

HOME CIRCUMSTANCES AND ASTHMA CONTROL IN JOHANNESBURG CHILDREN

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ABSTRACT

Background: The goal of asthma management is to attain optimal control of symptoms with minimal treatment-related side effects. Several factors contribute to poor asthma control: such as poor adherence to medications, or inappropriate inhaler technique, in addition to home circumstances that trigger asthma attacks.

Objective: To determine the level of asthma control and any home circumstances that may contribute toward poor asthma control in children seen at the Asthma and Allergy clinic at the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH).

Methods: A prospective cross sectional study was conducted in 115 asthmatic children, aged between 5 and 18 years, from July to October 2012. Children >12 years filled in the asthma control test, while those <12 years filled in the childhood asthma control test. A questionnaire on home circumstances was filled in by the parent or legal guardian or the patient. Adherence to medications was assessed and inhaler technique observed. All study participants underwent a full medical examination relevant to allergy and asthma, followed by the performance of a lung function test.

Results: A total of 115 patients were enrolled of which 59 (51.3%) patients were male. Ninety nine (86.1%) patients were black and 55.7% of the patients had controlled asthma (ACT or C-ACT > 19). None of the home circumstances were found to be associated with poor asthma control. Good adherence to medications was found to be associated with good asthma control; however good inhaler technique did not contribute to the overall level of control.

Conclusion: Taking the time to educate our asthma patients about the importance of **adherence** to medications is the most effective measure to achieve optimal asthma control. Home circumstances did not contribute to the overall level of asthma control.

INTRODUCTION

Asthma in children contributes significantly to school absenteeism, sleep disturbance, limitation in play activities and parental anxiety.¹ International guidelines for asthma management indicate that the primary goal of therapy should be optimum asthma control. Achieving asthma control implies the patient leads a normal and physically active life.

Classification of asthma control ranges from 'well controlled', in which the patient is totally unimpaired and unlimited, to

'extremely poorly controlled', which is a 'life-threatening' state.² Asthma control is a central focus of asthma care, in which clinicians are encouraged to concentrate on assessment of control, defined by symptoms, lung function and the presence or history of exacerbations.³ However, questions have been raised as to whether guideline-defined asthma control is achievable.

The Asthma Insights and Reality surveys of over 10,000 adults and children with asthma⁴ revealed a shortfall in the current level of asthma control worldwide, compared with

the guideline-defined goals of asthma care. Furthermore, the level of control achieved and the time taken to reach the relevant level also depends upon asthma measures being utilised with more time required to attain control using composite measures.⁵ Recent evidence suggests that asthma control is clearly achievable in most asthmatics.⁶ However, many surveys of asthma care suggest that only 5% of asthmatics are meeting the 'Goals of asthma management' as set out in Guidelines.⁷

It has been shown that many factors have been found to be associated with poor asthma control ranging from concomitant rhinitis (a common co-pathology and contributor to poor control)^{8,9} and co-morbidities,⁹ to poor adherence to medications or inappropriate inhaler technique,^{4,9} in addition to home or environmental factors.

Several factors around the home of asthmatic patients contribute to poor asthma control. These include the following:

- Parental smoking, or smoking by other relatives within the home;
- Biomass fuel exposure, especially cooking with open flames when the child is around the mother;
- Aeroallergen exposure;
- Parental/caregiver occupations or hobbies.

These factors all contribute to failure to achieve control despite adequate drug therapy.

Presence of infections may exacerbate asthma which may consequently give rise to poor asthma control.¹⁰ Viral respiratory infections represent the most common cause of asthma exacerbation and, hence, contribute to a loss of asthma control.¹¹

Several asthma control questionnaires have been developed. Some have been validated while others have not, and all have different ways of categorising levels of asthma control.

MATERIALS AND METHODS

This was a prospective cross sectional study conducted at the Paediatric Asthma and Allergy clinic at the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), Johannesburg, a tertiary care teaching and referral hospital in Gauteng, South Africa. It was carried out between July and October 2012 in 115 asthmatic children aged between 5 and 18 years. Ethical approval was approved by the Human Ethics Committee of the University of the Witwatersrand.

