Prevalence of asthma symptoms by sex in primary schoolers in Mitchells Plain (n=9765)
male
female
30
25
20
15
10
5
0
Prevalence (%)
wheeze
night cough
night waking
asthma ever
frequent wheeze
frequent night cough
frequent night waking
Symptom

4.6 ASSOCIATION OF RESPONDENT WITH SYMPTOM PREVALENCES

Table 15 summarises the distribution of respondents i.e. the adult who completed the self-administered questionnaire.

Table 15: *Distribution of respondents for sample by age group*

Respondent	**Age Group**			
	2-6 years		**7-12 years**	
	Number	**%**	**Number**	**%**
Mother	1859	81.9	3782	80.4
Father	295	12.9	622	13.2
Granny	80	3.5	184	3.9
Other	37	1.6	114	2.4

There was no association of respondent with asthma symptom prevalence (data not shown).

4.7 ASSOCIATION OF RESIDENTIAL SUBURB WITH SYMPTOM PREVALENCES

Symptom prevalences were similar among children from the nine residential suburbs. However, when children from Tafelsig i.e. the "poorest" suburb were compared to those from Westridge i.e. the "best off" suburb, all symptom prevalences were higher in Tafelsig children. In preschoolers, only the differences for night cough and night waking were statistically significant. Tables 16 and 17 and Figures 4 and 5 on the following pages demonstrate prevalence differences between Tafelsig and Westridge children for preschoolers and primary schoolers respectively.

Table 16: *Prevalence of asthma symptoms between Tafelsig (n= 338) and Westridge (n= 387) for preschoolers in Mitchells Plain*

Symptom	Tafelsig (poorest) %	Westridge (more affluent) %	Difference % (Tafelsig - Westridge)	P value for difference
Wheeze past 12 months	37.6	33.3	4.3	0.23
Night cough past 12 months	32.5	23.0	9.5	0.00
Night waking past 12 months	30.2	23.3	6.9	0.03
Asthma ever	14.5	9.8	4.7	0.05
Frequent[1] wheeze	13.0	12.1	0.9	0.72
Frequent[1] night cough	11.2	8.5	2.7	0.21
Frequent[1] night waking	12.1	9.0	3.1	0.17

[1]frequent refers to 4+ episodes in past 12 months

Figure 4: Comparison of asthma symptom prevalences between Tafelsig (n= 338) and Westridge (n=387) for preschoolers in Mitchells Plain

