THE PREVALENCE OF CHILDHOOD ASTHMA IN WHITE PRIMARY SCHOOLCHILDREN IN THE SOUTHERN SUBURBS OF CAPE TOWN

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This thesis is dedicated to all the children with asthma who have been both patients and teachers.

Abstract

The author participated in an international survey organised by the British Medical Research Council (MRC) epidemiological unit in Cardiff, Wales which set out to compare the prevalence of asthma in several countries. The motivation for participating in this study was that very little previous prevalence data for asthma is available for coloured or white children in South Africa. A protocol designed by the British MRC Epidaemiology Unit was followed. One thousand one hundred and seventy four white children aged 12 years attending a random selection of primary schools in the Southern Suburbs of Cape Town were studied. A standard MRC questionnaire on asthma was completed by parents. The subjects then underwent an exercise challenge test (ECT) which involved running on the level for six minutes. During the ECT, we measured the forced expiratory volume in 1 second (FEV1) before and after the exercise. A fall in post exercise FEV1 of 15% or greater was regarded as evidence of bronchoconstriction and considered diagnostic of asthma. This method is thought to identify 70-90% of asthmatics (Anderson 1985, Lee et al 1989, Pierson 1988). Using this criterion, 52 (4.4%) of the children had asthma. The prevalence of 4.4% in this study is higher than 3.1% reported in a previous study of black children in Guguletu (Van Niekerk et al, Clinical Allergy 1979). However the age spectrum of children was different in that study. Terblanche et al (1990) report the prevalence of exercise induced bronchoconstriction (EIB) in white

and coloured children to be 5.87% and 4.05% respectively. The level of FEV1 reduction for a diagnosis of EIB approved for this study was lower than usually accepted. Using conventional criteria for a diagnosis of EIB, Burr et al (1989) reported a prevalence of 7.7% in Cardiff, Wales.

This study confirms that exercise induced asthma is a common problem in 12 year old white children in Cape Town.

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The author also wishes to thank Dr M L Burr for the invitation to participate in the International survey, and for providing the questionnaire and standardised exercise challenge test used in this study.

Contents

Abbreviations and definitions

Abbreviations

1. ECT Exercise Challenge Test

2. EIB Exercise Induced Bronchoconstiction

3. BHR Bronchial Hyperreactivity

Definitions

1. Exercise Induced Bronchoconstiction (EIB): a post exercise percentage fall in FEV1 of 15% or more

2. Positive Exercise Challenge Test (ECT): post exercise fall in FEV1 of 15% or more than the baseline

3. Intermediate Exercise Challenge Test (ECT): post exercise fall in FEV1 of between 10 and 15% of the baseline

4. Negative Exercise Challenge Test: (ECT) post exercise fall in FEV1 of less than 10% of the baseline

5. Bronchial Hyperreactivity (BHR): increased bronchial response resulting in reduced FEV1 following a stimulus that does not provoke such a reaction in most normal healthy individuals (Neijens et al 1983).

Chapter One

Introduction

Childhood asthma is common (Godfrey 1991). The prevalence of asthma varies from 0.14% to 15% in reports from different parts of the world. Apart from variations in the actual prevalence of asthma, different definitions of asthma and different methods of assessing bronchial hyperreactivity also contribute to the variation in prevalence figures.

In an attempt to establish whether the difference in asthma prevalence is real or apparent, an international survey of asthma in school children is being undertaken. The coordinating authority for the international study is Dr M Burr of the MRC Epidemiology Unit in Cardiff, Wales.

This thesis forms part of the international study. It is a field study investigating the prevalence of exercise induced bronchoconstriction in the southern suburbs of Cape Town. The protocol and questionnaire used in this study were designed by the MRC in Cardiff, Wales but each centre has control over publication of its own data. Results from various participating centres will be compared by the Cardiff Medical Research Council and is to be published at a later stage. Differences in the prevalence of asthma in various countries will then become apparent.

Chapter Two

Review of the literature

1. Exercise and asthma

The phenomenon of exercise induced attacks of breathlessness is well known, and has been described for centuries.

'If from running, gymnastic exercises, or any other work, the breathing is difficult, this is called asthma.'

Arataeus

Second century clinician

Any child with a post exercise cough, shortness of breath or wheeze should be considered asthmatic unless proved otherwise (Godfrey 1983, Colin et al 1985). Others feel that all asthmatics have EIB (McFadden 1984, Bundgaard 1986). Bronchial hyperresponsiveness demonstrated by exercise is a fairly constant finding in asthmatic children. The exercise challenge test (ECT) is simply one way of provoking bronchoconstiction and is useful for inferring the presence of asthma. The ECT provides a good overall assessment of bronchial hyperreactivity. This test has been found to be acceptable to participants in large scale field studies. We

therefore believe that an acceptable prevalence of asthma could be obtained in a selected group of children by using the ECT.

2. Diagnosis of asthma

2.1 Wheezing: some workers may accept wheezing as sufficient evidence for asthma. While wheezing is a frequent finding in asthma, it is also found in other conditions such as pneumonia, cystic fibrosis and foreign body inhalation. It is therefore an insensitive indicator of asthma.

2.2 History of difficulty in breathing after exercise: the presence of EIB suggests a diagnosis of asthma. However, a history of post exercise breathing difficulty is an insensitive indicator of EIB as not all children with EIB are aware of it at the time (Bierman et al 1975).

2.3 Clinical diagnosis: a clinical diagnosis of asthma as a marker of prevalence is influenced by underdiagnosis by doctors. Also, parents are reluctant to accept a label of asthma, further contributing to underdiagnosis.

2.4 Bronchial provocation testing:

2.4.1 By non-pharmacologic stimuli:

2.4.1.1 Exercise challenge testing: EIB is a good indicator of asthma (Colin et al 1985). However, the presence of EIB needs to be documented with lung function measurements.

2.4.1.2 Other non-pharmacologic methods of assessing bronchial hyperresponsiveness include: hyperventilation, inhalation of nebulised hypertonic or hypotonic solutions and inhalation of cold air.

2.4.2 By pharmacologic agents: inhaled metacholine or histamine are also used to assess bronchial hyperresponsiveness. The agent is delivered to the airways as an aerosol. The dose of the agent is plotted against changes in FEV1. After administering 0.9% Sodium chloride, doubling doses of the active agent are administered until the FEV1 decreases by 20% (Bardin et al 1991).

McFadden (1984) concludes that there may be little to choose between different bronchial provocation tests with respect to clinical relevance.

2.5 Measurement of the volume of trapped gas: is a sensitive test for the detection of EIB (Svenonius et al 1978). However the method requires intensive cooperation and is therefore not suitable for smaller children. It also requires sophisticated equipment.

3. Exercise induced bronchoconstriction

3.1 Exercise induced bronchoconstriction in known asthmatics: EIB is a an important feature of asthma and is present in approximately 80% of known asthmatics. However, there is some disagreement as to exact frequency of occurrence of EIB in known asthmatics. Bundgaard reported from Denmark in 1986 that 75% of asthmatics have EIB on the first challenge. Other workers have had different findings. Kawabori (1976) and Bierman (1975) found that 63% of asthmatics had this problem. Berman et al (1982) suggest that EIB is present in approximately 90% of asthmatics. Kattan et al (1978) found that 77.2% of children with a positive history of EIB responded to the ECT. Between 80 and 90% of moderate and severe asthmatics can be identified by the ECT. However many mild asthmatics may not exhibit EIB of sufficient severity to diagnose asthma. It is generally accepted that 70-90% of the asthmatic population has EIB (Anderson 1985, Lee et al 1989, Pierson 1988).

3.2 Variation in the severity of exercise induced bronchoconstriction: exercise responsive bronchial hyperreactivity is not constant in any individual and may vary in severity from time to time (Neijens H J et al 1983). Approximately 20% of patients known to have active asthma may not exhibit a positive response to a single exercise test. Mussafi et al (1986) report greater airway hyperresponsiveness to exercise and histamine after allergen exposure than without such exposure. This may partly explain the fluctuating degree of bronchial hyperreactivity seen after exercise. However, EIB in asthmatics is always present while

such patients remain clinically active (Balfour-Lynn 1981).

4. The exercise challenge test

4.1 Type of exercise: EIB tends to be worst after free range running forms of exercise, such as running 1000 m. Hence, free range running is the most suitable method of demonstrating EIB. EIB is maximal if the exercise is moderately severe or severe. Steady-state exercise gives the most reproducible responses (Godfrey 1973). EIB is more common in runners than in swimmers (Holgate 1983). Swimming tends to be less bronchcoconstrictive (Gerhard et al 1980). This is explained in part by the fact that swimmers perform under humid conditions.

4.2 Duration of the exercise challenge: during the first few minutes of exercise the FEV1 increases. However, after 5-10 minutes bronchial constriction develops. Typically, the symptoms appear 3-5 minutes after exercise and not during exercise (Nixon et al 1988). Exercise lasting for longer than 6-8 minutes does not produce greater bronchoconstriction (Morton et al 1983) and may even lessen it. This has been called the 'run through' phenomenon (Silverman et al 1972).

4.3 Severity of exercise: EIB increases with increasing intensity of exercise until approximately 70% of aerobic working capacity is reached. Beyond 70% of aerobic working capacity there is no added

increase in EIB.

4.4 Heart rate and severity of exercise: bronchoconstriction increases with the amount of energy consumed. The energy consumed correlates well with the heart rate which provides a simple non-invasive and convenient method of assessing adequacy of the exercise. The heart rate should reach 170 bpm or more, as this indicates true submaximal exertion (Cropp 1979). There is no added benefit if the heart rate is made to rise beyond 170 bpm (Shapiro et al 1979). However this is influenced by the age of the child.

Eighty percent of predicted maximum heart rate for 12 year old children is approximately 160 beats per minute ($y = 209.2 - 0.74x$ where x = age in years: Cropp et al 1979). An easier calculation is simply 210 minus the age in years (Motala 1991). Eighty percent of this is approximately 158 beats per minute. A value of 160 or more was accepted as a marker of adequate exercise in this study.

4.5 Severity of EIB compared to severity of asthma: the severity of EIB is not necessarily related to the severity of asthma. Children with mild asthma may have similar degrees of measured EIB (FEV1) as those with severe asthma. Severe EIB (with the FEV1 falling to below 50% of the expected value) tends to be more common in steroid dependant asthmatics. A fall of 25% or more usually necessitates prophylactic therapy (Nagel 1990).