The study aimed to determine the level of asthma control and also to document the home circumstances that may contribute to poor asthma control in children attending the clinic. Children aged 7 years who gave assent and children 7 years whose parents or legal guardians gave consent, were enrolled. Children whose parents or legal guardian or themselves refused enrolment were excluded from the study. Newly-diagnosed asthmatic children were also excluded.

The Childhood Asthma Control Test (C-ACT), detailing asthma symptoms, was completed by the legal guardian and children less than 12 years. Children who were 12 years and older filled in the Asthma Control Test (ACT).

The sum of the scores of C-ACT were a total score 0-27, while that of ACT was 0-25.

- Scores of 25/27 - total/complete asthma control;
- > 19 - well controlled asthma;
- ≤ 19 indicated uncontrolled asthma;
- 16-19 - somewhat controlled asthma;
- < 16 - poorly controlled asthma.

For this study, scores of >19, using both questionnaires, were considered controlled asthma (merging well controlled and total control).

Another questionnaire relating to home circumstances was filled in by the legal guardian and by the patient. Factors such as the presence of a smoker at home, presence of pets, cockroaches and use of biomass fuel as well as about the child's sleeping environment (including carpet and soft toys in the bedroom) were asked.

Compliance with medications was assessed by asking each patient or legal guardian how many times he/she used the medications per day and comparing it with what had been prescribed by the doctor in the file.

Inhaler technique was also assessed by asking the patient to demonstrate how he/she used the inhaler. Patients who had a poor inhaler technique were corrected.

A full medical examination, relevant to allergy and asthma, was conducted on all study participants (i.e. general examination, skin, ear, nose and throat and respiratory). Specific features of atopy were looked for, such as the presence of allergic shiners, Dennie Morgans lines and swollen turbinates.

A lung function test was carried out on each patient using a spirometer manufactured by Erich Jaeger GmbH 97204, Hoechberg. 1992-2003.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

We enrolled 115 asthmatic children, comprising of 59 (51.3%) males and 56 (48.7%) females, giving a male to female ratio of 1.05:1.

There were 99 (86.1%) Blacks, 7 (6.1%) Coloured, 5 (4.3%) Whites and 4 (3.5%) Asians. The number of patients and the gender distribution in each race category is illustrated in Figure 1. The mean age $\pm$ SD of the study population was 11.69 ± 3.42 years; with a range of 5.10 years to 18.90 years.

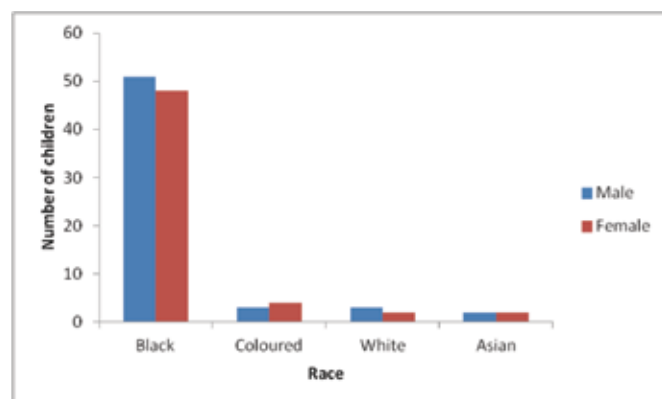


Figure 1. Number and gender of patients in each race category

ASTHMA CONTROL

Asthma control was determined using C-ACT in 59 patients (51.3%) and ACT in 56 (48.7%). Controlled asthma was seen in 64 (55.7%) children while 51 (44.3%) children had uncontrolled asthma. Of the patients with controlled asthma, 3 (2.6%) had total asthma control, while 61 (53.1%) had well-controlled asthma.

The mean $\pm$ SD of C-ACT was 19.86 ± 4.49 , with a minimum score of 9 and maximum of 26 while that of ACT was 19.00 ± 3.62 , with a minimum score of 11 and maximum of 25.

