INCREASE IN CHILDHOOD ASTHMA ADMISSIONS IN AN URBANISING POPULATION

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Objective. In South Africa, rapid urbanisation has increased the risk of childhood asthma. This report reviews the pattern of asthma admissions to the Paediatric Department of Ga-Rankuwa Hospital, South Africa, from 1986 to 1996.

Design. Inpatient admission data were reviewed for 1986 - 1996. A detailed analysis of the records of asthma patients admitted between 1992 and 1996 was done. Outpatient data were reviewed from 1992.

Setting. Ga-Rankuwa Hospital, situated on the border of the Gauteng and North West provinces of South Africa and serving a large black population in various stages of urbanisation.

Main outcome measures. Trends in admission numbers and demographic characteristics.

Results. Asthma admissions were 2.5 times higher in 1996 than 1986. The greatest increase in admissions was in the 1 - 47-month age group. The male to female ratio was 1.5:1. More patients came from urban than from rural areas. Admissions peaked during the summer. Re-admissions occurred most frequently within 3 months of the first admission.

Conclusion. Paediatric asthma admissions have shown an increase in the past decade. This may be associated with changes in the environment of the community. There is a need for preventive programmes for asthma at community and national level.

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Asthma, the most common chronic childhood disease, not only causes childhood morbidity, but also affects children's lives and imposes high monetary and personnel costs on health care services. Despite treatment, childhood asthma prevalence and incidence are increasing in both industrialised[1-3] and less developed regions.[4,5] Reports of increases are based on the results of cross-sectional surveys in which parents are interviewed about the symptoms of asthma in their children.[4-6] Magnus and Jaakkola[7] suggest that these apparent increases are due to methodological and diagnostic differences rather than to changes in the incidence of childhood asthma. The study of hospital admission numbers over the years can provide more reliable data on the incidence of childhood asthma. To *et al.*[8] reported an increasing trend of childhood asthma admissions in Canada during the 1970s and 1980s, with a levelling off in the early 1990s. In England and Wales, the rate of emergency admissions for children with asthma doubled from 22.4/10 000 in 1977, to 43.9/10 000 in 1990.[3]

Studies in South Africa, where the black population is undergoing rapid urbanisation,[9] have reported similar prevalence rates to those in industrialised countries.[10,11] Cross-sectional studies have reported on the presenting and clinical features,[12-14] risk factors[15,16] and course[17] of childhood asthma. Cape Town has the only reported trend of asthma admissions over time.[18] These admissions rose sharply from 1978 to 1984, and levelled off in 1990.

Childhood asthma is the most frequent chronic reason for admission to the Medical Paediatric Department of Ga-Rankuwa Academic Hospital, and after gastro-enteritis and other respiratory tract diseases (RTDs), it is the third most frequent diagnosis. This hospital serves a black population and is attached to the Medical University of Southern Africa (MEDUNSA). During the last decade rapid urbanisation has taken place in the area around the hospital. Many risk factors associated with childhood asthma are present, such as increased smoking, pollution and poor living conditions.[19,20]

To establish the trend of asthma hospital admissions and re-admissions and outpatient clinic visits, the Department of Paediatrics and Child Health's admission data were analysed for the period 1986 - 1996.

METHODS

Diagnosis of asthma

A diagnosis of asthma among inpatients admitted to Ga-Rankuwa Hospital was made by the admitting doctor according to the presenting clinical picture, and was confirmed by the consultant on the post-intake ward round. Clinical criteria for the diagnosis included any combination of the following: a history of tightness of the chest; recurrent cough with or without wheezing, worsening at night or after exercise; a personal history of allergic rhinitis, conjunctivitis or atopic eczema in association with the above; a family history of allergy or asthma; wheezing on clinical examination; hyperinflation and decreased peak expiratory flow rate (PEFR). PEFR was not relied on as a diagnostic criterion for children

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younger than 24 months. A weakness of the study was that the diagnosis of asthma among inpatients was made by different paediatric consultants and therefore diagnostic criteria may not have been consistently applied. The final discharge diagnosis, however, was used to identify asthma patients. Thus, only patients confirmed as asthmatics during hospitalisation were included.