4.6 Refractory period after an ECT: 40-50% of children known to have EIB will not demonstrate this phenomenon when subjected to an identical ECT for up to 3 hours after the initial exercise (Anderson 1985, Neijens et al 1983). This is described as the refractory period. This refractory period may be due to depletion of chemical mediators.

Reiff et al (1989) point out that mild warm-up exercise can produce this refractoriness to EIA during a subsequent important physical activity without itself causing marked bronchoconstriction. Morton et al (1979) found the incidence of EIB to be unchanged even after warm-up exercise. However, the intensity and duration of the warm-up exercise in this study may have been insufficient.

4.7 Late reaction: some children with EIB will demonstrate a late reaction 3-9 hours after the exercise by a second fall in FEV1 (Lee 1985, Lee 1989). However, Rubinstein et al (1987) found that a second asthmatic response occurring later after exercise to be uncommon. The late asthmatic reaction seen in EIB appears to be accompanied by the release of neutrophil chemotactic activity (Lee 1983). The rate of spontaneous recovery from early asthmatic reactions is slower in children with dual responses (early and late asthmatic reactions demonstrable). This slow recovery may be predictive of the development of late phase reactions (Likura 1985).

5. Advantages of the ECT

The exercise challenge method of bronchial provocation has certain advantages. The exercise challenge test requires a minimum of equipment, is non-invasive and lends itself to widespread out-patient application. The method is acceptable to parents and therefore a useful epidemiological tool (Tsanakas 1988). It can also be administered by relatively less trained personnel with a doctor on standby. The ECT is useful in evaluating new drugs and also as a research tool for studying the mechanisms of EIA. ECT could help in the identification of a child who is active but performing suboptimally because of unrecognised EIB. The test can also be used for the diagnosis of asthma in patients presenting in an unusual manner (Nixon et al 1988). Exercise testing is useful in known asthmatics to evaluate apparent failure of medication to prevent EIA (Young et al 1988).

6. Disadvantages of the ECT

6.1 Other factors influence the bronchial response to exercise:

various other factors influence the bronchial response to exercise. Neijens et al (1983) reports that these include exercise shortly before the ECT, prior drug treatment, fitness, circadian rhythm, baseline lung function, humidity, temperature of the inhaled air and muscle mass. Other variables include speed of the exercise, the level on which the running takes place and duration of exercise.

To eliminate these variables, some investigators advocate the use of standardised exercise testing using a treadmill, cardiotachometer, electrodes and spirometry equipment (Eggleston et al). Others have described a standardised system of free range running in controlled groups for use in prevalence surveys (Burr et al 1974, 1989).

6.2 EIB may occur in conditions other than asthma: the phenomenon is occasionally seen in children with previous bronchiolitis or relatives of asthmatics who are not themselves asthmatic and patients with cystic fibrosis. Some atopic subjects have EIA without evidence of previous or present asthma. Patients with allergic rhinitis often have moderate bronchial hyperreactivity less severe than children with asthma but more than normal individuals (Neijens et al 1983). Therapeutic intervention in such children with rhinitis and bronchial hyperreactivity can improve the rhinitis and prevent the disease from developing into symptomatic atopic asthma (Gniazdowski 1978).

Occasionally children without any history suggestive of asthma develop EIB.

6.3 Lack of sensitivity: the ECT is often too insensitive to diagnose mild asthma.

6.4 Criteria for a positive test: a fall in the post exercise FEV1

of 15% or more is widely accepted as the necessary degree of post exercise bronchoconstriction for a diagnosis of EIB to be accurate. Some authors have reported that normal non-asthmatic children may have a maximum post exercise fall in FEV1 of up to 15% (Godfrey et al 1973, Burr et al 1974, Kattan 1978, Bierman et al 1975). Despite this, Anderson (1985) and Terblanche et al (1990) accept a value of 10% or more as sufficient for a diagnosis of EIB. However, any post-exercise fall of more than 15% is indicative of significant bronchial constriction (Neijens et al 1983), and levels between 10 and 15% may include normal non-asthmatic children.

7. Which airways are involved in EIB ?

Both large and small airways were involved in the EIB, but not necessarily to the same degree. Therefore, only one spirometric test may be inadequate to detect EIB. Peak expiratory flow rates and FEV1 combined are more sensitive measures of EIB (Kattan et al 1978).

8. What is the prevalence of asthma ?

8.1 Asthma prevalence in South Africa: very little is known about the prevalence of childhood asthma in Southern Africa. In a recent study using the histamine challenge method of bronchial provocation, the prevalence of airways hyperresponsiveness in black children from rural Transkei was found to be 13% (Vermeulen et al,

1990). A prevalence of 3.1% was reported in a study of urban black children in Guguletu (van Niekerk et al 1973). In the same study they found the prevalence of asthma among rural blacks to be a much lower 0.14%.

Terblanche et al (1990) report that the prevalence of asthma in white school children in the Northern Suburbs of Cape Town is 5.87%. They report a prevalence in the coloured population of 4.05%. However, this study included children with a post exercise fall in FEV1 of between 10 and 15%, some of whom may have been non-asthmatic.

8.2 Asthma prevalence in other countries: the prevalence of asthma varies from 0.14% to 15% in different centres. One reason for these different findings is the lack of a universally acceptable and measurable definition of asthma. Colin et al report a prevalence of EIB of 8.6% in Israel. Braback et al (1988) report a prevalence of asthma of 4%.

9. Is asthma increasing ?

It is widely believed in centres in the United Kingdom and New Zealand that the prevalence of asthma is increasing (Burney 1988, Jackson et al 1982). The increase may be apparent and influenced by improved diagnosis of asthma along with improved management and reporting of medical statistics. Greater accessibility and use of

hospital facilities may be mistaken for an apparent increase in the condition. Taylor et al report from London (1984) that the prevalence of eczema is also rising. They found that prevalence rose from 5.1% in 1946 to 12.2% in 1970.

9.1 Time span during which the prevalence is assessed: the prevalence may vary depending on the time it is measured. The point prevalence is likely to be lower than that measured over a year or during a lifetime. Different workers investigate different population groups at different ages and in different seasons. Results from one study cannot easily be compared with those from another. This makes it difficult to decide whether the prevalence is increasing or not.

9.2 Methodological differences: these also contribute to different prevalence figures. Various methods of bronchial provocation have been used in the diagnosis and assessment of childhood asthma, each resulting in differing degrees of bronchoconstriction. Assessment of bronchial hyperreactivity to exercise or various pharmacological agents have insufficient sensitivity to identify mild asthma (Anderson 1989).

Whether or not the prevalence of asthma is actually increasing remains disputed.

10. Asthma mortality

While Anderson (1989) reports that there does not appear to be a true increase in asthma mortality, others have had different findings. Burney (1986, 1988) found an increase in asthma mortality in England and Wales. Jackson et al (1982) report an epidemic of mortality from asthma in New Zealand. Stewart and Nunn report from London (1985) that the death rate from asthma in males is still significant.

11. Sex difference in asthma prevalence

Asthma tends to be more severe and more common in boys than in girls (Burr et al 1974, Fitch et al 1971). Verity found that asthma is more common among boys than girls because of greater bronchial lability rather than increased atopy (Verity et al 1984).

12. What causes asthma ? The likelihood of developing allergic disease depends on the interaction of genetic factors and allergen exposure (Young et al, 1992). Exposure to allergens, especially in early life, predisposes to the development of clinical allergic disease (Potter 1992). On the other hand, children of allergic parents are more likely to develop allergic disease than children of non-allergic parents. The issue of an 'allergy gene' has recently been addressed by Potter (1992) who reports that the clinical expression of allergy depends on more than 1 gene and no 'atopy gene' has yet been identified.

12.1 Environmental and racial factors: Weitzman et al (1989) report that black children have significantly higher rates of asthma but that most of this difference can be accounted for by environmental factors such as maternal smoking. van Niekerk et al (1979) report a difference in asthma prevalence in rural versus urban black (Xhosa) children. They found that children from a rural area had a prevalence of 0.14% while urban children had an asthma prevalence of 3.17%. Andrae et al (1988) found that Swedish children exposed to environmental pollutants were more likely to have symptoms suggestive of bronchial hyperreactivity and allergy. It has recently been reported (Ronchetti et al 1992) that parental smoking in addition to allergen exposure, enhances sensitization of children. Klein (1990) also reports harmful effects of parental smoking on their children. This seems to suggest that genetic and racial factors that seem to predispose certain populations to asthma may be less important. It is possible that environmental influences are more important.

13. Mechanism of exercise induced bronchospasm

The mechanism of EIB remains unknown.

Various theories have been proposed to explain the pathophysiology of EIA. The central event is that hyperresponsive bronchi become constricted after exercise. Whether this results from the exercise itself or another mechanism such as the cool inspired air or simply

hyperventilation, remains disputed. Holgate (1983) reports that while exercise increases the respiratory rate and tidal volume, it is not essential to the bronchoconstriction. Busse (1991) suggests that the work relating eosinophil cationic protein to the degree of airways inflammation provides a unifying theory for the induction of EIB.

Bronchial hyperresponsiveness results from abnormal functioning of mechanisms controlling normal airway size. Patients with more severe asthma tend to have increased bronchial hyperreactivity (Neijens et al 1983). The severity of exercise is important in determining the severity of EIB, while climatic conditions modify this response (Noviski et al 1987).

13.1 Chemical mediators: chemical mediators are released and cause bronchoconstriction. One such theory is the "leaky mast cell theory". Alterations in local concentrations of inflammatory mediators result in an altered airway response threshold (Holgate, 1983). However, the release of inflammatory mediators may be secondary to temperature or hydration changes in the mucosa.

13.2 Respiratory water loss: Anderson reports (1985) that loss of water from the airway is the primary stimulus for EIB and that respiratory heat loss is a less potent stimulus. At high rates of ventilation, the water content of inspired air cannot maintain the respiratory epithelium osmolarity. This hyperosmolarity results in

EIB. Evidence for airway cooling as the stimulus for EIB also applies to the water loss theory. The inhalation of water vapour at body temperature prevents EIB. However, it may be the water content rather than the temperature achieving this effect. Drier inspired air results in an increased airway response.

13.3 Temperature and humidity of the inspired air: McFadden (1984) implicates the temperature or humidity of the inspired air. Cold dry air appears more likely to provoke EIA than warm humid air. This provides some explanation why swimmers are less likely to get EIB than runners performing the same amount of work (Holgate 1983).