Nocturnal awakening was seen in a small percentage of asthmatic patients with controlled asthma as shown in Table I. This was significantly associated with asthma control ($\chi^2 = 36.689$, $p = 0.0001$). Presence of daytime symptoms was seen more frequently in patients with poor asthma control, as shown in Table I. Daytime asthma symptoms were also significantly associated with asthma control ($\chi^2 = 23.354$, $p = 0.0001$).

Levels of asthma control were similar in males and females as shown in Figure 2.

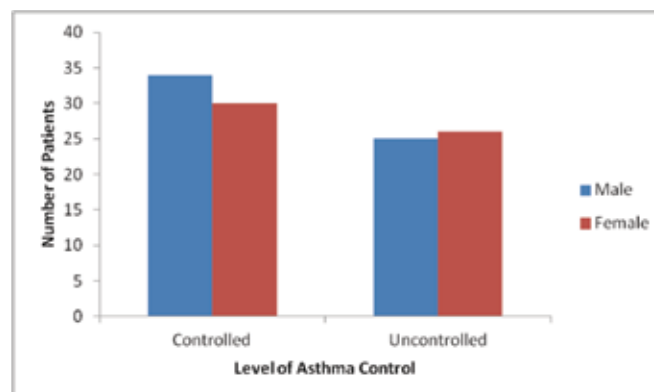


Figure 2. Asthma control and gender, $\chi^2 = 0.191$, $p = 0.662$

Most of the patients were black, of which 53 (46.1%) had well-controlled asthma and 3 had total asthma control. There was however, no statistically significant difference between asthma control and race ($\chi^2 = 3.22$, $p = 0.359$).

Twenty nine children aged 10-14 years had controlled asthma while only 12 children aged 15-18 years were controlled as shown in Figure 3. There was no significant difference between asthma control and age ($\chi^2 = 0.562$, $p = 0.755$).

Table I: Asthma control symptoms

Asthma control	Controlled Frequency (%)	Uncontrolled Frequency (%)	Total Frequency (%)
Nocturnal awakening	19 (30.1)	44 (69.9)	63 (100)
Day time symptoms	27 (38.0)	44 (62.0)	71 (100)

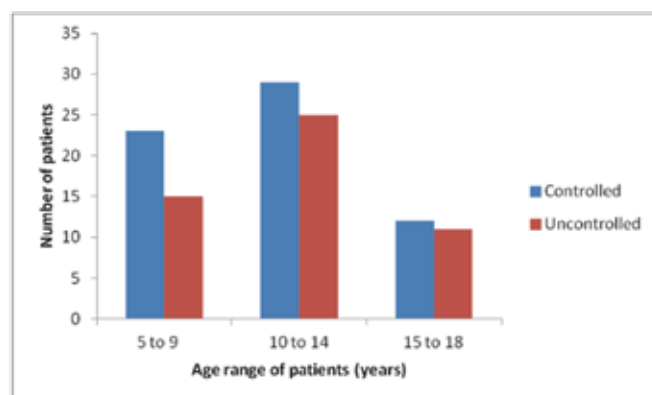


Figure 3. Asthma control in various age categories

HISTORY

Majority of the patients presented with history of coughing; and a family history of atopy in first degree relatives. They responded to bronchodilator therapy, as shown in the Table II. Good adherence to medications was seen in 82.6% of patients, while good inhaler technique was seen in 74.8% of patients.

Good inhaler technique was seen in 45 (52.3%) patients with controlled asthma and 41 (47.7%) patients with uncontrolled asthma. This was not statistically significant

($\chi^2 = 1.529$, $p = 0.216$). Good adherence to medications was seen in 59 (62.1%) patients with controlled asthma while, in those patients with uncontrolled asthma it was seen in 36 (37.9%) patients. Asthma control was significantly associated with adherence to medications ($\chi^2 = 0.217$, $p = 0.002$).

