The prevalence of exercise-induced asthma among school children

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Abstract

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Exercise-induced asthma (EIA) is one of the major factors that affect optimal performance in sport. The prevalence of EIA is reported to be on the increase among school children worldwide. The aim of this study was to indicate EIA prevalence among primary-school children in South Africa. A field study determined the prevalence of EIA. A convenience sample of 127 children aged 8 to 16 years was selected. A health- screening questionnaire was used. The criteria for selection were that the subjects should be non- asthmatics and should not have any other illness during the screening that could interfere with the results. Peak expiratory flow rate (PEFR) was measured pre- and post-exercise using an ASSESS peak flow meter. The subjects did a six-minute run on a school playground. The post-exercise PEFR was measured within 10 minutes of exercise. The determinant of EIA was ≥ 10% decrease in PEFR after exercise. A total of 112 (88%) subjects participated in the study. Fifteen subjects were excluded (eight had asthma, five had respiratory tract infection and two had other illnesses). The average exercise heart rate was ± 80% of predicted maximal heart rate. The prevalence of EIA was 23% (n = 26). The incidence of a history of allergic rhinitis was statistically significantly increased among those with positive tests (p = 0.027). This study highlights the need to screen all children so that EIA can be determined and addressed appropriately.

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Introduction

Current data overwhelmingly document the existence of a worldwide asthma epidemic.[1] Exercise is one of the most common triggers of asthma symptoms. Exercise-induced asthma (EIA) is a phenomenon of transient airflow obstruction associated with physical exertion. The transient airflow obstruction is accompanied by coughing, wheezing and chest pain and chest tightness. It is more commonly found in children and young adults because of their greater participation in vigorous activities.[2] Bronchospasm typically arises within 10 to 15 minutes during exercise and takes an hour or longer to subside.[3]

Recent studies, of which a few have been conducted in South Africa, show an increase in the prevalence of EIA among children and young adults. A study done by Van Niekerk et al[4] in 1979 found a prevalence of 0.14% among rural and 3.17% among urban black children. In 1990, Vermeulen[5] found a prevalence of 14.2% among black children, suggesting an increase in prevalence. Also in 1990, Terblanche and Stewart[6] found a prevalence of 5.1% among white and coloured children. In 1998, Kirkby and Ker[7] found a prevalence of 21.7% among boys. Most of these studies were conducted in the Eastern Cape and Western Cape provinces.

The aim of the current study was to determine the prevalence of EIA among children in the North West province of South Africa. Children that exhibit EIA symptoms struggle during physical education, competition and playing, and are often left out during running games. These problems can lead to exercise-avoidance behaviour, which could have a detrimental effect on health.

There is evidence that physical activity results in some health benefits for children and adolescents. Regular physical activity improves aerobic endurance and muscular strength. Among healthy young people, physical activity and physical fitness may favourably affect risk factors for cardiovascular disease. Physical activity among adolescents is consistently related to higher levels of self-esteem and lower levels of anxiety, stress and high-risk health behaviour.[8]

Sport participation is developed at an early age through playing, and elite athletes are often identified at a young age, even in primary school. Screening for EIA in school children can facilitate early management of EIA and enhance enjoyment of sport participation, thereby promoting a healthy lifestyle.

Research setting

The study was conducted in a school in Ga-Rankuwa, an African township that is located about 30 kilometres from Pretoria, South Africa.

Materials and methods

A sample of convenience comprised of 127 children aged 8 to 16 years participated in the study, which was conducted on the school grounds of a peri-urban township. The ethics committees of Medunsa and the University of Pretoria approved the study. Parents gave their consent and children had to assent after the parents had consented.

A health-screening questionnaire was conducted to exclude children from the study who had previously been diagnosed with asthma. It also gathered information regarding the family history of asthma, history

of allergies and the type(s) of sports in which the child engages. The field study was conducted during the winter season between 09:00 and 11:00. The average temperature was 16 °C and the average relative humidity was 41% (according to the weather bureau in Pretoria).

A pre- and post-test experimental method was used. The first author researcher designed and used a data-collection form. The subjects did not engage in physical activity two hours prior to testing. The exclusion criteria were known and previously diagnosed asthma, respiratory tract infections, musculoskeletal symptoms or any other illness that could interfere with the study.

The baseline measurements of weight in kilograms, height in centimetres, peak expiratory flow rate (PEFR) and heart rate were recorded. A standardised free-running asthma screening test (FRAST) was used. The application of FRAST[9] involved the subjects running as quickly as they could for six minutes around a flat playground, then taking three PEFR measurements per participant. The ASSESS peak flow meter was used to take PEFR measurements. The post-exercise measurements were done within the first 10 minutes after conclusion of exercise.[6,7] Physiotherapy students who were trained and supervised by the first author recorded the baseline and post-exercise measurements. The highest of the three PEFR readings was used to indicate the subject's best performance. Children ran in groups of 10 and were observed and encouraged by the school teacher. The heart rate during running was monitored in alternate children using a Polar heart rate monitor.