13.4 Respiratory heat loss (RHL): others feel that respiratory heat loss and subsequent airway cooling is the initiating stimulus for EIA (Lee 1985, Chen et al 1977). The degree of airway narrowing relates to the amount of heat lost in warming the inspired air to alveolar temperature. Increasing airway cooling causes increasing bronchial constriction. The mechanisms by which RHL and consequent airways cooling results in bronchoconstriction are unknown (Amirav et al 1986). The "leaky mast cell theory' and vagal reflexes are possibilities. The amount of heat lost is closely related to the amount of water lost from the airways during exercise (Anderson 1985).

13.5 Drying of the airways: respiratory water loss stimulates EIA by a direct drying effect on the airways (Anderson et al 1982,

Anderson 1984, Amirav et al 1986). However EIB may occur when the inspired air is close to body temperature. Anderson 1984 feels that the evaporation of mucosal water and the consequent osmolarity change in respiratory epithelium provides a unifying hypothesis for the mechanism of EIB.

13.6 Hyperosmolarity of the respiratory epithelium: Belcher et al (1989) showed a close relationship between inhaled hypertonic saline and exercise in inducing EIB. This suggests that respiratory water loss during exercise may initiate EIA by inducing a transient hyperosmolarity of the respiratory epithelium (Belcher 1989).

13.7 Vascular phenomenon: McFadden (1990) views EIA as a vascular phenomenon. The rapid increase in peribronchial vascular blood volume may result in the airway narrowing seen after exercise. The maintenance of increased air temperature during recovery after exercise produces greater airways constriction for the same exercise stimulus than if the air is cool. This evidence suggests that warm post exercise air maintains vasodilatation in the bronchial circulation which perpetuates bronchial constriction. However, the authors admit that the evidence is circumstantial and requires further investigation.

13.8 Pollutants and allergens: There have been numerous reports implicating pollutants and allergens as precipitators of bronchial hyperreactivity (Ronchetti et al 1992, Weitzman et al 1989, Andrae

et al 1988). The degree of EIB is likely to be worse after prior allergen exposure.

13.9 The role of eosinophils: Venge et al (1991) suggest a relationship between eosinophil activity and EIB. They found that blood levels of eosinophil cationic protein, a marker of eosinophil activity, correlated well with the degree of allergic inflammation in the lungs.

13.10 Other theories: Sterling (1968) proposes that hyperventilation causes EIB. Ward et al (1969) suggest that the lactic acidosis of exercise stimulates ventilation and results in hyperventilation induced bronchoconstriction. However, this observation may be coincidental. Challenge by hyperventilation and exercise induce asthma by the same mechanism (Anderson 1985). The airway response as measured by FEV1 reduction is the same for these challenges.

It is possible that several mechanisms are responsible for EIB and the search for a single responsible mechanism will remain unfulfilled (Godfrey 1986). Another possibility is that differing stimuli interact to initiate EIB.

14. Drugs and EIB

A number of drugs have been shown to inhibit EIB if given before

exercise.

14.1 Sympathomimetics: these include inhaled beta-2 sympathomimetic agents such as salbutamol and fenoterol. Pretreatment with salbutamol inhibits only the early response (Iikura 1988). Terbutaline may also be used to prevent EIB (Weinberg 1982).

14.2 Mast cell stabilisers: inhaled mast cell stabilisers such as sodium cromoglycate (Patel 1986) are also effective. Iikura et al (1985) found that the dual reaction was inhibited after pretreatment with sodium cromoglycate. Ketotifen (Zaditen) has also been shown to control symtoms (including EIB) in asthmatic children (Rackham et al 1989).

14.3 Corticosteroids: Likura et al (1985) found that corticosteroids did not inhibit the early response, only the late response. Hendriksen (1985) reports similar findings with budesonide. A very important advance in the treatment of severe EIB was the demonstration by Hendriksen and Dahl that an inhaled steroid (Budesonide) given regularly reduces the severity of EIA by up to 50% (Anderson 1985).

14.4 Nifedipine: Nifedipine has been shown to inhibit exercise-induced asthma in adults (Cerrina et al 1981).

14.5 Oral methylxanthines, oral beta-2 agonists and systemic steroids: oral methylxanthines, oral beta-2 agonists and systemic steroids do not prevent EIA in the majority of patients. However methylxanthines do prevent EIB in some patients but this is dose dependant (Magnussen et al 1988).

14.6 Other agents: Chudry et al report that nedocromil sodium significantly reduces post-exercise bronchoconstriction. Azelastine attenuates the broncho-constrictor effect of exercise to approximately the same degree as ketotifen (Magnussen 1988).

15. Reason for this study

Asthma remains a common clinical problem. The prevalence may be increasing. Further evaluation is required to assess the prevalence of asthma locally using a method which can be easily repeated in the future to provide longitudinal data.

Chapter Three

Aim:

The aim of the study was to establish the prevalence of EIB in white primary school children in the Southern Suburbs of Cape Town using the exercise challenge test and a questionnaire.

Chapter Four

Subjects and Methods

1. Study population

The study population was white boys and girls attending primary schools in the Southern Suburbs of Cape Town. Children who were twelve years of age in 1989 were included in the study (children born from January 1st 1979 to December 31st 1979). The survey was performed in June, July and August of 1989.

A sample size of approximately one thousand children was sought. To ensure that a representative sample was selected, at least one school was chosen from each municipal area within the Southern Suburbs. If more than one school existed in any given area, random number charts were used to select the school.

Principals of all selected schools were invited to participate. Each school principal was visited by the author and full details of the project were explained. The principals of all selected schools agreed to participate in the study. A list of all the children in each school born in 1979 was obtained.

2. Methods

2.1 Questionnaire

Through the school a three page questionnaire was sent to each participating child's parent (see appendix). These were available in English and Afrikaans. Parents were asked to complete the questionnaire and give it to the child to return to the school. These were then returned to the author who inspected them for completeness. They were then arranged to correspond with the proposed order of the exercise challenges.

2.2 Exercise Challenge Testing

An appointment was made with the school for the proposed exercise challenge tests. These were performed in the first few weeks of the third term so as not to interfere unnecessarily with school work or examinations.

Principals were reminded about the exercise challenge testing a few days before the testing was due to be done. The availability of facilities for the exercise challenge tests was confirmed. These included the use of a school hall, chairs for the children and a table for equipment.

The staffing needs for the study were met by four individuals: one

doctor, two medical technologists and one professional nurse.

Children performed the exercise challenge tests in groups of ten to twenty. These challenge tests were performed indoors in all schools except in one where there was no hall. In this case the exercise was undertaken outside on a patch of lawn. The exercise challenge consisted of a six minute run around the school hall, followed by a five minute rest.

Members of the research team were located at various points around the school hall. One researcher demonstrated the use of the Vitalograph. Another handed out identification labels to facilitate orderly management of children during the exercise testing. Each child had his or her questionnaire returned. A third researcher then discussed each questionnaire with the child concerned. Discrepancies were clarified. If uncertainty remained about any of the information provided on the questionnaire, the parents were later telephoned for verification.

While the questionnaires were being checked, heights and weights were recorded by the fourth member of the research team. Heights were measured using a metric tape measure fixed accurately to a wall. Weights were measured using a standard bathroom scale. This was calibrated against a large scale (Berkel Africa Pty Ltd, capacity 150 kg, divisions 500 grams). The calibrations were done twice weekly. The bathroom scale accurately represented the weight

of an object weighed on the Berkel scale.

Children were asked to remove their shoes and heavy clothing such as school blazers.

Careful timing of the ECT was undertaken by a medical technologist. A digital watch with a minute and second display was used. Children were identified by stickers bearing their name and number. Children were exercised in groups according to a list constructed to suit school routine. Where possible, children from the same class were exercised together.

The Vitalograph and peak flow equipment was placed on a table near the front of the hall. A Vitalograph (Vitalograph Wedge Spirometer, England) was used. This was carefully calibrated according to the manufacturers instructions. Each child was given a new disposable mouthpiece for their exclusive use during all PEFR and Vitalograph procedures. An experienced respiratory medical technologist operated the Vitalograph and ensured that the best possible result of three FEV1 recordings was obtained. The peak flow recordings were performed by an experienced asthma clinic professional nurse using a mini-Wright Peak Flow Meter. Each child performed five Peak Flow manoeuvres under supervision.

2.3 Precautions

2.3.1 All children who did not wish to or were unable to run were identified and excluded from the ECT. Non-participants in the ECT were still encouraged to complete the questionnaire.

2.3.2 Children known to suffer from asthma were interviewed before the exercise. The questionnaire record of their usual medication was checked. Those children who had previous adverse effects caused by running were not exercised.

2.3.3 Children who could not exercise because they had some other condition were excused and had this reason recorded.

2.3.4 Children whose highest FEV1 was below 70% of predicted for their height were not exercised. Wherever possible they were tested on another occasion after they had improved.

2.3.5 Some known asthmatic children did not show a fall in FEV1 of 15% presumably because they had taken mast cell stabilisers or bronchodilators within the previous 8 hours. Wherever possible the exercise was repeated in these children on another occasion prior to which medication was withheld. Children were not asked to stop taking steroid therapy either oral or inhaled.

2.3.6 Although the ECT is very safe, a beta-2 adrenergic aerosol (salbutamol) was available in case severe bronchospasm occurred. Children who developed post exercise bronchial constriction of 15%

or more from their baseline (positive responders) each received 2 puffs of the salbutamol aerosol. In all cases bronchoconstriction was reversed within a few minutes. Once reversal of the bronchoconstriction had been confirmed by a FEV1 improvement, children were allowed to return to their classroom. They were instructed to return to the hall should they experience any recurrence of wheezing.

3. Data collection

3.1. The questionnaire

The questionnaire (see appendix), contained the following information:

3.1.1 Information for parents

3.1.2 Parental consent

3.1.3 Family history and possible determinants of asthma

3.1.4 History of previous medication usage

3.1.5 Data proforma

3.2. The Exercise Challenge

3.2.1 Pre-exercise respiratory function testing: Three baseline FEV1 recordings were obtained. The best recording was taken as the

true value for that child.

Although PEFR recordings were carried out, the PEFR data was not utilised in the Cape Town study. PEFR recordings were required by the coordinating authority in Cardiff, Wales. All the pre-exercise recordings and post exercise recordings were done on the same peak flow meter. Only the best three values were retained. The value for each child was taken as the average of the three highest PEFR values.

3.2.2 The exercise challenge test: at intervals of two minutes, successive groups of children were asked to run around the school hall. At any one time, no more than six children were running together. The exact starting time of each was noted. The expected six minute stopping time and the expected five minute rest time were extrapolated from the starting time. In this way, accurate timing during the ECT was possible.