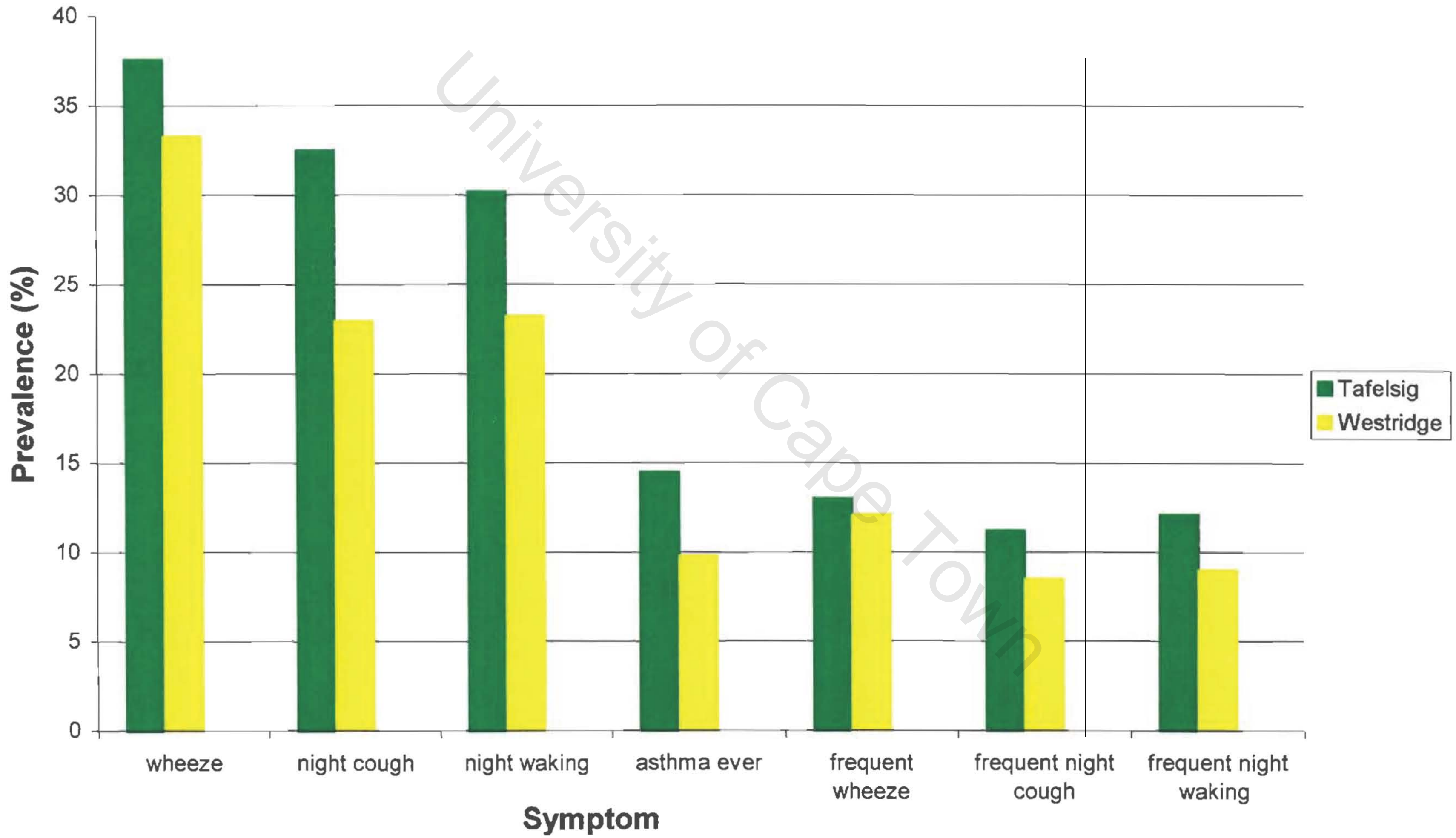


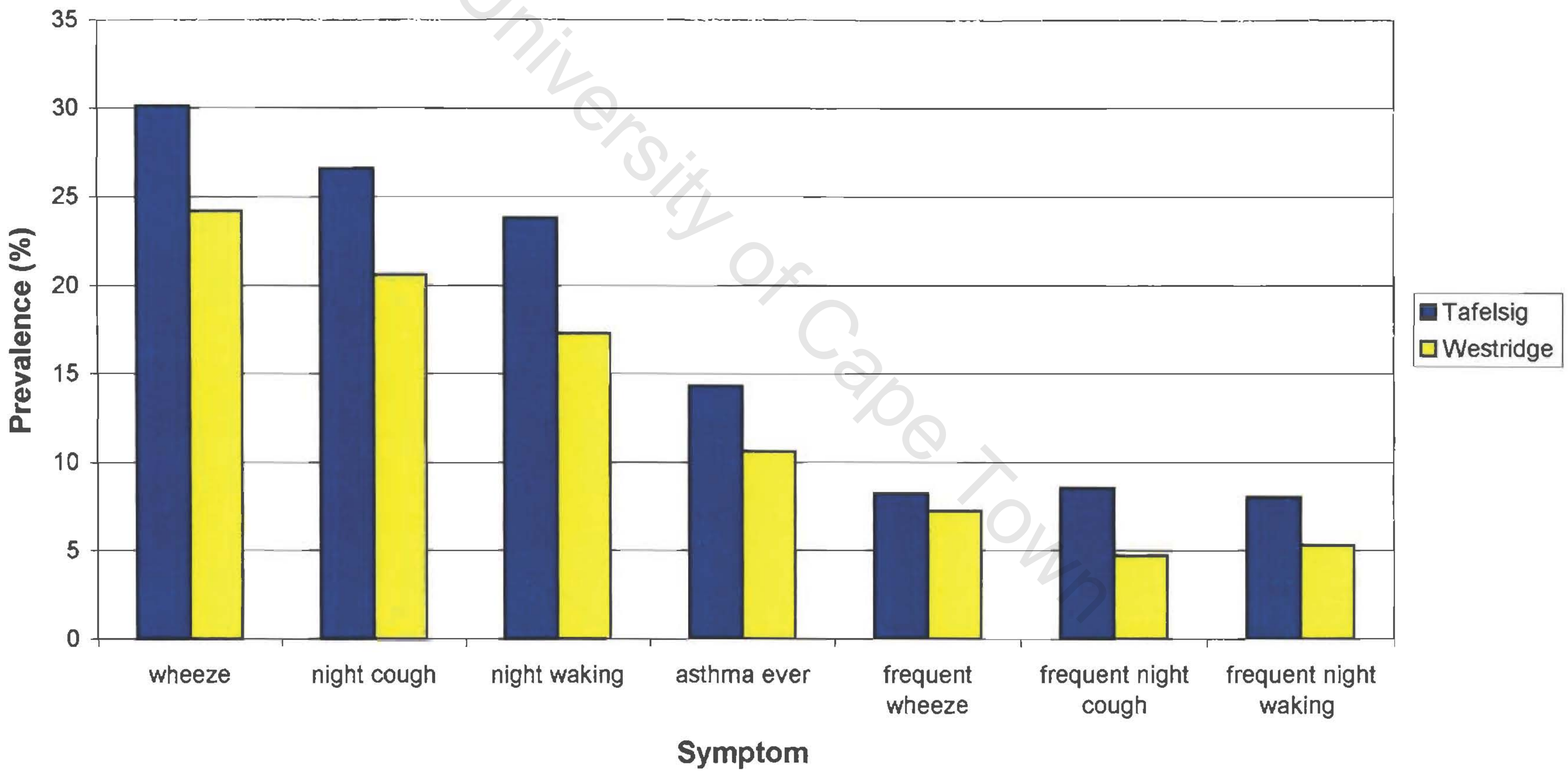
Table 17: *Prevalence of asthma symptoms between Tafelsig (n= 837) and Westridge (n= 1018) for primary schoolers in Mitchells Plain*

Symptom	**Tafelsig (poorest) %**	**Westridge (more affluent) %**	**Difference % (Tafelsig - Westridge)**	**P value for difference**
Wheeze past 12 months	30.1	24.2	5.9	0.00
Night cough past 12 months	26.6	20.6	6.0	0.00
Night waking past 12 months	23.8	17.3	6.5	0.00
Asthma ever	14.3	10.6	3.7	0.00
Frequent[1] wheeze	8.2	7.2	1.0	0.38
Frequent[1] night cough	8.5	4.7	3.8	0.00
Frequent[1] night waking	8.0	5.3	2.7	0.01

[1]refers to 4+episodes in past 12 months

In primary schoolers, most symptom prevalences were significantly higher in Tafelsig compared to Westridge. This is consistent with the belief that poorer children suffer higher morbidity from asthma when compared to their more affluent counterparts.

Figure 5: Comparison of asthma symptom prevalences between Tafelsig (n=837) and Westridge (n=1018) for primary schoolers in Mitchells Plain)



4.8 ASSOCIATION OF ASTHMA SYMPTOMS AND OTHER VARIABLES WITH REPORTED ASTHMA

Symptom prevalences were higher in the group of children who reported asthma compared to those who did not report asthma. (Table 18). A high proportion of children with frequent symptoms did not report asthma i.e. only 50.1% of all frequent wheezers and 50.4% of all frequent "night wakers" reported asthma (Table 19). The number of children who reported frequent symptoms but did not report asthma was less so in primary schoolers (Table 19). If the symptoms that were measured are indeed valid estimates of asthma, then this suggests underdiagnosis of the disease in the sample.

