

# Socio-epidemiological Aspects of Respiratory Allergic Diseases in Southern Africa

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**Abstract:** The prevalence of respiratory allergic diseases has been increasing in Southern Africa both in urban and in rural environments. Various factors may contribute toward this situation, namely, exposure to aeroallergens, such as grass pollens and house dust mites. However, other irritant environmental triggers, such as exposure to tobacco smoke and certain indoor and outdoor fumes, may also play a relevant part. Furthermore, certain parasitic and mycobacterial infections may act as allergic disease risk modifiers, although such an influence should be confirmed. Finally, certain cultural and socioeconomic factors may also influence accessibility to healthcare and adherence to treatment of these diseases.

**Key Words:** asthma, rhinitis, prevalence, Southern Africa

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The United Nations region of Southern Africa comprises South Africa, Namibia, Botswana, Lesotho, and Swaziland. However, the broader geographic region of Southern Africa also includes countries such as Angola, Zambia, Malawi, Zimbabwe, and Mozambique. This region is known to be affected by poverty and malnutrition and plagued by acquired immunodeficiency syndrome and tuberculosis (TB). However, allergies are far more prevalent than TB or acquired immunodeficiency syndrome, affecting 25 to 30% of the population and result in significant morbidity, employment absenteeism, loss of quality of life, and in some instances, fatal outcomes. Allergies pose a huge cost to the health sector, affecting all ages, from the poorest to the richest, across the geographical spectrum of Southern Africa.

Southern Africa is home to the Khoisan tribes of Namibia and Botswana, numerous African Bantu tribes, whites, Indians, and immigrants from all over the world. Superimposed on the vast ethnic genetic and cultural diversity of its peoples is a wide variety of climatic conditions (or biomes), a rich diversity of flora and fauna, and the rapid migration and urbanization of its peoples. It is against the backdrop of this change from the old to the new lifestyle that

we have observed a dramatic increase in the prevalence of allergies in the region. Southern Africa may therefore be one of the most informative parts of the world to study the factors that have contributed to the increased expression of the allergic phenotype worldwide.

## PREVALENCE RATES OF RESPIRATORY ALLERGIC DISEASES

It is generally accepted that rural Africans who live in the grasslands or deserts of Southern Africa in traditional accommodation with traditional dietary practices rarely, if ever, suffer from allergic disease. Asthma, for example, is so rare among certain peoples of Southern Africa, that until recently there was no term to describe the condition in the local indigenous idiom. Diseases such as eczema, food allergy, and allergic rhinitis are still rare in rural Africans. They were not even mentioned in a health survey of the Bushmen in the Kalahari published in *The Lancet* in 1989 by O'Keefe and Lavender.<sup>1</sup> However, there is evidence that the prevalence of allergic diseases is increasing in Southern Africa.

### Asthma

One of the earliest asthma studies was a questionnaire-based study of the prevalence of asthma performed in 1975, in a small Rhodesian (currently, Zimbabwean) town, involving almost 10,000 subjects aged 5 years and older. The overall prevalence of asthma was 1.40%, ranging between 1.20% in those under 20 years of age and 1.57% in adults.<sup>2</sup> Similar results were obtained in another study that analyzed the prevalence of childhood asthma in Southern Africa, in 1977.<sup>3</sup> These studies suggested that the prevalence of asthma in an African urban environment was low.

About 20 years later, in 1995, a study carried out in Cape Town, South Africa, used a questionnaire focusing on wheeze and asthma, which was completed by parents of 1955 children, followed by 620 personal interviews repeating the questions.<sup>4</sup> The prevalence of recent wheeze (previous 12 months) was 26.8% and that of self-reported asthma was 10.8%. Similarly, high prevalence values for wheeze were also found in a study carried out in one of the most polluted areas of South Africa, in Durban, KwaZulu-Natal.<sup>5</sup> About 10% of the children and 12% of adults reported doctor-diagnosed asthma, although the self-reported prevalence rates were higher for wheezing (37–40%) and for attacks of shortness of breath with wheeze (16–28%). These findings suggest

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that the hygiene hypothesis protecting the development of atopic diseases, such as allergic asthma, was not readily applicable to Southern Africa where asthma is increasing even in the poor areas of low saturation and income.

In a study aiming to assess the 12-month prevalence of wheeze and severe wheeze along with their potential risk factors within a 60-km radius from the Polokwane city center, Limpopo Province in South Africa, the 12-month prevalence rates of wheeze and severe wheeze were 11.2 and 5.7%, respectively.<sup>6</sup> In Thokoza, Gauteng, a total of four hundred seventy-five 9- and 10-year-old children performed the free-running asthma screening test, and an overall prevalence rate of bronchial hyperreactivity (BHR) of 7.26% was detected.<sup>7</sup>

In Mozambique, the International Study of Asthma and Allergies in Childhood (ISAAC) study was carried out in 1614 adolescents aged 13 to 14 years in schools located in urban, suburban, and semirural areas of Maputo.<sup>8,9</sup> The prevalence of current asthma was shown to vary between 11.9% (based on video) and 13.3% (based on the written questionnaire).