The running pace that children selected on their own was usually adequate. The aim was to perform enough work during the run to achieve 80% of the predicted maximum heart rate for age. Some children had to be encouraged to run faster and others asked to slow down in order to run for a full six minutes. Children were then asked to stop running after exactly six minutes. The heart rate was then recorded.

3.2.3 Post-exercise respiratory function testing: after resting for five minutes, a second set of FEV1 and PEFR recordings were performed. Children with a post exercise FEV1 which was lower than pre-exercise were easily identified.

3.2.4 Wet and dry bulb thermometer readings: wet and dry bulb thermometers were kept near the centre of the hall and readings taken for each group.

4. Data analysis and statistics

The data collected on the questionnaire proforma was computerised. Statistical analysis was performed by the Institute for Biostatistics of the Medical Research Council.

5. Consent

5.1 The Ethics and Research Committee of the University of Cape Town Medical School raised no ethical objection to the study.

5.2 Permission and consent was obtained from:

5.2.1 The Director of Education

5.2.2 School principals

5.2.3 Parents (written or telephonic)

5.2.4 The children

5.3 Feedback of results:

5.3.1 The parents of each participating child were notified in writing of the outcome of the ECT (see appendix).

5.3.2 Each participating school principal was thanked for their assistance. Each received a letter detailing the outcome of the ECT in their school. The letter indicated the number of children tested, the number having a positive ECT and the number having a negative or intermediate ECT. Principals and teachers were invited to refer all queries from parents to the author.

5.3.3 The Cape Department of Education was thanked for their cooperation.

Chapter Five

Results

Study population

One thousand, two hundred and fifty three children (1253) were enrolled into the study (650 boys and 603 girls). Of these, 1241 completed questionnaires (99.0%) and 1174 (93.7%) performed the Exercise Challenge Test (ECT). See Table 1.

The children were from twenty three randomly selected schools in the Southern Suburbs of Cape Town. The subjects age ranged from 11.6 to 12.7 years (mean 12.1).

Table 1: Study Population

	Total	Percentage
Questionnaire returns	1241	(99.04%)
ECT performed	1174	(93.70%)
Total number of 12 yr old children in the selected schools	1253	

The weight was recorded in 1193 children (including 19 children who did not perform the ECT). The weight ranged from 24 to 90 kg (mean

43.8kg). Height was also recorded. The height of 1193 children (including 19 who did not perform the ECT) ranged from 129 to 174 cm (mean 151.6 cm).

Heart rate

The heart rate was recorded at the end of the exercise. In this study 99.2% of the children (1165) managed to achieve a post-exercise heart rate of 160 or more beats per minute (bpm). A post exercise heart rate of 170 or more was achieved by 90.3% of children (1060) (see also Figure 1).

Only 0.8% of the children (9) were unable to achieve a heart rate of 160 bpm. None of these had a previous history of wheezing or of asthma. None had a positive ECT.

The mean heart rate after exercise was 186 (SD 13).

Outcome of the ECT

Fifty two children had a positive ECT. Twenty nine children had an intermediate ECT and 1093 a negative ECT (Figure 2 and Table 2).

Outcome of the ECT

Figure 1

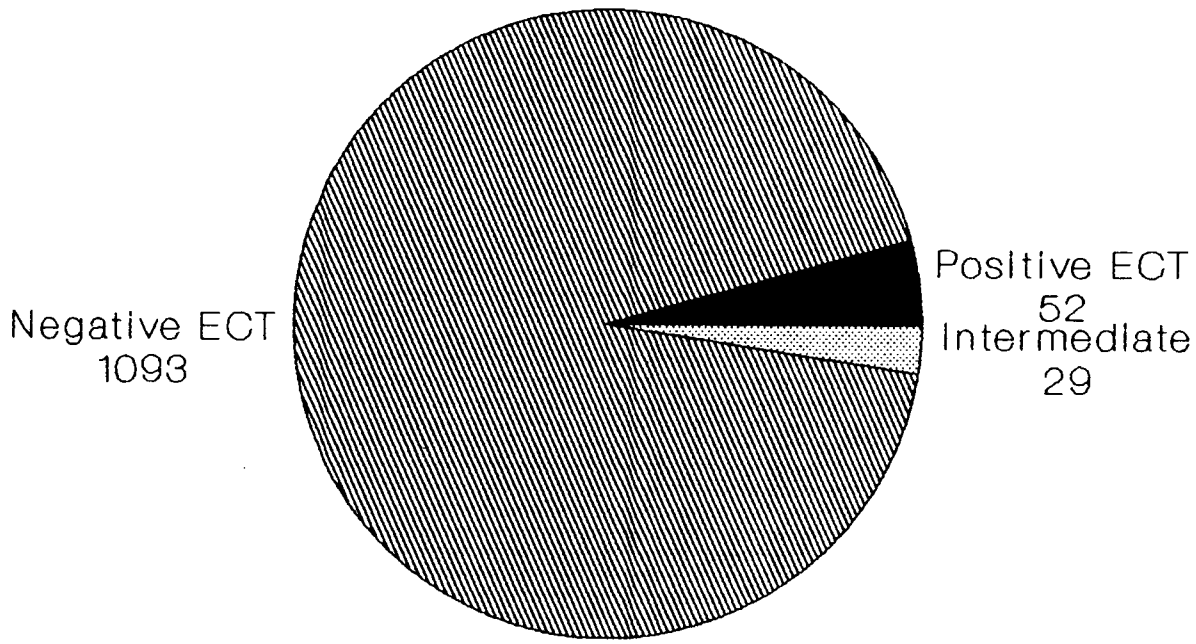

Table 2: Outcome of ECT n = 1174		
Result	Number	Percentage
Positive ECT	52 (b=34 g=18)	4.43%
Intermediate ECT	29 (b=13 g=16)	2.47%
Negative ECT	1093 (b=561 g=532)	93.00%

Table 3: Asthmatic Children Identified in this study n = 58		
Category	Number	Percentage
Clinical asthma	6	0.48%
EIB	52	4.15%
Total	58	4.63%

Six children had airways obstruction and were not able to run. These children all exhibited more than 15% improvement in FEV1 after administration of an beta-2 agonist metered dose inhaler.

Timing of asthma medication in relation to the ECT

Asthma medication had been taken by 22 children within 8 hours of performance of the ECT. In 12 of these children the ECT was repeated when the medication had been withheld for the early morning. Once the ECT had been performed, the morning medication was administered to these children in the usual way. Oral or

inhaled steroids, however, were not withheld prior to the ECT. In a further 8 children who had taken asthma medication prior to performing the ECT, it was not possible to perform a repeat ECT for logistical reasons.

Table 4: ECT and recent medication for asthma
n = 1174

Category	Number (percent)
ECT performed once only (without recent relevant medication)	1154 (98.3%)
ECT performed twice (no medication the second time)	12 (1.0%)
ECT performed once (asthma medication taken within 8 hrs)	8 (0.7%)

Parents diagnosis of asthma.

One thousand two hundred and twenty seven parents (1227) responded when asked if their child previously or currently had asthma (97.92%). Of these, one thousand and eighty six (1086) parents reported that their child had never had asthma. The other 141 reported current or previous asthma. Twenty six parents could not provide a definite answer (see Table 5).

Table 5: Parents diagnosis of previous or current asthma n=1227		
Parents diagnosis	Number	Percentage
Previous or current asthma	141 (b=90 g=51)	11.5%
No previous or current asthma	1086 (b=540 g=546)	88.5%

The ECT in children with current or previous asthma: 129 children with current or previous asthma performed the ECT. Thirty four of these children for whom a parent claimed they had asthma had a positive ECT (Table 6).

Table 6: The ECT in children with current or previous asthma n = 129		
Result	Number	Percentage
Positive ECT	34 (b=23 g=11)	26.3
Intermediate ECT	6 (b=3 g=3)	4.7
Negative ECT	89 (b=58 g=31)	69.0
Total	129 (b=84 g=45)	100.00

Parents history of current or previous wheezing

A wheeze was described for parents in the questionnaire as a high or low pitched whistling noise coming from their child's chest. Parents were asked to indicate whether they had ever heard such a

noise in their child during or preceding the previous twelve months. One thousand two hundred and thirty nine (1239) parents responded to this question (Table 7).

Table 7: Parents history of previous wheezing
n=1239

Report on wheezing	Number	Frequency
No wheezing reported	918 (b=447 g=471)	74.1%
Wheezing reported (anywhere in the past)	321 (b=193 g=128)	25.9%

In the group of 321 children who previously wheezed, 219 had done so within 12 months. This means that 17.7% of the 1241 children who returned questionnaires had wheezed within the last year. See table 8.

Table 8: Wheezing at least once during the previous 12 months
n = 219

	Number	Percentage
1-2 episodes	112 (g=34 b=78)	51.1%
3-9 episodes	74 (g=38 b=36)	33.8%
more than 10 episodes	33 (g=15 b=18)	15.1%

A total of 8.6% (107 children) of the 1241 children who returned questionnaires had wheezed three times or more in the preceding

twelve months.

Children with recent wheezing: the ECT was performed in 198 of the 219 children who had wheezed within 12 months. Of these, 34 children had a positive ECT (Table 9).

Table 9: n = 198
ECT in children with wheezing during the preceding year

Result	Number	Percentage
Positive ECT	34 (b=24 g=10)	17.0%
Intermediate ECT	15 (b=5 g=10)	7.6%
Negative ECT	149 (b=93 g=56)	75.2%
Total	198 (b=122 g=76)	

Children with no previous wheezing: eight hundred and seventy four (874) of the 918 children who had never wheezed before, performed the ECT (95.2%). Five of these children who had no history of wheezing had a positive ECT (Table 10).

Table 10: ECT in children who had never wheezed n = 874		
Result	Number	Percentage
Positive ECT	5 (b=3 g=2)	0.57%
Intermediate ECT	15 (b=6 g=9)	1.72%
Negative ECT	854 (b=418 g=436)	97.71%
Total	874 (b=427 g=447)	100.00%

Children with wheezing more than twelve months previously: one hundred and two children (102) had wheezed more than twelve months before, but not in the preceding twelve months. Ninety three of these performed the ECT. In this group, 7 children (7.0%) had a positive ECT.

Parents reports of specific diseases

Parents were asked to indicate in the questionnaire whether their child had ever suffered from any of the diseases listed in Table 11:

Table 11: Parental reports of specific diseases			
Disease	Number	Percentage	n
Asthma	141	11.2	1227
Hayfever/ allergic rhinitis	378	30.1	1235
Eczema	137	10.9	1235
Bronchitis	413	32.9	1235
Pneumonia/pleurisy	92	7.3	1235
Heart trouble	19	1.5	1235

Both asthma and hayfever were significantly more common in boys than in girls (Chi-square p = 0.000 and 0.008 respectively). Table 12.