Table 18: *Symptom prevalences by reported asthma for children in Mitchells Plain.*

Age Group	Prevalence (%)			
	Reported asthma	Wheeze past 12 months	Night cough past 12 months	Night waking past 12 months
2-6 years (n = 4018)	Yes	89.0	67.1	79.4
	No	28.8	23.2	21.9
7-12 years (n=9765)	Yes	81.9	63.9	71.0
	No	20.7	18.4	14.4

Table 19: *Prevalence of frequent symptoms i.e. 4+ episodes in the previous 12 months in children where asthma was reported.*

Age Group	Prevalence (%)			
	Reported asthma	**Frequent wheeze**	**Frequent night cough**	**Frequent night waking**
2-6 years (n =1460)	**Yes**	50.1	44.1	50.4
	No	49.9	55.9	49.6
7-12 years (n=2687)	**Yes**	59.1	50.6	60.7
	No	40.9	49.4	39.3

A slight positive trend was observed when reported asthma was compared with age as a continuous variable (Table 23). Reported asthma did not differ by sex nor residential suburb.

Children who were reported to be asthmatic were significantly more likely to have a usual private doctor compared to children who were not reported to be asthmatic i.e. 57% vs. 24.4%; $p< 0.001$ for pre-schoolers and 55.8% vs. 19.3%; $p< 0.001$ for primary schoolers. The proportion of respondents reporting asthma also rose as the number of visits to a private doctor increased (Table 20).

Table 20: *Prevalence of reported asthma by number of visits to a private doctor in past 12 months*

	Prevalence %	
Number of visits to a private doctor	**Age group**	
	2 - 6 years (n=4018)	**7 - 12 years (n=9765)**
Usual private doctor		
0	5.1	4.9
1-2	17.0	21.7
3	33.2	41.3
4+	54.3	60.3
Other private doctor		
0	7.1	6.6
1-2	25.2	29.7
3	44.4	54.0
4+	54.5	65.2

4.9 ASSOCIATION OF ASTHMA SYMPTOMS AND OTHER VARIABLES WITH MODERATE OR SEVERE ASTHMA (MSA)

According to the devised symptom score, 526 preschoolers and 795 primary schoolers were identified as moderate or severe asthmatics (MSA). These children were classified as "reported" or "unreported" MSA by their response to the question "Have you ever had asthma?" The distribution of reported and unreported MSA is shown in the table below.

Table 21: *Distribution of reported and unreported asthma among children with MSA by age group (n=1321)*

Age group	reported asthma n (%)	unreported asthma n (%)	Total (%)
2-6 years (n=526)	260 (49.4)	266 (50.5)	100
7-12 years (n=795)	448 (56.4)	347 (43.6)	100

Of the symptom prevalences that were examined in preschoolers, only recent night waking prevalence was higher in the reported vs. unreported group i.e. 50.5% vs. 49.5%, but the difference was not statistically significant. In primary schoolers, recent wheeze as well as recent night waking were significantly more common in the reported vs. unreported group i.e. 57.4% vs. 42.6% and 58.6% vs. 41.4%; $p<0.001$ respectively. The prevalence of recent night cough was similar in both groups. Hence, it is clear that parents may not completely understand the significance of night cough in their children.

The prevalence of frequent wheeze and frequent night waking was higher in both preschoolers and primary schoolers for whom asthma was reported. Frequent night cough was, however, higher in the unreported group for preschoolers. This suggests that parents may not recognise night cough as a symptom of asthma.

It is important to note that a high proportion of these frequently symptomatic children with high symptom scores were not reported as having asthma. This confirms underrecognition of asthma in the population.

Table 22: *Prevalence of frequent symptoms, i.e. 4+ episodes among children with MSA by reported asthma.*

Symptom (%)	Age Group			
	2 to 6 years		7 to 12 years	
	reported asthma n=526		reported asthma n=795	
	YES	NO	YES	NO
Frequent[1] wheeze	41.5	38.0	48.3	29.4
Frequent[1] night cough	35.7	37.6	41.8	29.9
Frequent[1] night waking	40.3	37.2	47.0	26.2

[1]frequent refers to 4+ episodes in past 12 months

4.10 PREDICTORS OF REPORTED ASTHMA

A logistic regression analysis was done on the binary outcome variable, "reported asthma". Recent wheeze and night waking were found to be the best predictors of reported asthma in preschoolers and primary schoolers (Tables 23 and 24). Attendance at a usual private doctor and male sex were less predictive, while recent night cough and age were not predictive. Of the frequency variables, wheeze, night waking and repeated visits to a usual private doctor were the strongest predictors of reported asthma. In both age groups, frequent night waking and frequent night cough were not predictive of reported asthma.

Table 23: *Logistic Regression analysis showing predictors of Reported asthma in preschool children in Mitchells Plain (N= 4018)*

Symptom[1]	Scale	Odds Ratio	P value	95% Confidence Interval
Wheeze	Yes/No	6.4	0.0001	4.5 - 9.2
Night waking	Yes/No	3.2	0.0001	2.4 - 4.3
Wheeze frequency	4+/0-3[2]	1.8	0.0001	1.5 - 2.1
Usual doctor	Yes/No	1.7	0.0001	1.4 - 2.1
Usual doctor visits	4+/0-3[2]	1.5	0.0001	1.3 - 1.7
Male sex	Yes/No	1.3	0.0024	1.1 - 1.4
Night cough	Yes/No	1.3	0.0284	1.0 - 1.7
Night waking frequency	4+/0-3[2]	1.2	0.0019	1.1 - 1.4
Other doctor visits	4+/0-3[2]	1.2	0.0033	1.1 - 1.3
Age	Years	1.1	0.0001	1.0 - 1.2
Night cough frequency	4+/0-3[2]	0.9	0.6874	0.8 - 1.3

[1] refers to past 12 months unless otherwise specified

[2] 4+ episodes vs. 0 to 3 episodes in past 12 months

Table 24: *Logistic Regression analysis showing predictors of Reported asthma in primary school children in Mitchells Plain (N= 9765)*