An important South African study aimed to document the current prevalence of BHR by comparing traditional rural Xhosa children, recently urbanized Xhosa children, and established city white children and to consider factors that may account for the observed increase in all these groups.<sup>10</sup> The sample included 1457 schoolchildren aged 10 to 14 years from the rural Transkei, from a recently urbanized peri-urban area, and from urban Cape Town areas. Four hundred eighty of these children had histamine challenges, and 492 were skin prick tested for atopy. Bronchial histamine challenge showed that 17% of rural and 34.4% of recently urbanized Xhosa children had increased BHR, which is a marked increase from the 0.03 and 3.17% prevalence of increased BHR that had previously been found using the exercise challenge. The prevalence of increased BHR in white urban children was 33%.

Comparing data from Phase I or Phase II versus Phase III ISAAC study, allowing comparison of data between 1995 and 2002, focusing on self-reported symptoms in 13- to 14-year-old adolescents (5178 in 1995 and 5037 in 2002) in the Cape Town area,<sup>11</sup> found that the 12-month prevalence of wheezing (16 vs 20.3% for 1995 and 2002, respectively), exercise-induced wheeze (21.5 vs 32.5%), nocturnal cough (23.6 vs 36.6%), sleep disturbance due to wheeze (9.6 vs 16%), or severe wheeze (5.1 vs 7.8%) had increased significantly. A rise in asthma symptoms was confirmed by the video questionnaire responses, in which the 12-month prevalence of wheezing (6.5 vs 11.2%), exercise-induced wheeze (11.5 vs 13.9%), nocturnal wheeze (3.9 vs 5.3%), nocturnal cough (11.6 vs 19.2%), or severe wheeze (5 vs 7%) had also increased significantly. Overall, there is evidence to confirm that the prevalence of asthma and asthma-related phenotypes (eg, BHR; wheezing) has been increasing in Southern Africa, not only in rural but also in urban settings,<sup>12</sup> which also is not consistent with the hygiene hypothesis.

## Rhinitis

Fewer studies have analyzed the prevalence of allergic rhinitis in Southern Africa. The Mozambican ISAAC study that included 27 schools in urban, suburban, and semirural

areas around Maputo showed that the prevalence of rhinoconjunctivitis was 23% in teenagers and 8.8% in 6- to 7-year-old children. In symptomatic adolescents, 41.3% had rhinoconjunctivitis, whereas only 18.1% of children had this condition. Hay fever was commoner in the semi-urban area.<sup>9</sup> These values suggest that the prevalence of allergic rhinitis in Southern Africa is not much lower than that observed in industrialized countries, which is not expected from the hygiene hypothesis. The ISAAC Phase III versus Phase I comparison study, using surveys carried out 7 years apart in 13- to 14-year-old adolescents, in randomly selected schools in Cape Town showed that the 12-month prevalence of symptoms of allergic rhinitis (30.4 vs 38.5%) and rhinoconjunctivitis (17.6 vs 24.3%) had increased significantly between the 2 time points.<sup>11</sup>

## TRIGGERS AND RISK FACTORS FOR RESPIRATORY DISEASES

### Atopy and Sensitization to Aeroallergens

The main aeroallergens in Southern Africa are house dust mites (HDMs), cockroach, and pollens. Ordman<sup>13,14</sup> first showed that mite levels were consistently higher along humid coastal areas and usually lower in areas of high altitude, in South Africa. Further studies including Soweto, Johannesburg,<sup>15</sup> Durban,<sup>16</sup> and Cape Town<sup>17,18</sup> confirmed the presence of high levels of HDMs in coastal and inland cities. In Cape Town, in vivo skin tests in 209 children with known allergic disease were positive to *Dermatophagoides pteronyssinus* (*Der p*) in 73% of cases.