Patients with proven or suspected asthma were referred from the wards or from the paediatric outpatient clinic to the paediatric asthma outpatient clinic. Lung function tests were performed on children aged 5 years and older who were able to follow the instructions for forced expiration and inspiration. Asthma diagnosis was confirmed by full lung function tests obtained by standard spirometry indicative of obstructive airway disease, a favourable response to β2- bronchodilators, and raised immunoglobulin E (IgE) blood levels in the absence of parasites or other causes. Furthermore, all patients were assessed and classified as mild, moderate or severe asthmatics according to the criteria set by the 1991 and subsequently the 1994 Consensus Statements of the South African Childhood Asthma Working Group (SACAWG).[21,22] One paediatric consultant (JWO), with extensive experience in paediatric pulmonology, was responsible for the assessment and management of all patients attending the clinic during the period covered by this report.

Sources of data

Computerised demographic and clinical data of inpatient admissions were available for the periods 1986 - 1990 and 1992 - 1996, but not for 1991 owing to computer system failure. The demographic data consisted of each patient's name, birth date, age, gender and address. The clinical data were admission date, admission diagnosis, discharge date, patient outcome and discharge diagnoses, coded according to the *International Classification of Diseases* (*ICD-9*).[23] We made a detailed analysis of the 1992 - 1996 data and used the 1986 - 1990 data to examine changes in admission trends. The outpatient visit data were obtained from the asthma outpatient clinic record books dating back to 1991.

Inpatient identification

The data of all children aged between 1 month and 13 years admitted between 1992 and 1996 and discharged with a discharge diagnosis of asthma (*ICD-9* code 493[23]) were included. As some patient address information was incomplete, we analysed a random sample of 100 patients' data from each year to describe the areas of residence.

Upon first admission, the hospital assigned patients a unique number to be used on all subsequent occasions. To trace re-admissions, we searched hospital numbers with an *ICD-9*[23] discharge diagnosis code 493 on the database and verified the identified patients' demographic data and asthma discharge diagnosis.

Statistical analyses

Data were analysed as frequency distributions of the total sample and according to age, gender, area of residence and season of admission. Statistical significance of the differences between proportions of admissions among sub-groups was tested using the chi-square test. The re-admission data were analysed using programmes written using the FoxPro software.[24] Statistical analyses were done using the EpiInfo version 6 software.[25]

RESULTS

Admissions

Table I compares 1986 - 1996 asthma inpatient admissions with admissions for other RTDs and total admissions. In this decade asthma and RTD admissions rose (the latter by 100%), yet there was a 40% decrease in admissions to the paediatric wards. Compared with total admissions, the percentage of asthma admissions increased by 300% from 1.2% in 1986 to 5% in 1996. In 1996 asthma admissions (190) were 2.5 times higher than in 1986 (75). The greatest increase (56%) took place between 1986 and 1987. Asthma and other RTD admissions appeared to level off in 1995 and 1996. Bronchiolitis accounted for 7.5% of RTD admissions and showed no significant change during the study period. The mean duration of an asthma hospital stay was 3.03 (standard deviation (SD) = 0.96) days. The range was 0 - 55 days (91 patients were admitted and discharged within 24 hours). The number of outpatient visits doubled from 845 in 1991 to 1 686 in 1992, and then stabilised (2 180, 2 135 and 2 098 for 1994, 1995 and 1996 respectively).

Admissions for asthma are analysed in Table II by gender and age group (1 - 47 and 48 - 156 months). Admissions of children in the 1 - 47-month age group increased by 25% between 1992 (87) and 1996 (109). The older age group showed no change in admissions. Except for 1992 and 1993, significantly more children in the younger age group were admitted ($P = 0.02$, 0.00 and 0.01 for 1994, 1995 and 1996 respectively). The percentage of males admitted was higher than the percentage of females, except in 1993 (1 - 47-month group), 1992 and 1996 (48 - 156-month group). Overall, the ratio of males to females was 1.5:1.