Symptom[1]	Scale	Odds Ratio	P value	95 % Confidence Interval
Night waking	Yes/No	2.7	0.00	2.3 - 3.2
Wheeze	Yes/No	2.6	0.00	2.1 - 3.1
Wheeze frequency	4+/0-3[2]	2.2	0.00	1.9 - 2.4
Usual doctor	Yes/No	1.5	0.00	1.3 - 1.7
Usual doctor visits	4+/0-3[2]	1.5	0.00	1.3 - 1.6
Night waking frequency	4+/0-3[2]	1.3	0.00	1.1 - 1.4
Other doctor visits	4+/0-3[2]	1.3	0.00	1.2 - 1.5
Night cough	Yes/No	1.3	0.00	1.0 - 1.5
Night cough frequency	4+/0-3[2]	1.1	0.26	0.9 - 1.2

* controlled for age and sex

[1] refers to past 12 months unless otherwise specified

[2] 4+ episodes vs 0 to 3 episodes in past 12 months

4.11 EFFECT OF NUMBER OF OLDER CHILDREN IN THE HOUSEHOLD (0;1;2;3;4+) ON ASTHMA SYMPTOM PREVALENCES

In both preschool and primary school children, as the number of older children in the household increased from 0 to 4+, there was a decreasing trend in all symptom prevalences (Table 25). Trends for wheeze, night waking and asthma ever in preschoolers were statistically significant. None of the trends among the primary schoolers were statistically significant.

Table 25: *Recent symptom prevalences i.e. past 12 months by numbers of older children in the household (0;1;2;3;4+) among children in Mitchells Plain*

Age group	Symptom (%)	Number of older children in the household					X^2 trend	P value
		0	1	2	3	4+		
2-6 yrs n=4018	**Wheeze**	36.3	39.4	35.3	25.5	28.9	12.62	0.01
	Night cough	28.6	29.6	28.4	27.7	26.5	0.66	0.88
	Night waking	26.0	31.6	29.5	24.2	24.1	12.18	0.01
	Asthma ever	14.4	12.8	14.2	9.7	9.6	26.10	0.00
7-12 yrs n=9765	**Wheeze**	27.9	27.1	25.6	17.8	6.7	4.90	0.18
	Night cough	23.9	22.8	22.3	13.7	6.7	4.03	0.26
	Night waking	20.5	21.6	20.4	13.7	6.7	6.95	0.07
	Asthma ever	11.5	10.7	9.5	8.2	6.7	0.06	0.99

Frequent wheeze in preschoolers decreased significantly as the number of older children in the household increased (Table 26). All other frequent symptom prevalences showed no trend in both preschoolers and primary schoolers.

Table 26: *Frequent symptom prevalences i.e. 4+ episodes in past 12 months by number of older children in the household (0;1;2;3;4+) for preschool children in Mitchells Plain*

Symptom (%)	Number of older children in the household					X^2 trend	P value
	0	1	2	3	4+		
Frequent[1] wheeze	10.9	12.8	11.2	9.3	9.6	15.7	0.00
Frequent[1] night cough	9.9	10.2	9.7	9.0	9.6	0.23	0.98
Frequent[1] night waking	8.8	10.8	11.7	10.0	10.8	2.32	0.51

[1] frequent refers to 4+ episodes in past 12 months

4.12 ASSOCIATIONS OF OTHER MEASURES OF HOUSEHOLD SIZE WITH SYMPTOM PREVALENCES

Symptom prevalences did not differ between household size grouped as 0-2; 3-5 and 6+. Being an only child vs. not an only child showed no association with symptom prevalences. Number of younger children in the household (0; 1;2;3;4+) had no effect on symptom prevalences (data not shown).

4.12 SECULAR TREND IN ASTHMA SYMPTOM PREVALENCES OVER TIME

All symptom prevalences except night cough showed a small increase between 1993 and 1997 (table 27). Only the increase in wheeze prevalence (+3.5%) was statistically significant, although the confidence interval was wide.

Table 27: *Secular trend of asthma symptom prevalences in 7-9 year old children in Mitchells Plain between 1993 and 1997.*

Symptom	1993 (P1) (%)	1997 (P2) (%)	Difference (P2-P1) + 95% confidence interval	% change per annum
Wheeze past 12 months	26.8	29.8	3.5 0.6-5.4	0.9
Night cough past 12 months	25.4	24.9	-0.5 -1.8-2.8	-0.1
Night waking past 12 months	20.4	22.1	1.7 -0.5-3.9	0.4
Asthma	10.8	11.6	0.8 -0.9-2.5	0.2
Frequent[1] wheeze	6.4	8.2	1.8 -0.1-3.7	0.4

[1]frequent refers to 4+ episodes in past 12 months

CHAPTER FIVE

DISCUSSION

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5.1 VALIDITY OF THE STUDY

Population surveys may be compromised by a lack of precision (random error) or validity (systematic error). Small surveys are prone to random error and low response rates may cause selection bias. Random error was minimised by an adequate sample size and selection bias by a high response rate (96.5%). It was higher than the 90% reported in the 1993 survey (Ehrlich 1995) and the majority of ISAAC centres. It was also higher than response rates reported for a study on preschoolers (Luyt 1993) and others on primary schoolers. (Anderson 1986, Gergen 1988, Mitchell 1983, Peat 1994)

The sampling method did not initially allow for the inclusion of first-born preschoolers in the study. However, first-born preschoolers were ultimately part of the study sample (from formal preschool classes at some schools). No differences in symptom prevalences were found between this group and preschoolers who were not first-born. It may still be argued that these children may not be entirely representative of all first-born preschoolers in Mitchells Plain. However, Rona et al. (1997), in a study of primary schoolers, also found no difference in asthma symptom prevalences between first-born and non first-born children.

Selection bias could have arisen from the choice of suburbs (in the wider study) based on family income. This led to the inclusion of children from schools from the three suburbs with the highest average income and only one suburb with a lower average income. However, as children were reached via schools and not by the "door-to-door" method in each suburb, the actual sample of children came from all nine suburbs in Mitchells Plain. We were thereby able to compare symptoms between children across both poor and more affluent suburbs.

5.2 PREVALENCE OF ASTHMA SYMPTOMS

The estimated cumulative prevalence of reported asthma in preschoolers was 13.1%. This figure is similar to asthma prevalences reported from Leicestershire (11.0%) (Luyt 1993), Manitoba (10.0%) (Manfreda 1993) and Birmingham (11.4%) (Morrison Smith 1976). It is however much lower than prevalences reported from Lismore (22%) and Wagga Wagga (18%) in Australia (Haby 2001), and much higher than in a study from the United States (4 to 8%) (Schwartz 1990).