Sex differences in disease prevalence Table 12	
Parental diagnosis	p value
Bronchitis	NS
Asthma	0.00
Hayfever	0.01
Eczema	NS
Pneumonia	NS

Active asthma

Ninety seven children where the parent had provided a diagnosis of

asthma had wheezed within the last twelve months (8.4%). These children were regarded as active current asthmatics for this study.

Non-asthmatic children: the ECT was positive in 18 children not known to have current or previous asthma (Table 13). These 18 children form part of the group of 52 with a positive ECT (Table 2). On further questioning, many of these children admitted to experiencing exercise related wheezing.

Table 13: The ECT in children with no current or previous diagnosis of asthma
n = 1037

Result	Number	Percentage
Positive ECT	18 (b=11 g=7)	1.74%
Intermediate ECT	22 (b=9 g=13)	2.12%
Negative ECT	997 (b=499 g=498)	96.14%
Total	1037 (b=519 g=518)	100.00%

Features associated with wheezing

Parents were asked to indicate if any of the features listed in Tables 14 and 15 were associated with wheezing.

Table 14: Features associated with wheezing.

Feature	Positive association	Percent
Breathlessness	206 (n = 1237)	16.7
Wheezing during a cold	268 (n = 1236)	21.7
Wheezing without a cold	142 (n = 1237)	11.5
Disturbed sleep	190 (n = 1236)	15.4

Factors precipitating wheezing

Table 15: Factors thought by parents to precipitate wheezing in their children
n = 321

Factor	Precipitating factor	Percent
Running	186	15.0
Food	73	5.9
Animals	74	6.0
Worry	39	3.1
Excitement	56	4.5
Other factors (eg weather)	168	13.6
these figures are not mutually exclusive		

Exercise induced wheezing: parental reports of exercise induced wheezing in children at some time were present in 186 children (15%).

Estimated age of first wheeze

Of the 321 parents reporting wheezing in their children, 309 were able to estimate the age at which the wheeze first occurred. One hundred and seventy eight first wheezers (57.6%) were older than three years when they suffered their first wheezing illness. The mean age of wheezing for the first time was 4.3 years. The remaining 131 children (42.4%) were less than 3 years old when they had their first wheezing episode. The mean age of first wheeze in boys was 4.25 years (median 3 years), and girls 4.75 years (median 4 years).

Estimated age of last wheeze

The age of last wheezing was estimated by 309 of 321 parents whose children had previously wheezed. The mean age that these children had last wheezed was 10.1 years (median 11). Only ten of were in the bronchiolitic age group of less than three years when they last wheezed. The other 299 parents (24.1%) reported wheezing in their children after 3 years of age. Most of these children (277) had wheezed after the age of six years, well outside the age that bronchiolitis is commonly encountered (22.4%).

Hospital admission for chest problems

Eighty four parents (6.8%) indicated that their child had been admitted to hospital at least once because of chest trouble. The mean age of their first admission was 3.1 years (median 2 years). Of these, 24 (28.6%) were over the age of three years at the time of their first hospital admission.

Family history of allergy in first degree relatives (father, mother, brothers or sisters).

Table 16: Allergic Family History in First Degree Relatives of subjects		
Allergic disease	Frequency	Percent
Asthma (n=1231)	348 (g=182 b=166)	28.3
Eczema (n=1230)	57 (g=24 b=33)	4.6
Hayfever (n=1230)	414 (g=208 b=206)	33.7
Eczema and hayfever (n=1230)	99 (g=53 b=46)	8.0
NB: figures are not mutually exclusive (g= girls, b= boys)		

Parental record of aerosol usage in children

Parents indicated whether their children had ever used aerosol inhalers or nebulizers (table 17). There were 1237 respondents to this question.

Table 17: Record of aerosol usage n = 1237		
Inhaler usage for the last 12 months	Number	%
Used but not within last 12 months	73	5.9%
used 1-2 times	30	2.4%
used 3-9 times	33	2.7%
used more than 10 times	64	5.2%
total	200	16.2%

Approximately 16% (200) of the 1237 respondents had used an inhaler

device before. About 10% (127) had done so at least once during the preceding twelve months. Of these, 7.8% (97) had done so on more than two occasions. The remaining 1037 children had never used a pressured inhaler or nebuliser before.

Parental record of other treatment for chest trouble

Parents were also asked to record *any additional treatment* kept in the house to give to their child should they develop wheezing (Table 18).

Table 18: Medications kept at home for wheezing n = 1233

Medication	Frequency (percent)
Beta 2-agonists	31 (2.5%)
Anticholinergics	0 (0%)
Mast cell stabiliser	9 (0.7%)
Inhaled corticosteroid	1 (0.1%)
Oral bronchodilator	72 (5.8%)
Oral corticosteroid	8 (0.6%)
Other medication (eg cough mixture)	39 (3.2)

Sustained use of maintenance bronchodilator therapy: only thirty out of 1235 respondents (2.4%) reported using treatment for chest trouble every day for as long as 3 months over the previous 12 months.

EIB and relative humidity.

A correlation was sought between EIB and the relative humidity of exercise environment. The post exercise percentage fall in FEV1 was divided into four groups (table 19). No correlation was found between these groups and the respective relative humidity of each.

Table 19: EIB and relative humidity

FEV1 Percentage fall	Spearman Correlation Coefficient
< 2% or increase in FEV1	NS
2 - 10%	NS
10 - 15%	NS
15%	NS

Reasons for children not participating in the study

Seventy-nine of the 1253 eligible children did not participate in the ECT (6.3%). Eight had a respiratory complaint (0.64%), (Table 20). Six of the children with a respiratory complaint had acute severe asthma, one had cystic fibrosis and one had an acute influenza-like illness. The FEV1 recordings in all six children who had acute severe asthma improved by more than 15% after use of a beta 2-agonist metered dose inhaler. These six children (0.48%) are included in the study as definite asthmatics.

Seventeen parents refused permission for their children to participate in the study (1.4%). Forty one children (3.3%) were absent from school and could not be tested. Twelve out of 1253 eligible children did not return the questionnaire (0.96%). This figure includes parents who refused to participate and parents whose children were absent from school at the time of the study. Thirteen children (1.0%) could not participate in the ECT because of some other physical condition such as a fracture of the femur.

Table 20: Reasons for non-participation in the ECT
n = 79 (6.3%)

Respiratory complaint:		
Acute severe asthma	6 *	
Acute Influenza-like illness	1	
Cystic Fibrosis	1	
Total	8	(0.64%)
Parents refused	17	(1.36%)
Absent from school	41	(3.27%)
Another physical condition eg fracture femur	13	(1.03%)

* recorded as definite asthmatics

Comparative data from the multicentre study:

As indicated, the data from our study has been compared to data from similar studies conducted in the United Kingdom, New Zealand and Sweden. This analysis is being done by the MRC Epidemiological Unit in Cardiff, Wales (Table 21). Incomplete questionnaires were excluded from analysis in this multicentre comparison. We chose to utilise data that was provided rather than exclude all incomplete questionnaires. Therefore only 1227 questionnaires were included in the multicentre analysis while 1241 questionnaires were actually returned.

Table 21: Parental reports of asthma symptoms

	UK Children	NZ Children	Swedish Children	S African Children
Asthma ever	12.0	16.8	4.0	11.5
Current Asthma	9.1	11.1	2.8	8.7
Wheeze ever	22.3	26.6	21.7	25.9
Wheeze in the past year	15.2	17.9	9.2	17.7
Breathless wheeze ever	14.0	17.8	7.1	16.7
Wheeze without a cold ever	13.8	16.3	9.2	11.5
Wheeze brought on by running ever	10.5	14.9	4.7	15.0
Eczema ever	15.9	15.9	22.0	11.1
Hayfever ever	16.0	21.0	13.9	30.6

Record of pets kept by subjects

The questionnaires asked parents to compile a list of household pets (Table 22).

Table 22: Record of pet ownership

Pet	Frequency	Percent
Dog	938	75.7
Cat	521	42.1
Bird	321	25.9
Other mammal (eg horse)	53	4.3
Other pet (eg tortoise)	183	14.8

Reproducibility

Reproducibility of the information obtained from the questionnaires was assessed. Every tenth parent was telephoned approximately three months after the original questionnaire had been completed (109). They were asked to complete a second identical questionnaire telephonically. No parents objected to this request. The data from the second questionnaire was compared with the original questionnaire for reproducibility. The Kappa Test was used to test the reproducibility of data.

a) $K > 0.75$ excellent reproducibility

b) $K = 0.4\text{-}0.75$ good reproducibility

c) $K < 0.4$ marginal reproducibility

Kappa as derived from comparing the duplicate questionnaire with the original was always good to excellent. The maximum 'wrong' answers on any given variable in the duplicate data set never exceeded 10 out of 109 repeat answers.

Chapter Six

Discussion

EIB is easily diagnosed. Failure to diagnose EIB may result in unnecessary physical and psychological restrictions (Gerhard et al 1980). Once identified, the management of EIB is relatively simple.

In this study, a prevalence of EIB of 4.15% was found in white primary school children in the Southern Suburbs of Cape Town. In addition, six children were found to have documented reversible airways obstruction, but were too distressed to perform the ECT. By including these 6 children the prevalence increases to 4.63%.

It is likely that this represents an underestimate of the true prevalence of asthma in the sample population. Some 20-30% of known asthmatics do not exhibit EIB at any one ECT. Also, a total of 20 children had taken medication protecting against EIB within eight hours of the ECT. Eight of these could not be retested on another occasion when the medication had been withheld for the ECT. Had it been possible to retest these children without medication, it is probable that some would have had positive ECT results.

Another reason for the figure of 4.63% possibly being an underestimate, is that some of the 29 children with an intermediate result,

were only marginally below the criterion of 15% required for a diagnosis of EIB. These children may have had reduced bronchial hyperreactivity (BHR) on the day of the ECT, but still be clinical asthmatics. A positive ECT may have been demonstrable if they were retested at another time.

Sample population

One strength of this study is that all children tested were born within a twelve month period. These data are difficult to interpret now, but as the results of the international survey become available, so they will fall into place with respect to eliminating age as a variable. Further studies may then be needed to determine the influence of age on the prevalence of asthma.

The Southern Suburbs of Cape Town were chosen for this study because this area provided a logistically acceptable geographical location for transport of researchers and equipment to and from the 23 primary schools. There is no definite evidence to suggest that the prevalence within the Southern Suburbs is markedly different from other areas within the Cape Town metropolitan area. The selection of schools within the Southern Suburbs represented a good cross section of the study population. At least one school was chosen from each municipal region. Random number charts were used to select schools when more than one existed in any given region.