HOME CIRCUMSTANCES

Use of biomass fuel was uncommon as only five homes were found to be using wood and coal. Two homes used kerosene while no homes used animal dung. Of the 7 patients exposed to biomass fuel, 6 had controlled asthma. There was no association between the use of biomass fuel and asthma control ($\chi^2 = 6.202$, $p = 0.185$).

When home circumstances were compared with the level of asthma control, there was no significant association seen as shown in Table III.

CLINICAL FEATURES

Most of the patients that were enrolled were stable; hence few patients were seen with features of concurrent infection or acute asthma as shown in Table IV.

CLINICAL FEATURES OF ATOPY

Fifty four patients (55.7%) had multiple atopic features.

Table II: Questions on Asthma diagnosis and management

	Frequency (number)	Percentage (%)
Cough	114	99.1
Family history of atopy	112	97.4
Family history of asthma	51	44.3
Response to bronchodilator	114	99.1
Adherence to medications	95	82.6
Good inhaler technique	86	74.8

Table III: Association between home circumstances and asthma control

Home factor	Frequency	%	Controlled	Uncontrolled	χ^2	p
Dust	46	40.0	25	21	0.053	0.818
Cockroach	39	34.0	19	20	1.150	0.284
Carpet	38	33.0	17	21	2.740	0.098
Pets	26	22.6	15	11	0.057	0.812
Toys in bed	20	17.0	9	11	1.113	0.291
Smoking	13	11.3	6	7	0.536	0.464

Table IV: Examination findings

	Frequency (number)	Percentage (%)
Infection	8	7.0
Fever	1	0.9
Hyperinflation	27	23.5
Tachypnoea	7	6.1
Wheeze	12	10.4

Ninety nine patients had swollen turbinates (86.0%), 56 had allergic shiners (48.7%), 28 had Dennie Morgan's lines (24.3%) and 19 had eczema (16.5%).

SPIROMETRY

The mean $\pm$ SD PEFR for the study population was 87.03 ± 22.94 L/min and mean $\pm$ SD FEV₁ was 84.78 ± 16.48 , the FEV₁/FVC of the study population was 95.29 ± 16.21 .

a. Asthma control and FEV₁

The FEV₁ percentage of predicted cases was categorised as <60%, 60-80% and $\geq 80\%$. Fifty four (84.4%) patients had good asthma control with FEV₁ of $\geq 80\%$ while only 3 (4.7%) patients with good asthma control had FEV₁ of <60% as shown in Figure 4.

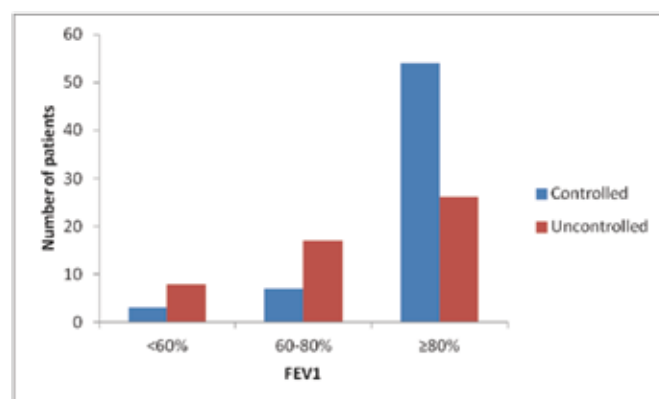


Figure 4. Level of asthma control and FEV₁

When asthma control was compared with FEV₁, there was a statistically significant difference as shown in Table V.

Normal FEV₁ which is $\geq 80\%$ of predicted was seen in 33.0% of patients with nocturnal symptoms and 38.3% of patients with day time asthma symptoms as shown in Table VI. (see next page). Both nocturnal and daytime asthma symptoms were significantly associated with FEV₁.

b. Comparison of controlled and uncontrolled asthmatics with FEV₁ and PEFR

There was a statistically significant difference when FEV₁ was compared between controlled and uncontrolled asthmatics, $t = 55.173$, $p = 0.0001$. Similarly this difference was seen when PEFR was compared between controlled and uncontrolled asthmatics, $t = 40.683$, $p = 0.0001$.