The estimated prevalence of wheeze in the previous 12 months (36.7%) was high by international standards. It was higher than recent (previous 12 months) wheeze in Lismore (30.8%), Wagga Wagga (28.8%) and Leicestershire (13.0%). Environmental factors known to trigger asthma may explain the higher symptom prevalences of recent wheeze, night cough and night waking in this study. The study was carried out in October, i.e. in the spring season that coincides with an increase in respiratory allergens such as pollens. The high symptom prevalences may therefore reflect the seasonality of asthma (Goldstein 1984, Roux 1993). A high prevalence of house-dust mite and smokers in the population are additional environmental factors that may account for the higher asthma symptom prevalences. Mitchells Plain lies along the coast where climatic factors and humidity favour the proliferation of house-dust mite (Van Niekerk 1977). A high smoking prevalence especially among women in this community has previously been documented (Ehrlich 1996).

Other reasons that could account for the range of prevalences across different studies include ecological variation, change in asthma prevalence over time, the use of different epidemiological tools to measure asthma prevalence and differing diagnostic practices among doctors as well as in public perception of the disease in different places.

The cumulative prevalence of asthma in Lismore (30%) and Wagga Wagga (27.3%) was much higher than that reported in our study (13.1%). The reasons for this difference may be multiple. Children with reported asthma in Lismore and Wagga Wagga appear to include mild, moderate and severe asthmatics, whereas reported asthma in our study may be weighted towards moderate or severe asthmatics. The high prevalence of asthma (30%) in Lismore is, for example, close to the prevalence of recent wheeze (30.8%) in this study. The prevalence of "admission to hospital for asthma" (6.3%) in Lismore was much lower than the prevalence of recent wheeze and asthma.

In our study, reported asthma (13.1%) was closer to frequent wheeze (11.8%) and frequent night waking (10.6%) than to recent wheeze (36.7%). The estimate of reported asthma is thus more likely to represent children with more severe asthma. As frequent wheeze was not elicited as a symptom in the Australian study moderate or severe asthmatics were not identified as a separate group. If "wheeze in the previous 12 months" is a good indicator of asthma prevalence, then the figure in our study (36.7%) would be higher than the prevalence of asthma in Lismore (30%).

The interpretation of wheeze in the preschool child is however, very difficult. In the absence of an objective measure of reversibility, it is difficult to determine which wheeze represents viral illness and which represents asthma. Questions on frequency of wheeze are able to separate recurrent wheezers from children with only isolated episodes of the symptom. However, children commonly suffer from viral infections and recurrent wheezing may well be from recurrent viral illnesses. Current literature (Dodge 1996, Sporik 1991) suggests that recurrent viral wheeze is more common in the under 2 year age group and that wheeze present from 3 years onwards is more likely to represent asthma.

A problem with our study is that the interpretation of the symptom "wheeze" was not previously tested in this age group in the study population. A previous study of older children using a similar questionnaire showed that "wheeze or whistling in the chest" and "tight chest" were interchangeable terms (Ehrlich 1998). It is possible therefore that the symptom "wheeze" may have been subject to different interpretations by parents. This may have contributed to overreporting of wheeze (36.7%). It may be argued that "night cough" (28.9%) and "night waking" (29.5%) are less open to misinterpretation and hence that these prevalences may be closer to the true estimate of asthma prevalence in this population. If this were true, then the prevalence of asthma in our population may indeed be as high as that in Lismore and Wagga Wagga.

Overreporting may also account for the high prevalence of reported asthma in Australia. Previous studies have shown Australia to have a high prevalence of asthma (Bauman 1993, Peat 1994, Robertson 1991). This may have contributed to an increased public awareness of the disease (Comino 1996). Parents may thus be more likely to overreport mild respiratory symptoms and misinterpret them as indicative of asthma. Doctors may also have a lower threshold for diagnosis of the disease. Haby and Peat argue against this as a cause of the high reported asthma prevalence. They claim that because of the tight definition used for asthma, their estimate of asthma prevalence is a valid one. Recent asthma was defined as ever having been diagnosed with asthma, having used an asthma medication in the previous 12 months and having had symptoms of cough or wheeze in the previous 12 months. Using this definition the prevalence of reported asthma decreased to 21.7% in Lismore and 18.1% in Wagga Wagga. This is still well above the prevalences reported for Leicestershire and in our study.

Haby and Peat hypothesise that the high prevalence of asthma in their population of preschoolers may be due to a diet rich in polyunsaturated fats. It has been postulated that such diets alter the ratio of omega-6 to omega-3 fatty acids. The altered ratio favours PG E2 synthesis, which may increase asthma (Black 1997). Other studies have linked obesity to asthma (Beckett 2001, Chinn 2001, Figueroa-Munoz 2001). These variables were not measured in our study. Future studies in this population should examine such associations.

The prevalence of reported asthma in our study (13.1%) was similar to that reported by Luyt (11.0%) for Leicestershire. The prevalence of reported asthma in the Luyt study was close to recent wheeze (13%), but the authors believe that asthma was at least 25% underdiagnosed in the study population. At least 27.2% of children under 4 years in Leicestershire gave a history of recurrent cough without colds. Recurrent cough in the absence of a cold may be a sign of asthma (Dales 1997). The closeness of "recent wheeze" and asthma estimates may indicate that doctors In Leicestershire correctly associate the "wheezing child" with asthma. "Recurrent cough" may however not be recognised as suggestive of asthma and this may explain the underdiagnosis suggested by Luyt.

5.2.1 Underdiagnosis of asthma

Many other international studies have suggested that the underdiagnosis of asthma limits reported prevalences of the disease (Bauman 1992, Luyt 1993, Speight 1983, Taylor 1996).

This problem was also identified in a prevalence study of asthma in primary school age children in Mitchells Plain (Ehrlich 1995). We believe that there is evidence to suggest that asthma is underdiagnosed in preschoolers in our study. The reasons for this are as follows.