Ideally the schools selected for this study should have represented a broad cross-section of the general population. This was not possible as schools for different races fell within the ambit of different controlling authorities. While arrangements to conduct the study in white primary schools progressed fairly quickly, problems were encountered in extending the study to children attending schools for other population groups. It was decided to continue with the study in white primary school children. A similar study could then be considered subsequently in other population groups.

Terblanche et al (1990) were able to investigate the prevalence of EIB in both white and coloured children in the Northern Suburbs of Cape Town. They found the prevalence of EIB to be 5.87 in white children and 4.05 in coloured children. Their results indicate a higher prevalence of asthma of 5.87% in the white children they studied as compared with our study. We found the prevalence of EIB in white children in the Southern Suburbs to be 4.43%. However, the study from the Northern Suburbs included children with levels of post exercise bronchoconstriction not severe enough to be generally accepted as EIB. This may explain why the prevalence figure for EIB in the Northern Suburbs is higher than that for the Southern Suburbs. A study from Cardiff, Wales (Burr et al 1989), found the prevalence of EIB to be 7.7% while Colin et al reported a prevalence of EIB of 8.6% in Haifa, Israel. However, the age spectrum of the children in these studies was different. Direct comparison of

the various prevalence figures is unreliable. Different definitions of EIB are used. Braback et al (1988) report from Sweden that the overall prevalence of asthma was 4%.

The exercise challenge test

The protocol and questionnaire were provided by the MRC in Cardiff, Wales. Use of previously constructed material was necessitated by the need to have comparable data for the international survey. While this provided the advantage of a complete protocol and questionnaire, some weaknesses in the proposed study were also inherited. Among these was that the use of the ECT to demonstrate EIB is not without problems.

EIB results from bronchial hyperresponsiveness that characterizes asthma (Motala 1991). The exercise challenge test provides an overall assessment of bronchial hyperreactivity. It is widely accepted that approximately 80% of children with clinical asthma will have a positive ECT. Exercise induced bronchoconstriction is a sensitive indicator of asthma (Balfour-Lynn 1981). The prevalence of EIB is a practical measure of asthma (Colin et al 1985).

However, the ECT is not a sensitive marker of EIB in mild asthma. Terblanche et al (1990) report that the ECT is an insensitive predictor of childhood asthma. They found the negative predictive value of the ECT to be 95% while the positive predictive value was

only 46%. This is probably because many school children with asthma have only mild disease. Many children with mild asthma do not demonstrate EIB. However the sensitivity of the ECT improves considerably when used in moderate or severe asthmatics. While a positive ECT suggests the presence of asthma, a negative test does not exclude the diagnosis (Terblanche et al, 1990). Use of the ECT in epidemiological studies will therefore underestimate the prevalence of EIB. Despite this, the ECT is 'acceptable, feasible and cost effective' in identifying school children with EIB (Tsanakas et al 1988).

Rarely, the ECT may result in a false positive diagnoses of EIB. This is seen in some children with previous bronchiolitis, relatives of children who are not themselves asthmatic and patients with cystic fibrosis. Some atopic subjects have EIB without evidence of previous or present asthma. Occasionally, children without any history suggestive of asthma, demonstrate EIB. It may be that these children will develop asthma in the future.

Other methods of evaluating BHR include bronchoprovocation using pharmacologic agents such as histamine or methacholine. The procedure takes approximately 30 minutes and requires close medical supervision by an experienced clinician. This method identifies patients with hyperresponsive airways but who may not necessarily be symptomatic (Bardin et al 1991). The test is more sensitive than the ECT especially in mild asthma. However, it may be overly

sensitive and suggest a falsely positive diagnosis of asthma in asymptomatic subjects or those with atopic rhinitis but not asthma (Bardin et al 1991). In addition, they may be less acceptable to parents than the ECT when applied in large field studies. Also, BHR to metacholine is present in children with both asthma and chronic lung disease such as cystic fibrosis and post-viral bronchiolitis. However, BHR to exercise is present in only those with asthma (Godfrey et al, 1991). These tests are widely used however in the assessment of BHR.

Degrees of BHR in the general population have a Gaussian distribution. Individuals with normal lungs tend to have less BHR while asthmatics tend to have higher degrees of BHR. It may be difficult to decide on a cut-off point between normal and hyperresponsive individuals (Bardin et al, 1991). The study by Terblanche and Stewart (1990) includes the intermediate range of the ECT as positive (ie: 10-15% reduction in FEV1) and report a prevalence in white children of 5.87%. If similar criteria are applied in our study the prevalence of asthma would be 6.9%. However, normal children, relatives of asthmatics who do not themselves have asthma and children with other allergic diatheses such as allergic rhinitis but not asthma may all exhibit this intermediate response to exercise. Such false positive results make this lower criterion unreliable and a post exercise fall in FEV1 of 10% or more is therefore not an accepted definition of EIB. Only children with post exercise levels of 15% or more should be regarded as having

EIB.

The ECT performed with an inadequate exercise stimulus may be insufficient to detect mild EIB. The exercise needs to be sufficient to achieve a heart rate of at least 80% of maximum predicted for age viz 160 beats per minute. In this study the mean heart rate was 186 (SD 13). This indicates that the quality and severity of the exercise used to induce EIB in this study complied with standard expectations (Motala personal communication 1991, Godfrey 1974).

The five children with a positive ECT who had never wheezed before may have mild EIB without overt wheezing but with other symptoms such as coughing. A positive ECT was found in 18 children with no current or previous diagnosis of asthma. These 'normal' children may either be undiagnosed asthmatics or may become overtly asthmatic later. Tsanakas et al (1988) report similar findings.

The protocol required that PEFR measurements be done to detect bronchial constriction. PEFR measurements are not as sensitive as the FEV1 in detecting lower airway obstruction. For this reason PEFR measurements were performed as dictated in the protocol. However, FEV1 recordings were also performed. The PEFR recordings were not analyzed but merely provided to the coordinator of the international survey. Only FEV1 results were analyzed in this study.

Parents who did not return the initial questionnaire were contacted telephonically. Parents who indicated at this or any other stage that they did not want their children to participate in the study were not contacted again. Those who had merely forgotten to return the questionnaire were asked to complete one telephonically. In this way the questionnaire returns were improved from approximately 81% to the final figure of 99.04%.

The 79 children out of the total number of eligible children (1253) who did not perform the ECT, was relatively small. However, only 12 of these children did not return a questionnaire (0.96%). Many of these 12 children were away for an extended period at the time of the study and could not be contacted. Occasional parents refused to complete questionnaires.

No child participated in the ECT without written or telephonic consent from parents. After the ECT, parents were notified in writing of the outcome of the ECT in their child. This notification invited parents to discuss the outcome of the ECT with the author. All those with a positive response were asked to consult their doctor for a full clinical evaluation. In the notification the author offered to convey the result of the ECT to the child's family doctor. Where parents accepted this offer, the family doctor was informed of the ECT result. Some parents of children previously thought to have clinical asthma but with a negative exercise challenge test, made contact with the author. The possibility that

these children were in a stable phase of reduced BHR at the time of the ECT was explained to these parents. It is possible that some may have had seasonal asthma. Other possible reasons for this outcome were discussed with them. They were also asked to show the result of the ECT to their doctor for evaluation in the child's clinical setting.

Questionnaire

The prevalence of parents perceptions of various symptoms suggesting asthma was much higher than the prevalence of EIB documented by the study. Duplicate questionnaires were completed in approximately 10% of children. Those duplicated were not significantly different from the original which had been completed by the parents a few weeks earlier. This accurate reproducibility suggests that the questionnaire information is reasonably reliable.

While the prevalence of EIB was 4.15%, the parentally perceived prevalence of exercise induced wheezing was 15%.

The prevalence of parental impressions of other markers of asthma were also common. A parental diagnosis of asthma was present in 11% of children and a history of previous wheezing in 25%. A history of wheezing for the first time after the age of three years was present in 14.3%. Altogether, 22.4% reported the presence of wheezing in their children after 6 years of age. Just over 8% had

wheezed more than 3 times in the preceding year.

Approximately one third of the study population reported hayfever, while bronchitis was also present in a third. Eczema was present in 11%. It is interesting to note that the majority of children had cats or dogs as pets. Children in this study without household pets were in the minority. The presence of endemic animal dander and other pet related allergens may be a factor contributing to the frequency of reported allergies.

Wheezing had caused breathlessness in 17% and disturbed sleep in 15%. About 10% of the subjects had found it necessary to use an asthma inhaler device at least once in the preceding year.

Significant allergies such as asthma or hayfever in first degree relatives of the subjects was common. One third of the subjects had a positive family history of hayfever while one third also reported asthma.

The parents' estimates of childhood asthma as recorded in the questionnaire are probably inaccurate. Parents depend on their perception of what constitutes asthma as well as recall from memory for this information. Parental misconceptions about the meaning of the words such as 'wheeze' contribute to inaccuracy. Resistance to labels such as asthma with preference for terms such as bronchitis and bronchospasm would underestimate asthma prevalence.

However, it is striking that there was a high prevalence of symptoms which may be related to asthma. The reproducibility of this data suggests that the parents themselves are convinced that the symptoms are a problem.

The true prevalence of childhood asthma or allergy in this study population is probably higher than the ECT estimation of 4.63%. However it is unlikely to be as high as the 22.4% which was the percentage of children over 6 whose parents had reported wheezing.

Asthma and allergic rhinitis in this study were more common in boys than in girls. This is consistent with findings elsewhere (Burr et al 1974, Fitch et al 1971).

This study was not able to demonstrate that EIB was more common in dry cold air as reported by others (McFadden 1984, Anderson 1985). There was no statistically significant relationship between the temperature of the inspired air, the relative humidity of this air and EIB.

Chapter Seven

Conclusion

It remains difficult to make an accurate community assessment of the prevalence of asthma. There is no highly accurate and simple method available to achieve this.

Any method used to determine the community prevalence of asthma, has to be acceptable to parents of participating children and the children themselves. Factors such as age variation, sex, race, definition of asthma and standardisation of the testing procedure, all influence the prevalence of asthma and need to be considered in planning studies of this nature.