DISCUSSION

Asthma control is of critical importance and is now more important than the actual level of severity of asthma.

Previous reviews of surveys assessing asthma prevalence and control across the world have concluded that the majority of patients with asthma do not achieve adequate asthma control and underuse controller medication, but these studies have included a majority of adult subjects.^{9,13} South African studies that looked at asthma control showed that different measures to assess asthma control disagree with each other¹² and most patients assessed were found to have poor asthma control.^{7,12}

Table V: Comparison of asthma control with FEV₁

FEV ₁	< 60%		60-80%		$\geq 80\%$	
	t	p	t	p	t	p
CACT	4.70	0.018	14.98	0.0001	37.94	0.0001
ACT	15.47	0.0001	15.66	0.0001	31.81	0.0001

Table VI: Asthma control symptoms and FEV₁

FEV ₁ % predicted	≥ 80% Frequency (%)	< 80% Frequency (%)	Total Frequency (%)
Nocturnal awakening	38(33.1)	25(21.7)	63(54.8)
Day time symptoms	44(38.3)	27(23.5)	71(61.8)
Nocturnal awakening $\chi^2 = 5.628$, $p = 0.018$			
Day time symptoms $\chi^2 = 5.054$, $p = 0.025$			

Previous studies revealed a lack of agreement between C-ACT and specialist assessment of asthma control.¹⁴ A conflicting association has been observed between C-ACT and spirometry¹⁵ for the assessment of asthma control. This cross sectional study is the first in South Africa to assess asthma control in relation to home circumstances.

Although cross-sectional surveys only provide current level of asthma control which can vary over time, they are helpful in identifying several factors associated with poor asthma control in children.

The high prevalence of asthma in the world and the impact of morbidity warrant the need to ensure patients are well controlled. Home circumstances that constitute part of the environmental triggers of asthma need to be identified and intervention offered so that asthma control can be fully achieved, which is the goal of asthma therapy.

The Asthma Insight and Reality surveys found that the current level of asthma control in children was poor and falls far short of the goals set out in the GINA guidelines.⁹ Other recent surveys determining asthma control based on GINA guidelines have found high levels of inadequate asthma control in the United States,⁴ Canada,¹⁰ New Zealand,¹⁶ Hungary,¹⁷ and Switzerland.¹⁸

There were more males than females in this study. This conforms to the fact that asthma in childhood is more common in males.^{1,19} The male preponderance for asthma before adolescence appears to be a universal finding as similar observations were made by other workers.^{1,20} The reason for the male preponderance is not exactly clear, but may be partly due to the fact that males are more adventurous and more likely to come in contact with trigger factors.²¹ There was no association between gender and asthma control.

This study showed that the majority of the patients had good asthma control which is higher than the 50% obtained

in a South African study.²² It is also higher than that obtained by the New Zealand,¹⁶ Hunair,¹⁷ Switzerland¹⁸ and Japan²³ studies. This difference may be due to a difference in methodology. Previous studies used different instruments and definitions to determine poorly controlled asthma.

The mean ACT of 19 in patients with controlled asthma in this study seems very similar to 20.7 obtained by Greenblatt et al.,²⁴ but higher than 12.8 obtained in those with uncontrolled asthma. The higher rate of controlled asthma may be due to improved asthma management and care. Other reasons are good inhaler technique and adherence to medications. Patients seen in our hospital, which is a tertiary referral centre, are mostly those with moderate-to-severe persistent asthma that requires specialist care.

Blacks constituted the majority of study participants. This is due to the fact that they constitute 79.4% of the South African population.²⁵ They are also more likely to patronise the South African public hospitals, as fewer black families access private care. The lack of the significance of a link between asthma control and race may be attributable to the small number of patients in other races as compared to the Blacks.

Males were not better controlled than females. No significant association was seen between asthma control and gender, which is similar to what was obtained by Kuehni et al.²⁶ and in contrast to what was observed by Greenblatt et al.²⁴ where they found significant difference between the sexes. The lack of significance cannot be explained.