First, 36.7 % of preschoolers reported recent wheeze, 28.9% reported recent night cough and 29.5% reported recent night waking with wheeze while only 13.1% reported asthma ever. It may be argued that the question on reported asthma had a high specificity and that the questions on period prevalence of symptoms have a high sensitivity as opposed to specificity. In the absence of a gold standard for asthma diagnosis and the lack of an objective measure of reversible bronchoconstriction, actual sensitivities and specificities could not be calculated. Nevertheless, 18.7% of children reported frequent wheeze with 3 or more episodes in the previous 12 months. It seems unlikely that recurrent wheeze is entirely explained by recurrent viral illness as a significant proportion of children also gave a history of 3 or more episodes of night cough (14.2%) and night waking (14.9%), symptoms suggestive of asthma.

It may be argued that our study, in common with most such asthma surveys, is limited by the absence of any measure of the temporal relationship of respiratory symptoms to a viral illness. This information, however, may not necessarily be useful as viral illness is a known trigger of asthma in children with reactive airways (Busse 1989). The discrepancy between the estimates of symptom prevalences and asthma may thus indeed reflect an underdiagnosis of the disease.

The second reason why asthma may be underdiagnosed in this population is that private doctors interviewed in another part of this study, stated that they found it difficult to diagnose asthma because patients either do not come to them with each wheezy episode or do not keep follow up appointments (Bheekie 2001). This limits the number of opportunities to either elicit the history of reversible bronchoconstriction or to demonstrate it. Many preschool asthmatic children therefore remain undiagnosed. The doctors believe that patients do not present regularly because of the relatively high cost of private medical care (at least R70 per visit) as well as because of the practice commonly called doctor "shopping" or "hopping". This refers to the use of several different doctors instead of regular attendance at a single one. This belief is supported by the finding that less than one third (28.7%) of asthmatic preschoolers and just over half (57%) of all asthmatic primary schoolers in our study reported attending a usual private doctor. The reasons for doctor "shopping" are unclear but may include the variable cost of consultations among different private practitioners and a reluctance on the part of parents to accept that their child may be suffering from a chronic illness. It may be argued that cost should not limit access to good medical care in this population since state medical care is available free of charge to all children under five years of age. The Community Health Centre in Mitchells Plain, however, suffers from a negative image among residents (Ehrlich 1996, Jones 2000) and attendance at this centre has previously been shown to be associated with a higher degree of non-recognition of asthma than attendance at a private practitioner (Ehrlich 1998).

Third, the diagnosis of asthma may still carry a stigma (Ehrlich 1998). Parents may therefore be reluctant to accept the diagnosis of asthma. This is supported by the fact that many interviewed doctors felt that they would prefer to use terms other than asthma to denote the disease (Bheekie 2001).

In conclusion, the study design did not allow for objective measures of bronchial hyperresponsiveness and some of the high asthma symptom prevalence may be explained by overreporting of viral wheeze or confusion of terminology. Nevertheless, we feel that the prevalence of reported asthma in this population is probably weighted towards moderate or severe asthmatics and that asthma is underdiagnosed and underreported. The true prevalence of asthma in preschoolers (i.e. mild, moderate and frequent) is therefore likely to lie somewhere between the prevalence of reported asthma (13.1%) and prevalence of wheeze in the previous 12 months (36.7%).

5.3 ASTHMA SYMPTOMS AND AGE

The prevalence of asthma symptoms in children aged between 0 to 2 years was high when compared to the older children. Wheezing is very common in this age group, but it is believed to be mostly due intercurrent viral infections rather than bronchial hyperreactivity (Hart 1986, Lenney 1978, Martinez 1995). The majority of these children are therefore not asthmatic. Sporik et al. (1991) found that of 21 children who wheezed before their second birthday, most never wheezed again. Of the 21 children who wheezed after their second birthday, 17 were still wheezing at 11 years. Martinez et al. (1995) looked at asthma and wheezing in the first six years of life in a prospective study of 1246 newborns in Tuscon, Arizona. They concluded that the majority of infants with wheezing have transient conditions associated with diminished airway function at birth and do not have increased risks of asthma or allergies later in life. Wheeze in a substantial minority of these children is however, probably related to a predisposition to asthma (Martinez 1995).

When reported asthma was compared between children aged 0 to 2 years and those aged between 2 to 12 years, a lower prevalence was found in the younger children. As the question refers to "asthma ever", this must, by definition increase with age, even if recent wheezing (and recent asthma) reduce with age. The lower prevalence in younger children may therefore be explained by the difficulty in separating viral induced wheeze from the wheeze of asthma. Young children are also unable to use a peak flow meter, which may add supportive evidence for reversible bronchoconstriction.

The natural history of asthma is for its prevalence to decrease with age (Martin 1980, Sears 1998). More than half of all symptomatic children will outgrow their disease by adulthood

(Blair 1977, Martin 1980). In our study, the prevalence of asthma symptoms decreased with age from the age of 6 years. The greatest drop in reported prevalence was found in children between 12 to 15 years of age. This finding has been attributed to biological factors rather than sudden changes in environmental exposure (Gregg 1983). It is suggested that as children grow older, they may develop some protective mechanism so that agents which formerly provoked their attacks no longer do so. An alternative theory is that bronchial hyperreactivity may decline with age.

5.4 SEX DIFFERENCES IN ASTHMA PREVALENCE

Similar to other studies on preschoolers (Luyt 1993, Silverman 1998, Strachan 1985) and primary schoolers (Crockett 1995, Ehrlich 1995, Robertson 1998, Strachan 1985), we found higher prevalences of asthma symptoms in boys than in girls. The ratio of symptoms between boys and girls is believed to decrease with age, and by adolescence, to reverse (Strachan 1985). Theories attempting to explain the male excess in symptoms include: dysanaptic lung growth (Pagtakhan 1984) and higher prevalences of atopy and hyperreactivity in boys (Berlier 1997). Primary school boys in Mitchells Plain have been shown to have higher prevalences of asthma symptoms than girls but there is no published measure of atopy or bronchial hyperreactivity by sex in this population of which I am aware.