The effects of rapid urbanisation can be seen in the increasing percentages of asthma admissions from the informal settlement areas (24% in 1996 compared with 15% in 1992), while the admissions from the rural areas remained constant (Table III). The percentage of admissions from the established urban areas was lower in 1996 (67%) than in 1992 (78%).

Table IV shows the seasonal variation in admissions. Almost half of the admissions occurred during the summer months, peaking in February, March and April. This finding was consistent over all the years analysed.

Table I. Total inpatient asthma and upper respiratory tract disease admissions to the Medical Paediatric Department 1986 - 1996, expressed as a percentage of total admissions

Year	Number of asthma admissions	Number of RTD* admissions	Total number of admissions	% asthma of total admissions	% RTD* of total admissions
1986	75	924	6 371	1.2	14.5
1987	117	1 204	6 229	1.9	19.3
1988	132	888	5 088	2.6	17.5
1989	158	895	5 573	2.8	16.0
1990	146	1 130	4 816	3.0	23.5
1992	171	919	4 957	3.4	18.5
1993	146	1 000	4 202	3.5	23.7
1994	170	1 104	4 045	4.1	27.3
1995	196	1 028	3 782	5.2	27.0
1996	190	894	3 800	5.0	23.5
Total	1 501	9 986	48 863	3.1	20.4

*RTDs include pneumonia, bronchiolitis, bronchitis, upper respiratory tract infections.
RTD = respiratory tract disease.

Table II. Age and gender distribution of inpatient asthma admissions (1992 - 1996)

	1 - 47 months of age						48 - 156 months of age						
	Males		Females		Total		Males		Females		Total		
Year	*N*	%	*N*	%	*N*	*P*-value*	*N*	%	*N*	%	*N*	*P*-value*	*P*-value†
1992	63	71	25	29	88	0.00‡	42	49	41	51	171	0.88	0.67
1993	33	54	38	46	71	0.40	57	76	18	24	146	0.00‡	0.64
1994	55	57	41	43	96	0.04‡	44	60	30	40	170	0.02‡	0.02‡
1995	85	67	42	33	127	0.00‡	43	63	26	37	196	0.004‡	0.00‡
1996	68	62	41	38	109	0.00‡	37	46	44	54	190	0.35	0.01‡
Total	304	62	187	38	491	0.00‡	223	58	159	42	873	0.00‡	0.00‡

* *P*-value for differences between proportions of males and females within the age group.
† *P*-value for differences between proportions of age groups.
‡ Difference statistically significant $P \leq 0.05$.

Table III. Area of residence of inpatient asthma admissions and total admissions (1992 - 1996)

	Rural		Informal settlement		Urban	
Year	Asthma (%)	Total admissions (%)	Asthma (%)	Total admissions (%)	Asthma (%)	Total admissions (%)
1992	7	28	15	21	78	52
1993	18	31	19	19	63	52
1994	10	30	22	28	68	40
1995	4	28	25	32	71	65
1996	8	25	24	25	67	50
Total	9.4	28.4	21	25	69.5	52

Regarding admissions, 48% occurred within 3 months of the first admission. Seventy per cent occurred within 6 months. Only 20% of patients were re-admitted more than 1 year after first admission.

DISCUSSION

Little has been published about the background and admission patterns of children with asthma in rapidly urbanising communities. Therefore, although we recognise shortcomings of a study using past patient records, such as inaccurate and missing data, we believe that this study gives important insight into both the factors contributing to and the trends of paediatric asthma admissions in developing countries. Since this was a hospital-based study, it did not set out to measure incidence or prevalence of paediatric asthma.