As 52 of 1174 children had a positive ECT, about 1 child per class had EIB. Only 34 of these had current or previous asthma. This suggests that many children with EIB as well as their parents are unaware of the nature of the condition or of the fact that it is immanently treatable. Asthmatics are often exempted from physical exercise at school. In addition, they may avoid other sporting activities. Teachers and parents need to be made aware that EIB and asthma are controllable with simple safe medication. Physical exercise needs to be encouraged in asthmatic children. The image of bronchial asthma can be improved by pointing out to the children, parents and teachers that many high achievers in sport are in fact

asthmatic. Not only can the hindering effects EIB be prevented in many cases if medication such as beta-2 adrenergic aerosols are used, but established EIB can be easily reversed. Myths that asthma is an emotional illness can be dispelled along with notions that asthma is invariably debilitating.

In this study only 4.43% of children had a positive ECT. On the other hand, 11.5% of parents reported a previous or current diagnosis of asthma and 10.3% reported use of an inhaler device on more than one occasion within the previous 12 months. This suggests that the ECT is an insensitive method of diagnosing EIB and that the true prevalence of EIB is higher than 4.43%.

We showed that EIB is a relatively common problem in white primary school children in the Southern Suburbs of Cape Town. Parental estimates of asthma and wheezing in their children are even more common.

Chapter Eight

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Appendix: Table of participating schools

Table of Schools				
School Name	Code	Participating subjects	Percent	Total
Ferndale Primary	1	39	3.1	39
Claremont Primary	2	22	1.8	61
Observatory	3	18	1.4	79
Mary Kihn School for the hard of hearing	4	11	0.9	90
Rondebosch Boys Primary School	5	74	5.9	164
Kirstenhof Primary	6	75	6	239
Wynberg Girls Primary School	7	95	7.6	334
Wynberg Boys Primary School	8	90	7.2	424
Sweet Valley Primary School	9	81	6.5	505
John Graham	10	78	6.2	583
Rustenberg Girls Primary School	11	99	7.9	682
Timour Hall	12	40	3.2	722
S A College School Boys Primary	13	108	8.6	830
Bergvliet Primary	14	87	6.9	917

Continued...

School Name	Code	Subjects	Percent	Total
Grove Primary	15	90	7.2	1007
Wescott Primary	16	35	2.8	1042
Sunlands Primary	17	46	3.7	1088
Simon van der Stel	18	33	2.6	1121
Rondebosch East	19	23	1.8	1144
Zwaanswyk Primary	20	27	2.2	1171
Windsor Primary	21	41	3.3	1212
Greenfield Primary	22	28	2.2	1240
Observatory	23	13	1.0	1253

Appendix: letter to parents (English)

June 8, 1989

Dear Parent

The number of children with asthma appears to be increasing worldwide. To find out if this is true for Cape Town as well, we would like your child to participate in a survey testing for asthma. The study is being conducted internationally, with the South African investigation being run in Cape Town under my coordination. Professor E Weinberg of the Allergy and Asthma Clinic at the Red Cross Children's Hospital, is supervising the project. A total of 23 schools and 1000 children are participating.

The first part of this very important study is the completion of the enclosed two page questionnaire by PARENTS. Please complete it and have your child return it to his/her teacher within the next few days BEFORE THE END OF TERM. Each and every questionnaire must be returned for the study to be successful.

The second part of the study will be carried out next term. A team of trained asthma workers will perform lung function measurements on your child. Then we will ask him/her to run around the school hall for 6 minutes and repeat the measurement. We can tell from this test whether or not he/she has asthma. The lung function measurement is very easy to do. Your child will only be required to blow into a simple machine (Vitalograph) for six seconds. We have full permission and cooperation from THE DEPARTMENT OF EDUCATION AND CULTURE AND YOUR PRINCIPAL. If you have any queries do not hesitate to phone me at the number below.

If you consent to your child participating please sign below.

SIGNATURE: _____

Yours sincerely

Dr F O NAGEL Mb.ChB. DCH (SA). FCP (SA)
Allergy and Asthma Senior Registrar

Telephone: 685 5011 ext 222

Appendix: letter to parents (Afrikaans).

12 Junie 1989

Geagte Ouer

Wereldwyd skyn dit asof die aantal kinders wat aan asma ly. Om uit te vind of hierdie toename ook in Kaapstad plaas vind, sou one graag u kind wou insluit in 'n oorsigstudie om die voorkomsyfer van asma plaaslik te bepaal. Hierdie oorsig, wat deel is van 'n internationale studie, word in Kaapstad deur my gekoordineer. Professor E Weinberg van die Asma en Allergiekliniek by Rooikruis Oorlogsgedenkhospitaal vir kinders is die toesighouer. Drie-en-twintig skole en 1000 kinders is betrokke by die studie.

Hierdie baie belangrike projek bestaan uit twee dele, waarvan die eerste deel die ingeslote vraelys van twee bladsye is. Dit moet asseblief deur die OUERS voltooi word en binne die volgende paar dae ann u kind se onderwyser VOOR DIE EINDE VAN DIE KWAARTAAL terug besorg word. Dit is noodsaaklik dat ons elke vraelys terugkry om sodoende die sukses van die projek te verseker.

Die tweede deel van die studie sal tydens die volgende kwartaal afgehandel word. 'n span van opgeleide asmawerkers sal longfunksietoetse op u kind uitvoer. Daarna sal die kind gevra word om in die skoolsaal rond te hardloop vir 6 minute waarna die longfunksietoetse kerhaal sal word. Sodoende sal ons kan vasstel of u kind aan asma ly al dan nie. Meting van longfunsie is 'n maklike prosedure. U kind sal slegs gevra word om 6 sekondes lank in 'n eenvoudige apparaat (Vitalograaf) te blaas. One het reeds volle verlof en same werking van beide die DEPARTEMENT VAN OPVOEDING EN KULTUUR EN U PRINSIPAAL verkry. Indien u eenige vrae will opper kan u my gerus skakel by die onderstaande nommer.

Teken asseblief waar aangedui indien u u toestemming verleen vir u kind se deelname.

Handtekening: _____

Met opregte dank

Dr F O Nagel
Allergie en Asma Senior Kliniesassistent
Telefoon: 685 5011 uitbreiding 222

Appendix: Coding schedule for questionnaires

Column		Question and coding (NB: 'no information' should be coded 9 where applicable)	
1,2	School or area		
3-6	Serial number within area		
7-12	Date of birth (day/month/year)		
13	sex	M = 1, F = 2	
14	Q.1	Bronchitis	No = 0, Yes = 1
15		Asthma	No = 0, Yes = 1
16		Hayfever/allergic rhinitis	No = 0, Yes = 1
17		Eczema	No = 0, Yes = 1
18		Pneumomia/pleurisy	No = 0, Yes = 1
19		Heart Trouble	No = 0, Yes = 1
20	Q.2	No = 0, Yes = 1	
21	Q.3	No = 0, Yes = 1 (NB: first degree relatives only)	
22	Q.4	Neither = 0, Eczema = 1, Hayfever = 2, Both = 3 (first degree relatives only.) Code 3 if both diseases occur, whether in the same relative or not.	
23-26	Q.5-5c	No = 0, Yes = 1. If col 23 = 0, code cols24-38 as 0	
27-28	Q.5d	Year of age: never = 00, <1yr = 88 (NB: not 00)	
29,30	Q.5e	Year of age: never = 00, <1yr = 88 (NB: not 00)	
31	Q.5f	0 = 0, 1-2 = 2, 3-9 = 3, >10 = 4. NB: no code 1	
32	Q.5g	No = 0, Yes = 1	
33	Q.5h	Running:	No = 0, Yes = 1
34		Worry:	No = 0, Yes = 1

35		Excitement:	No = 0, Yes = 1
36		Animals:	No = 0, Yes = 1
37		Food:	No = 0, Yes = 1
38		Other factors:	No = 0, Yes = 1
39	Q6.a	Inhaler	No = 0 Yes 'ever' but 0 in last 12 mo = 1, 1-2 = 2, 3-9 = 3, >10 = 4 (NB: distinction between codes 0 and 1)
40	Q.6b	Adrenergic (beta agonist)	) Not in last 12 mo = 0
41		Anticholinergic (eg ipratropium)	) Last 12m, not last 48 hr = 1
42		Mast cell stabiliser	) Last 48 hr = 2
43		Corticosteroid	)
44	Q.7	Bronchodilator (any non-inhaled type):	No = 0, Yes = 1
		Corticosteroid:	No = 0, Yes = 1
		Other:	No = 0, Yes = 1
47	Q.8	Inhaled adrenergic (beta agonist)	No = 0, Yes = 1
48		Inhaled anticholinergic:	No = 0, Yes = 1
49		Inhaled mast cell stabiliser:	No = 0, Yes = 1
50		Inhaled corticosteroid:	No = 0, Yes = 1
51		Oral bronchodilator:	No = 0, Yes = 1
52		Oral corticosteroid:	No = 0, Yes = 1
53		Other:	No = 0, Yes = 1
54	Q.9	No = 0, Yes = 1	
55,56	Q.10	Age in yrs at first admission, never = 00, <1 yr = 88 (not 00)	
57,58		Age in yrs at last admission, if admitted twice or more Admitted never or once = 00, <1 yr = 88 (not 00) NB: code for respiratory distress only (not heart disease)	

59	Q.11	Dog	No = 0, Yes = 1
60		Cat	No = 0, Yes = 1
61		Other mammal	No = 0, Yes = 1
62		Bird	No = 0, Yes = 1
63		Other	No = 0, Yes = 1

64-69 Q.12 Date questionnaire completed (day, month, year)

Questionnaire completed: wholly by parent/gardian = 1

partly by child = 1, wholly by child = 3

71-71 Height in cm

74-76 Weight in Kg

77 Exercise test:

performed once, no relevant treatment	= 0
performed once, treatment within 8 hrs	= 1
performed twice, no treatment 2nd time	= 2
performed twice, oral/inhaled steroids 2nd time	= 3
not performed due a respiratory condition	= 4
not performed, other physical condition	= 5
refused	= 6
child unavailable for exercise	= 7

NB: Code 1 for bronchodilators, mast cell stabalisers or steroids; record type of treatment or reason for non-exercise after boc 77.

1-15 Five initial PEFR values. If none of these attain 70% predicted PEFR, record 5 further values on another occasion immediately above the original values; (ie. within the broken lines) and then delete the original values: code 1 in column 31

16-30 Five post-exercise PEFR values: not performed, code 9 throughout

31 Initial (pre-exercise) PEFR: not repeated before exercise = 0

repeated, original value deleted = 1

NB: this refers to a repeat PEFR undertaken because the original values were < 70% predicted, not to a repeat exercise test

undertaken because of treatment on the first occasion

32-34 Heart rate per minute (per 15 secs X 4).