Uterine factors may also be responsible for the higher prevalence of asthma symptoms in boys. Male babies are more prone to preterm labour (Cooperstock 1999, James 2000) and asthma is more common in preterm babies (Gissler 1999). Boys are also known to be more susceptible to lower respiratory tract infections than girls (Gissler 1999), and respiratory tract infections are well known triggers of acute asthma (Busse 1989). The female excess of symptoms in adolescence may be due to the effect of sex hormones responsible for menstruation on airway function in females (Pagtakan 1984).

5.5 SOCIO-ECONOMIC STATUS AND ASTHMA

Asthma symptom prevalences did not differ when the nine municipally defined suburbs were compared, where residential suburb was indexed ecologically by an index of income per household. This differed to findings in national surveys from the United States (Halfon 1986, Schwartz 1990, in which children from poorer households reported higher asthma symptom prevalences. This may be explained by the small income gradient across the nine suburbs, i.e. the average income per household was relatively homogenous across the measured suburbs. In Tafelsig which is the "poorest" suburb, 96.2% of the households earn less than R15 000 per annum compared to Mandalay, the "better-off" suburb where 74.5% of the population less than R15 000 per annum. The income differential in the US (e.g. Halfon 1993) was much higher, i.e. children from households earning <$9100 per annum were compared to children from households earning >$27 300 per annum. In addition, more than half of our sample of children came from households with a very similar income index, i.e. 92% of the households earn less than R15 000 per annum.

To overcome this lack of gradient, we compared asthma symptom prevalences between Tafelsig where 96.2% of the population earn less than R15 000 per annum and Westridge where 86.5% of the population earn less than R15 000 per annum. Although this is also a small differential, this was the largest gradient available. In addition, sample sizes were approximately equal. In this analysis, all symptom prevalences in preschoolers and primary schoolers were higher in Tafelsig than in Westridge. This contrasts with what Poyser et al. (2002) found in young adolescents in Cape Town i.e. a higher prevalence of asthma in affluent adolescents but a higher morbidity from asthma in poorer children. The finding in our study may be explained by the very small income differential between the groups measured. In addition, the study was limited by the use of only two study areas to compare symptom differences by socio-economic status. Poyser's data may be also be confounded by race, a marker of a large number of life circumstances as a result of apartheid*.

* Term used to denote a system of racial segregation, legally repealed in 1994.

5.6 PREDICTORS OF REPORTED ASTHMA

The data suggest that the more symptomatic a child is, the more likely the respondent is to report asthma. In spite of this, between 60 to 70% of preschoolers and primary schoolers who reported wheeze, night cough or night waking in the previous 12 months, did not report asthma. It is plausible that a proportion of these children may have mild or transient symptoms or may not be asthmatic. However, even where children had recurring symptoms, only half of the preschoolers and primary schoolers reported asthma. This supports earlier findings of underdiagnosis of asthma in the population.

The logistic regression analysis confirms that frequently symptomatic children are more likely to report asthma as recent wheeze, frequent wheeze and night waking were found to be good predictors of reported asthma. This was similar to results from Leicestershire, where Luyt et al. identified frequency of symptoms and male sex as good predictors of doctor-diagnosed asthma. Interestingly, night cough emerged as a poor predictor of reported asthma in both preschoolers and primary schoolers. While wheeze is commonly acknowledged to be a symptom of asthma and night waking is often linked to illness, knowledge of the significance of a recurrent dry night cough is poor (Dales 1997). Patients are therefore unlikely to report it especially if doctors fail to enquire about it during history taking. Such factors should be addressed in the development of appropriate educational packages designed for doctors and patients.

Among those who met the criteria for "moderate or severe asthma", asthma symptom prevalences were higher in the group who reported asthma compared to the group who did not report asthma. The converse was observed by Ehrlich et al. in primary schoolers in

Mitchells Plain in 1993. They argued that when respondents were aware of their children's diagnosis, they were more likely to be on appropriate therapy and hence less likely to be symptomatic. If this is so, then it follows that in our study even where respondents are aware of their children's diagnosis, they may still be inappropriately treated. The alternative explanation is that diagnosis of asthma is appropriately based on higher frequency of symptoms. This prevalence survey did not evaluate treatment of identified asthmatics, but 71% of Mitchells Plain doctors who were interviewed by Bheekie for another part of this project said that they would use inhaled bronchodilators as first-line therapy for asthma (Bheekie 2001). However, almost 60% of them were reluctant to use steroids in children.

5.7 ASTHMA SYMPTOMS AND NUMBER OF CHILDREN IN HOUSEHOLD

Asthma symptom prevalences decreased as the number of older children in the household increased for both preschoolers and primary schoolers in the study. This concurred with findings of the Wellington Asthma Research Group (Crane 1994) and lends support to the "infection" hypothesis.

Unlike reports from elsewhere though, no effect could be demonstrated for household size per se or for number of younger children in a household (Crane 1994, Rona 1997, Sears 1996, Strachan 1989). This may be explained by the fact that whereas Rona et al. found that a family size of 3 or more siblings was required for a significant finding, in our study approximately three-quarters of preschoolers and primary schoolers had fewer than 3 other children living in the same household (Rona 1997). Alternatively, number of children living in the same household may not necessarily reflect intensity of early exposure to infections. Day-care attendance may alter the relationship of asthma symptoms to various measures of household size (Infante-Rivard 2001).

Although the "infection" hypothesis is supported by recent literature, it is clear that it may not be the only factor in the association between family size and numbers of siblings and asthma. Other factors that have changed over time may be confounders of the above association. These include various exposures related to "westernisation" of society viz. childhood vaccinations, early antibiotic exposure , a move away from a farming lifestyle, the nutritional status of children, the socio-economic status of larger families and household hygiene and cleanliness. We did not measure these variables and hence are unable to comment on possible interactions.

5.8 THE SECULAR TREND IN ASTHMA SYMPTOM PREVALENCES OVER TIME (1993 to 1997)

The figures are consistent with a small increases in prevalence of wheezing over this period. This is in contrast to increases in prevalence reported in studies elsewhere, which were done over longer time intervals (Gergen 1988, Mitchell 1983, Ninan 1993, Peat 1994). The question of whether these observations reflect a true increase in prevalence is an important one. For a variety of reasons related to epidemiological study design and validity including changes over time in diagnostic labelling and questionnaire design, the evidence to support a true increase in prevalence is controversial.