The study showed an increase in childhood asthma admissions over the 10 years between 1986 and 1996. Possibly,

Table IV. Seasonal variations in asthma admissions, 1992 - 1996

	January - April		May - August		September - December	
Year	*N*	%	*N*	%	*N*	%
1992	83	48.5	42	24.6	46	26.9
1993	65	44.5	44	30.1	37	25.3
1994	91	53.5	48	28.2	31	18.3
1995	88	44.8	65	33.2	43	21.9
1996	85	44.7	53	27.9	52	27.4
Total	412	47.3	252	28.9	206	23.6

the introduction of the computerised record system in 1986 improved data collection from 1987. This change also applied to total admissions so that the percentage of asthma admissions should not have been affected. The increase in asthma admissions despite a decline in the total admissions, suggests that the increased asthma admissions were real. Some studies have ascribed these increases to changes in diagnostic practices,[9,11,12] accompanied by a simultaneous decrease in the diagnosis of bronchitis and bronchiolitis. Particularly in children younger than 48 months, acute bronchiolitis may be misdiagnosed as asthma on admission. We used the final discharge diagnosis of asthma. Therefore, incorrect diagnoses made at admission would have been revised by time of discharge, excluding incorrect diagnoses. Since the number of other RTDs also increased during the study period, it does not seem as if these conditions were being mistakenly diagnosed as asthma. Although other respiratory disorders may be inappropriately diagnosed as asthma, there is the possibility that the presenting symptoms of a patient may not be recognised as asthma, and underdiagnosis may occur.[12] For example, in paediatric patients the absence of wheeze does not necessarily exclude the diagnosis of asthma, as described by Green and Luyt.[12]

In Cape Town, Ehrlich and Weinberg[18] found a levelling off in admissions from the mid 1980s to 1990. Similarly, Canadian research[8] showed rapid increases in the 1970s and 1980s, with a slowing down in the early 1990s. In comparison, we recorded the sharpest increases between 1986 and 1989, with steady increases up to 1995. The initial increase appeared approximately a decade later than in the other studies, possibly owing to the later urbanisation of our population.

The most significant admission increases involved male children younger than 4 years old. Other studies[6,8] have reported a higher incidence of asthma in males and young children. The male/female ratios (1.5:1) in our study were very similar to those of Baragwanath Hospital black patients (1.6:1)[13] and the Johannesburg white population (1.74:1).[12] These ratios are similar to those reported in developed countries.[11] In contrast, studies of other black African populations found no difference in gender prevalence or female predominance.[26]

The high proportion of admissions from the urban and informal settlement areas possibly reflects the increasing urbanisation of the population. The findings of studies in the South African Eastern Transvaal (Mpumalanga),[16] Eastern Cape and Cape Town[18] support this. Increasing urbanisation goes with industrial pollution, crowded living conditions, poor socio-economic status, high exposure to cooking fuels, and smoking within the home, all of which may serve as asthma triggers.[13,16,19,20] Not all studies have shown a significant difference in risk between urban and rural areas.[5] It is also impossible to determine whether the higher incidence of asthma in the urban areas is due to a real increase in asthma prevalence or to greater awareness and access to health care in urban areas.

Over the 5-year period the highest number of admissions for asthma consistently occurred in the summer months. This trend was in contrast to the pattern of asthma admissions reported from Cape Town, which peaked in early to mid-winter and spring.[14] Reports from Finland[27] and Ireland[28] have shown peaks in the spring (May) and autumn (August and September). Trends reported from England and Wales[29] show peaks in late summer to autumn, while in the USA, admissions peaked between autumn and early winter for the 5 - 34-year age group.[30]