The majority of the patients had good adherence (82.6%) and good inhaler technique (74.8%). The reasons for the good adherence in our study may be due to the fact that patients are regularly taught how to use inhalers and adherence is assessed at each clinic visit. The rate of non-adherence in our study is lower than was reported by Kuehni et al.²⁶ where the rate of non-adherence was the same (28%) in children with well-controlled, and children with

poorly-controlled asthma. However, significant association was observed between adherence and asthma control, which was in contrast to that observed by Kuehni et al.²⁶ and Ho et al.²⁷ Other studies have reported poor adherence to asthma management guidelines, even for children who have been hospitalised for their asthma,^{27,28} which is probably an important factor influencing asthma control. Technical difficulties with inhalation therapy are also likely to be more common in younger children, although few problems were reported by parents in our study. We had children with uncontrolled asthma despite good adherence and good inhaler technique. This may be due to inadequate dosage of the controller medications. However, we always cross checked the prescribed dosage and what the child was actually inhaling during clinic visits.

Most of our study patients had swollen turbinates (86%) which suggests the presence of allergic rhinitis. This may be due to the fact that allergic rhinitis has been shown to co-exist with asthma in about 80% of patients.²⁹ Concomitant rhinitis has been found to contribute to poor asthma control.^{8,9,30} In this study, however, the majority of the patients had good asthma control, despite the presence of swollen turbinates.

The use of biomass fuel was not common in the present study, probably because Gauteng is a more developed province, where less than 1% of households use wood for cooking.³¹ No significance was observed between biomass fuel use and asthma control, which is similar to an observation by Azizi et al.³² but which contrasts with reports by Halterman et al.³³ The reason for this dissimilarity may be attributable to the number of respondents.

The presence of furry toys on beds (17.4%) and cats (0.8%) and dogs (19.1%) was found to be lower than that in other studies and not significantly associated with asthma control.^{33,26} Prevalence of cockroaches (33.9%) was higher than that found by Halterman et al.³³ and Finkelstein.³⁴ This may be responsible for the widespread cockroach allergy in South Africa.⁸ Presence of carpeting in homes of asthmatic patients was found to be lower than that reported by Finkelstein et al.³⁴ and similar to 33% obtained by Kuehni et al.²⁶ The reason for the dissimilarity may be due to the increase in the usage of floor tiles and removal of carpets in homes of asthmatics, as a form of allergen-avoidance in asthma management. However, despite the high prevalence of cockroaches and use of carpets, which harbour house dust mites in the homes of our patients, it was not found to affect asthma control, probably due to the fact that not

all patients are sensitised to cockroach or house dust mite allergen which can worsen asthma symptoms and lead to poor control. Exposure to smoking (11.3%) was similar to what was reported by Halterman et al.³⁵ However, smoking was not found to be associated with poor asthma control in this study which is in contrast to earlier studies.^{34,36} This may be due to the small number of patients that had smokers in their homes. Furthermore, none of these home circumstances were found to be significantly associated with asthma control, probably due to the relatively small size of respondents in our study compared to other studies.

Most of the children had experience with performance of lung function. The mean PEFR predicted value of 87.03% was similar to 84.1% obtained in the study done by Hammer et al.³⁵ FEV₁ was significantly associated with asthma control. This conforms to the recommendation by Global Initiative for Asthma (GINA) guidelines. Lower ACT and C-ACT was associated with a lower FEV₁ per cent predicted, which is similar to that obtained by Friedlander et al.¹⁵

In conclusion, this study demonstrates that 56% of the asthmatic patients attending the Paediatric asthma and allergy clinic at the Charlotte Maxeke Johannesburg Academic Hospital had well controlled asthma. However, no association was seen between home circumstances and asthma control. The use of biomass fuel at home was uncommon. Having a history of day time or nocturnal asthma symptoms was significantly associated with poor asthma control. Good adherence to medications was found to be associated with good asthma control, therefore taking the time to educate our asthma patients about the importance of adherence to medications is the most effective measure to achieve optimal asthma control.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

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