35,36 Dry bulb temperature, degrees C

37,38 Wet bulb temperature, degrees C

39-44 Date of exercise test

45-50 Two initial FEV1 values. If none of these attain 70% of predicted for height, record a further two values on another occasion immediately above the original two values (ie within the broken lines) and then delete the original values: code 1 in column 57

51-56 Two post exercise FEV1 values: not performed code 9 throughout

57 Initial (pre-exercise) FEV1: not repeated before exercise = 0

repeated, original value deleted = 1

Appendix: reply letter to parents whose children had a positive ECT

Thank you for allowing your child _____
to participate in this study. Your cooperation was very much appreciated and was very valuable. We have not as yet completed the overall analysis but would like you to be aware of your child's result.

As you know, we used a simple exercise test to try and identify children with a tendency to asthma. After your child had run, we were able to demonstrate a degree of airways narrowing. Within the limits of the exercise challenge test this would suggest a tendency to asthma.

If you feel that this is a reflection of an actual or potential problem (eg your child is having episodes of coughing or wheezing) please contact your doctor to make an assessment (if you have not already done so).

If this tendency is not a problem at present but does become manifest in the future (eg coughing or wheezing) please report these findings to your doctor.

If I can be of any assistance please contact me at the number below.

Yours sincerely

Dr F O Nagel Mb ChB (UCT), FCP (Paeds)

Tel: 6855011 222

Appendix: reply letter to parents whose children did not have a positive ECT

Thank you for allowing your child _____ to participate in this study. Your cooperation was very much appreciated and was very valuable. We have not as yet completed the overall analysis but would like you to be aware of your child's result.

Within the limits of the exercise challenge test we were unable to demonstrate any tendency to asthma on the day of the test.

If I can be of any assistance please contact me at the number below.

Yours sincerely

Dr F O Nagel Mb ChB (UCT), FCP (Paeds)

Tel: 6855011 222

QUESTIONNAIRE : CHILDHOOD ASTHMA : CONFIDENTIAL

School/Form ..... Address ..... 1 [ ][ ]

Name .... 3 [ ][ ][ ][ ]

Date of birth .... 7 [ ][ ][ ][ ][ ][ ]

PLEASE PUT A RING AROUND THE RIGHT ANSWER LIKE THIS - YES or NO

13 [ ]

1. Has your child ever suffered from any of the following?
(Put a ring around the name of any disease(s) he/she has had)

BRONCHITIS ASTHMA HAYFEVER/ALLERGIC RHINITIS

ECZEMA PNEUMONIA/PLEURISY HEART TROUBLE 14 [ ][ ][ ] [ ][ ][ ]

2. Does he/she cough on most days for as much as 3 months per year?
YES NO 20 [ ]

3. Have any of your child's closest relatives (parents, brothers, or sisters) ever suffered from asthma? YES NO [ ]

If YES, which members of the family? ..... 21 [ ]

4. Have any of your child's closest relatives ever suffered from eczema or hay fever (allergic rhinitis)? YES NO 22 [ ]

If YES, which relative & which disease? ..... [ ]

5. Has a wheeze - that is a whistling noise (high or low pitched) ever been heard coming from your child's chest? YES NO 23 [ ]

If YES,

(a) Has he/she ever been at all breathless when the whistling noise occurred? YES NO 24 [ ]

(b) Has the whistling noise ever occurred when he/she had a cold? YES NO 25 [ ]

(c) Has the whistling noise ever occurred when he/she did not have a cold? YES NO 26 [ ]

(d) How old was he/she when it first occurred? ..... 27 [ ][ ]

(e) How old was he/she when it last occurred? ..... [ ][ ]

(f) How many times has it occurred during the last 12 months?

(tick) 0 [ ] 1-2 [ ] 3-9 [ ] 10 or more [ ] 31 [ ]

(g) Has it ever disturbed his/her sleep YES NO 32 [ ]

(h) Please ring any of the following which you think may have brought on the wheeze

RUNNING WORRY EXCITEMENT 33 [ ][ ][ ]

ANIMALS e.g. ..... FOODS e.g. ..... [ ][ ]

Any other factor ..... [ ]

6. Has he/she ever used a pressured inhaler, aerosol or nebulizer for chest trouble? YES NO

If YES,

(a) On how many days in the past 12 months?

(tick) 0 ☐ 1-2 ☐ 3-9 ☐ 10 or more ☐ 39 ☐

(b) Name of inhaler/nebulizer solution used in last 48 hours ..... ☐☐☐☐

(c) Other inhaler(s)/nebulizer solution used in last 2 months .....

7. Please record any other treatment he/she is currently taking for chest trouble ..... 44 ☐☐☐

47 ☐☐☐☐

8. Apart from treatment he/she is taking at present, do you keep any treatment in the house to give him/her for wheezing? YES NO ☐☐☐

If YES, name(s) of this treatment .....

9. During the past 12 months, has he/she taken treatment of any kind for chest trouble every day for as long as 3 months? YES NO 54 ☐

10. Has he/she ever been admitted to hospital because of chest trouble? YES NO 55 ☐☐

If YES, age(s) and diagnosis ..... ☐☐

11. What pets, if any, do you have? ..... 59 ☐☐☐☐☐

12. Todays date ..... 64 ☐☐☐☐☐

THANK YOU FOR YOUR HELP, PLEASE LEAVE THE SPACE BELOW

71 Ht ☐☐☐ 74 Wt ☐☐☐ Kg x 10 77 Ex. test ☐

1 Initial PEFR ....

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

31 Rpt in PEFR ☐ HR/min 32 ☐☐☐

16 Post-ex. PEFR

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

35 DB ☐☐ 37 WB ☐☐

45 Initial FEV .....

☐☐☐☐☐☐

39 Date D M Y ☐☐☐☐☐☐

51 Initial PEFR .....

☐☐☐☐☐☐

57 Rpt. in FEV 1 ☐

☐☐☐☐

VRAELYS : ASMA BY KINDERS : VERTROULIK

Skool/Graad ..... Adres ..... 1 ☐☐

Naam .... 3 ☐☐☐☐

Geboortedatum .... 7 ☐☐☐☐☐☐

TREK ASSEBLIEF 'N KRING OM DIE REGTE ANTWOORD SOOS VOLG - JA of NEE

1. Het u kind ooit aan een van die volgende gely? 13 ☐
(Trek 'n kring om die naam van enige siekte(s) wat hy/sy gehad het).

BRONGITIS ASMA HOOIKOORS/ALLERGIESE RINITIS

EKSEEM LONGONTSTEKING/PLEURITIS HARTPROBLEME 14 ☐☐☐ ☐☐☐

2. Hoes hy/sy bykans elke dag vir soveel as 3 maande per jaar? JA NEE 20 ☐

3. Het enige van u kind se naaste familielede (ouers, broers of susters) ooit aan asma gely? JA NEE ☐

Indien JA, watter lede van die familie? ..... 21 ☐

4. Het enige van u kind se naaste familielede ooit aan ekseem of hooikoors (allergiese rinitis) gely? JA NEE 22 ☐

Indien JA, watter lede van die familie? ..... ☐

5. Het u ooit gehoor dat 'n fluitgeluid (op 'n lae of 'n hoë toonhoogte) uit u kind se bors kom? JA NEE 23 ☐

Indien JA,

(a) Was hy/sy ooit enigsins uitasem as die fluitgeluid voorgekom het? JA NEE 24 ☐

(b) Het die fluitgeluid ooit voorgekom wanneer hy/sy verkoue was? JA NEE 25 ☐

(c) Het die fluitgeluid oot voorgekom wanneer hy/sy nie verkoue was? JA NEE 26 ☐

(d) Hoe oud was hy/sy toe dit die eerste keer voorgekom het? ..... 27 ☐☐

(e) Hoe oud was hy/sy toe dit die laaste keer voorgekom het? ..... ☐☐

(f) Hoeveel keer het die gedurende die laaste 12 maande voorgekom?

(merk) 0 ☐ 1-2 ☐ 3-9 ☐ 10 of meer ☐ 31 ☐

(g) Het dit ooit sy/haar slaap versteur? JA NEE 32 ☐

(h) Trek 'n kring om enige van die volgende wat u dink die fluitgeluid kon veroorsaak het

HARDLOOP BEKOMMERNIS OPGEWONDENHEID 33 ☐☐☐

DIERE bv. ..... KOS bv. ..... ☐☐

Enige ander faktor ..... ☐

3. Het hy/sy ooit 'n inasemingstoestel, aerosol of verstuiwer vir borsprobleme gebruik? JA NEE

Indien JA:

(a) Op hoeveel dae in die afgelope 12 maande?

(merk) 0 ☐ 1-2 ☐ 3-9 ☐ 10 of meer ☐ 39 ☐

(b) Naam/name van die inasemings-/verstuiweroplossing(s) wat in die laaste 48 uur gebruik is ..... ☐☐☐☐

(c) Ander inhalator(s) verstuiwers wat in die laaste 12 maande gebruik is.....

. Teken asseblief enige ander medikasie aan wat hy/sy tans vir borsprobleme neem ..... 44 ☐☐☐

Behalwe die medikasie wat hy/sy tans neem, hou u enige medikase in die huis om vir hom/haar te gee wanneer sy/haar bors fluit? JA NEE 47 ☐☐☐☐ ☐☐☐

Indien JA, wat is die naam/name van hierdie medikasie .....

. Het hy/sy gedurende die afgelope 12 maande daagliks enige medikasie geneem vir so lank as 3 maande aanmekaar? JA NEE 54 ☐

10. Is hy/sy ooit in die hospitaal opgeneem as gevolg van die medikasie? JA NEE 55 ☐☐

Indie JA, ouderdom(me) en diagnose ..... ☐☐

11. Watter troeteldiere, indien enige, hou u aan? ..... 59 ☐☐☐☐☐

12. Vandag se datum ..... 64 ☐☐☐☐☐

DANKIE VIR U SAMEWERKING

MOET ASSEBLIEF NIE DIE VOLGENDE AFDELING VOLTOOI NIE

71 Ht ☐☐☐ 74 Wt ☐☐☐ Kg x 10 77 Ex. test ☐

Initial PEFR .....

.....

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ 31 Rpt in PEFR ☐ HR/ min 32 ☐☐☐

6 Post-ex. PEFR

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ 35 DB ☐☐ 37 WB ☐☐

5 Initial FEV

.....

☐☐☐☐☐☐

39 Date D ☐☐ M ☐☐ Y ☐☐

1 Initial PEFR

.....

☐☐☐☐☐☐

57 Rpt. in FEV 1 ☐

☐