The definition of EIA was ≥ 10% decrease in PEFR post-exercise.[7] The 10% cut-off point was selected as the outcome measure of EIA because any appreciable airway obstruction could be detrimental to exercise performance.[10]

The standardised formula used for a change in PEFR post-exercise[4,11] was:

$$\% \text{ fall in PEFR} = \frac{\text{highest baseline PEFR - highest exercise PEFR}}{\text{highest baseline PEFR}} \times \frac{100}{1}$$

Data was analysed using the Statistical Analysis Software (SAS) package version 6.12.

Results

A total of 112 subjects participated in the study. Fifteen subjects were excluded (eight were reported or confirmed asthmatics, five had respiratory tract infections and two had other illnesses). The ratio of male to female was 56:44.

The demographic data of the subjects are shown in Table I.

Table I: Demographic data of subjects (n = 112)

	Range	Mean	Standard deviation
Age in years	8–16	10.8	±1.58
Weight in kg	20–90	32.5	±9.5
Height in cm	124–163	141	±8.6

All boys participated in soccer. All girls but one participated in netball. Athletics (6%) was participated in the least. Twenty-six (23%) of the children were diagnosed as having EIA, as shown in Table II. Of these, 15 were boys and 11 were girls.

Table II: Results of exercise challenge test

Result	Number of subjects	Percentage
Positive	26	23%
Negative	86	77%
Total	112	100%

Of the various symptoms of EIA stated above, the most common was cough (51%) followed by wheeze (35%), chest pain (9%) and lastly chest tightness (5%). Eighteen (69%) had a positive history of EIA symptoms and 22 (85%) had a positive history of allergies. Out of 112 children, 24 (21.4%) had a positive history of allergic rhinitis. Seven per cent of children that tested positive in the exercise challenge had negative histories of EIA symptoms. The association between the type of sporting activity and the exercise challenge was not statistically significant. The incidence of a history of allergic rhinitis was statistically significant (0.027). There was a correlation between EIA and exercise challenge, as depicted in Table III below.

Table III: Correlation of history of allergic rhinitis with EIA symptoms and a positive exercise challenge

Allergic rhinitis	EIA symptoms	Exercise challenge
Positive n = 24	Positive n = 10	Positive n = 10
	Negative n = 14	Negative n = 14
	Total n = 24	Total n = 24

Of the 24 children that had a positive history of allergic rhinitis, 10 had a positive history of EIA symptoms (cough, wheezing, chest pain and chest tightness during or after exercise). These children tested positive in the exercise challenge test as well.

Discussion

The aim of this study was to determine the prevalence of EIA among school children. The results show a high prevalence of 23% among school children. This is similar to the prevalence found by Kirkby and Ker in 1998.[7] A history of allergic rhinitis was the only variable that had a significant statistical association with the positive challenge test ($p = 0.027$).

The findings of this study should be seen in the context of recent studies indicating an increase in the prevalence of EIA among South African children.[5,7] These findings correspond with those of studies conducted in the rest of the world that indicate an increase in the prevalence of EIA among children. Studies by Ng\ang\a et al[12] in Kenya, Sano[13] in Brazil, Sagher[14] in Libya and Zainudin et al[15] in Malaysia serve as examples. Many theories are presented to explain the increase of EIA among children but these theories are controversial and consensus has not been reached, highlighting the need for further elucidation of the actual cause of the increase in EIA prevalence.[16]

The presence or absence of symptoms of EIA does not indicate that the results of an exercise test would be positive or negative. This implies that all children need to be screened for EIA. Eight (7%) children tested positive in an exercise challenge but had a negative history of EIA symptoms. This finding is supported by previous studies that indicated that a history of EIA symptoms does not necessarily indicate a positive exercise challenge.[4]

The high incidence of a positive history of allergies could be attributed to the presence of industries in Ga-Rankuwa and the surrounding area, where the study was conducted and the children live. Working in some industrial areas and even in close proximity to them, with the resultant environmental pollution, has been linked to increased prevalence of a range of allergic reactions and respiratory difficulties.[17,18,19]

The percentage of children that participated in athletics was low. This could be explained by the fact that running requires a high oxygen demand that stimulates an increase in minute ventilation, the type of sport that most children presenting with respiratory difficulties tend to avoid. These children have therefore learnt by previous experience to avoid running, as it triggers respiratory difficulty.

Conclusion

In this study, a high prevalence of EIA among primary school children was documented in Ga-Rankuwa, an African township in the North West province of South Africa. The researchers have identified a need to conduct preseason exercise testing for school children. The findings have implications for sports coaches and athletic trainers at schools, who need to develop programmes for school children experiencing EIA, in order to identify them and thereby manage the phenomenon early and appropriately. This will enable children who have EIA to continue with sports despite the phenomenon.

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