Some of the reasons suggested for a real increase are the increase in urbanisation, a diet which is low in anti-oxidants, omega-3 fatty acids and high in "fast" foods and altered environmental exposures and changed diagnostic practices (Woolcock 1995). A number of studies now suggest a true increase in atopy (Burney 1990, Burr 1989, Ninan 1992, Peat 1994). Trends that are attributable to such factors can only be measured over long periods of time. The time interval between the two studies examined by us was thus too short to be able to draw any meaningful comparisons.

CHAPTER SIX

CONCLUSION

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6.1 CONCLUSIONS

Our study has shown that the prevalence of asthma symptoms is high in preschoolers and that asthma is underdiagnosed in this population. Differences in symptom prevalences by age, gender and residential suburb have also been demonstrated. The best predictors of reported asthma were found to be recent wheeze, frequent wheeze and night waking. We also found that symptom prevalences decreased as the number of older children in a household increased. A small increase in wheeze prevalence was demonstrated in 7 to 9 year old children between 1993 and 1997.

This study hopefully makes a contribution to both the local and international literature. It is the first estimate of the burden of asthma in preschool children in this country and one of few such studies worldwide. To the best of our knowledge, it is also the first such study in a developing country. Also, by using an internationally standardised and validated tool, ecological comparisons with studies from other countries are possible.

It may be argued that results from a single prevalence survey must be interpreted with caution. Reasons for this include the variability of asthma symptoms and the subjectivity of a self-administered questionnaire (Peat 1992). Imprecise estimates can arise from the imperfect parental recall of symptoms and psychological and socio-cultural factors which affect parental attitude towards asthma. In addition, prevalence estimates may be affected by mode of questionnaire administration (Peat 1992). Nevertheless, an internationally standardised questionnaire such as the ISAAC questionnaire is widely accepted as the best tool for a large initial prevalence survey to estimate the burden of disease in a population (ISAAC 1998).

Hence, in spite of the limitations of a study of this nature, we believe that this is an important and valid baseline estimate of childhood asthma symptoms in preschoolers in Mitchells Plain. We believe however that asthma is underdiagnosed by doctors in the population. The true cumulative prevalence of asthma therefore is likely to be higher than the 13.1% reported in this study.

6.2 RECOMMENDATIONS

Our results suggest a considerable burden of disease in preschoolers and confirm the existence of one in primary schoolers. Given the cost that an asthmatic child poses to the family and the state, as well as the preventable or modifiable nature of the disease, this study can be used to support strategies to improve the awareness, diagnosis and management of childhood asthma. Such strategies have proved to be successful elsewhere (Jenkins 1996). Another part of this study, an evaluation of an educational intervention, showed reduced morbidity in asthmatic children (Bheekie 2001).

The study also emphasizes the need to target parents of younger children, not only because these children suffer the highest morbidity, but also because the recent onset of their symptoms may make such parents more receptive to new information on their child's illness. By appropriately informing parents at this crucial stage, their attitudes and coping mechanisms can be shaped. It is important to note that their current behaviour patterns can determine the future course of their child's illness as it has been shown that children whose parents are aware of the diagnosis of asthma during their childhood are less likely to be asthmatic in their adult life (Jenkins 1996).

Educational campaigns about asthma must be comprehensive and should target patients, health care providers as well as the general public. The use of local and validated guidelines should be aggressively promoted among local physicians with a view to improving the diagnosis and management of the disease. The negative image of the state community health centers is an important issue to be addressed (Ehrlich 1998, Jones 2000). This is especially in view of the emphasis of the current Health Department in South Africa on primary health care. Doctors and nurses who staff these facilities must be interviewed to find out what barriers they face in making a diagnosis of asthma. By taking into account the specific barriers to optimal care that they and their patients face, guidelines could be made more widely applicable and acceptable. Guidelines on asthma management should also be made locally acceptable in collaboration with primary care physicians from the public and private sector.

The National Asthma Education Programme (NAEP) has made an important start locally, in an attempt to improve asthma education of the general public. The current government of South Africa has recognised the danger of exposure to environmental tobacco smoke, and new anti-smoking laws are in force. However, much more support is required from the authorities responsible for National Health to drive an effective national campaign on asthma.

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APPENDIX

<u>Self-Administered Questionnaire</u>

1. First names of child ____________________
2. Surname of child ____________________
3. Sex of child ____________________
4. How old is the child today in years? ________________
5. What is the child's date of birth? Day_________Month_______Year_________
6. Address of child ____
7. You are the child's ? Mother ______
   Father ______
   Grandmother ______
   Other (specify)______
8. <u>In the last 12 months</u>, has this child had tight chest or wheezing or whistling in the chest?
   Yes ______
   No ______
9. <u>How many times</u> has this child had tight chest or wheezing or whistling in the chest in the last 12 months? None ______
   1 or 2 times ______
   3 times ______
   4 or more times _____
10. In the last 12 months has this child had a troublesome dry cough at night, that was <u>not from a cold or a chest infection?</u> Yes ______
    No ______

11. How many times in the last 12 months has this child had a troublesome dry cough at night that was not from a cold or chest infection?

None ______

1 or 2 times ______

3 times ______

4 or more times _____

12. In the last 12 months has this child woken up at night due to a tight chest or wheezing or whistling in the chest?

Yes ______

No ______

13. How many times has this child woken up due to tight chest or wheezing or whistling in the chest in the last 12 months?

None ______

1 or 2 times ______

3 times ______

4 or more times _____

14. Do you have a usual private doctor for this child?

Yes ______

No ______

15. How many times in the last 12 months has this child been to this usual doctor for chest or breathing problems?

None ______________

1 or 2 times ________

3 times ___________

4 or more times _____

16. How many times in the last 12 months has the child been to any other doctor for chest and breathing problems?

None ______________

1 or 2 times ________

3 times ___________

4 or more times _____

17. Has this child ever had asthma? Yes _______________

No _______________

18. How many babies and children younger than 18 years of age live in this house? ______