Differences in admission patterns may be due to climatic variations. The influence of climate on asthma is, however, controversial.[31] In southern Africa, most cases are perennial in nature, with some seasonal peaks,[32] which seems to reflect the pattern of admissions to Ga-Rankuwa Hospital. Ga-Rankuwa and its peripheral regions are in the highveld of the country, where very high grass pollen counts are found throughout the year, with a fall-off in May, June and July,[32] which may in some part account for the drop-off of our admissions during this period. Although pollen exposure is an uncommon precipitant of asthma attacks in South Africa,[33] grass pollens have been found to be among the most common allergens related to childhood asthma in the Johannesburg-Soweto area,[12] which has a similar climate and vegetation to the Ga-Rankuwa area. In pollen-sensitive individuals exposure to pollen may increase the irritability of the airways to other triggers.[33] In contrast to the climate of the Ga-Rankuwa area, the Mediterranean-type climate in Cape Town may be more conducive to allergenic

fungal spores that show a slight increase in the autumn and winter months.[32]

Increased air pollution has also been thought to enhance sensitivity to allergens.[31] Although the areas surrounding Ga-Rankuwa Hospital are prone to severe smog, especially during the winter, this was not reflected by an increased admission rate. Unfortunately, no allergy tests were conducted on the patients during the period covered by this report. During the 3 - 4 years since the study, however, some patients have been tested for inhaled allergens by means of the Phadiatop test (Pharmacia Upjohn). These tests are not routine and are usually only given to atopic patients with asthma. The impression of the paediatric pulmonologist (JWO) is that the most common reactions were to house dust mite, grass pollen and mould, and that most patients reacted to all allergens. As individual sensitivity to the many climatic and environmental precipitating factors of asthma vary,[31] it is impossible to isolate any one factor to explain variations in admission rates during the year. Detailed epidemiological and environmental studies are necessary to unravel the complex of precipitating factors in any area.

The percentage of re-admissions dropped from 23% in 1992 to 10% in 1996. A separate study of patients attending the asthma outpatient clinic during 1996 reported that 16% of the patients had been admitted to hospital for acute asthma attacks more than once during the previous 12 months (unpublished data). Tracing re-admissions is difficult for several reasons. First, patients admitted for the first time may be referred from a peripheral hospital, and subsequent admissions may be to the peripheral hospital. Second, a patient may give a different name when re-admitted and therefore be treated as a new admission. Nevertheless, most patients appear to be re-admitted within 3 months of their first admission. Further investigation is needed to ascertain whether re-admissions were due to the severity of the illness or to inadequate management.

The present study did not attempt to describe the grade of severity of asthma patients seen in our Department, or to discuss the management and follow-up of asthma patients. Management at the asthma outpatient clinic follows the SACAWG guidelines.[21,22] A study (unpublished data) of patients who attended the paediatric asthma outpatient clinic during 1996, reported that according to the SACAWG criteria[21,22] 53%, 32% and 15% of patients were classified as severe, moderate and mild asthmatics respectively. Patients with severe persistent asthma are reviewed monthly, moderately severe asthmatics are reviewed every 2 - 3 months and mild asthmatics are given longer periods of up to 6 months for review. All patients may report to the hospital's casualty department or another doctor in the event of an acute asthma attack.

CONCLUSION

Drawing definite conclusions based on admission data of one hospital in the area is problematic. In addition, as already mentioned, the use of past patient records has limitations, including lack of consistency in the diagnosis of asthma, missing and inaccurate information in the patient records and lack of information on the management and progress of the patients. Our data, however, show that hospital admissions for asthma appear to have increased in parallel with rapid urbanisation.

This has implications for both community and hospital paediatrics. Very few, if any, programmes in the community address childhood asthma. Programmes are needed to inform communities and particularly those working with children, of the signs, management and prevention of asthma attacks. Support groups could help sufferers and their families to cope better with the condition, improve patient compliance and reduce re-admissions. Lay educators from the community could be trained to provide this type of service (similar to the service for malnutrition and gastro-enteritis).[34] At the clinical level, ways of improving the diagnosis and management of children with asthma need to be investigated.

This paper has examined only one aspect of the increasing trend of childhood asthma, that is, increasing hospital admissions. Nevertheless, it highlights the risk of asthma associated with rapid urbanisation and the need for action to be taken before this trend reaches even more serious proportions.

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