The levels of the HDM allergen *Der p* 1 were studied over a 4-season period during 1994 to 1995 by sampling mattresses and carpets in the main bedrooms of 30 randomly selected suburban homes and analyzing the levels of mite aeroallergens in the Edenvale area in South Africa.<sup>19</sup> All homes tested positive for *Der p* 1. Similar results were obtained in Zimbabwe, showing that IgE-mediated allergies were common in Zimbabwe and that HDM and grass pollens represented the most prevalent allergen sources.<sup>20</sup> In South Africa, dust mites have been found in both humid areas and in areas of low humidity, such as Johannesburg.<sup>21</sup>

Both HDM and cockroach were shown to be the main sensitizers in asthmatic patients living in the coastal town of Durban, South Africa.<sup>22</sup> Similar results in terms of HDM sensitization were found in asthmatic children in the Cape Peninsula,<sup>23</sup> in Zambia,<sup>24</sup> and in Zimbabwe.<sup>25</sup>

In a prospective analysis of 455 black asthmatic children (277 boys) attending the Johannesburg-based Baragwanath Hospital asthma clinic,<sup>26</sup> associated atopic conditions were present in 75.5% of patients and a family background in 22.2%. Other respiratory diagnoses were commonly made, particularly TB, which was diagnosed in 7.4%. Importantly, the commonest allergens were HDM and grass pollens. A study carried out in the Free State, South Africa, in 50 consecutive patients with allergic rhinitis attending the ear, nose, and throat clinic at Universitas Hospital showed that 46% were sensitized to mites and cockroaches.<sup>27</sup>

Pollen allergy was first documented in Southern Africa by Potts between 1919 and 1921.<sup>28-30</sup> Ordman, for example,

studied the distribution of aeroallergens in various areas of Southern Africa and concluded that grass pollens and the fungus *Cladosporium* were the most frequent inhalants in former Southern Rhodesia (now Zimbabwe), the Cape Province, Namibia, and Natal (now Kwazulu-Natal).<sup>31–36</sup> Allergic rhinitis is predominantly caused by grass pollens, namely, Pooideae and Chloridoideae, Bermuda grass (*Cynodon dactylon*).<sup>37,38</sup> More than 95% of grass-allergic individuals in Gauteng and 80% of grass allergic subjects in the Cape Province have IgE antibodies to Bermuda grass.<sup>39</sup> In addition, southern African grass pollens, kikuyu grass (*Pennisetum clandestinum*),<sup>40</sup> buffalo grass (*Stenotaphrum secundatum*), and Boer love grass (*Eragrostis curvula*),<sup>41</sup> have also been identified as highly allergenic grass pollens in South Africa.<sup>42,43</sup>

An important clinical feature of grass allergy in Southern Africa is that grass pollen allergic symptoms occur up to 10 months per year, due to a long pollination season. Grass pollens are important in Zimbabwe.<sup>20</sup>

Of the tree allergens, the predominant trees inducing allergy in Southern Africa are oak (*Quercus*) and plane (*Platanus acerifolia*) trees. The *Acacia* genus, including the “doringboom” tree, seems to be weakly allergenic. Whereas the prosopis tree (mesquite) found in Namibia is highly allergenic (Christo Buys, personal communication).

### Risk Factors

Most studies addressing the issues of risk factors in respiratory allergic diseases in Southern Africa have focused on bronchial asthma. In a study based on a random sample of 742 students aged 13 to 14 years attending various schools at Polokwane, in the Province of Limpopo, South Africa, persistent cough [odds ratio (OR) = 4.01], exposure to smoke at the household level (OR = 2.39), and lack of access to flush toilet at the household level (OR = 1.89) were key predictors of asthma in children.<sup>5</sup> In another comparative study<sup>10</sup> of adolescents included 1457 students aged 10 to 14 years from the rural Transkei, from a recently urbanized peri-urban area, and from urban Cape Town areas, passive cigarette smoking was not identified as a risk factor for increased BHR or atopy. Wood smoke in the indoor environment did not play a role in the rural Xhosa children’s BHR. Finally, *Ascaris* infection did not seem to play any modifying role in the development of increased BHR in the rural or urban children.<sup>3</sup>

A cross-sectional survey of 213 households in the communities of Merewent (97% Indians) and Austerville (98% coloreds), in Durban, South Africa, showed that the factors in the community that were associated with asthma, wheeze, and shortness of breath with wheeze among the adult population included cigarette smoking, use of insecticides (coils and pump spray), and home ownership. In contrast, an association between asthma among children and household risk factors, such as dampness, carpet, pets, or use of pesticides, was not apparent in the community.<sup>44</sup> Thus, there are differences in the findings of different studies relating to risk factors.

Environmental tobacco smoke exposure is also associated with decreased BHR in children.<sup>45</sup> This study involved

249 asthmatic children aged 7 to 11 years identified in a community survey in Cape Town. Children with asthma whose mothers smoked had a lower frequency of BHR than asthmatic children of nonsmoking mothers. BHR was also less common among children sharing a house with 4 or more smokers versus fewer or none. In contrast, FEV1 was lower among children whose mothers currently smoked.

In a questionnaire completed by parents of 1955 children aged 7 to 9 years, from which 368 cases and 294 controls were selected on the basis of reported asthma diagnosis or symptoms,<sup>46</sup> an exposure–response relationship between the urinary cotinine to creatinine ratio and asthma/wheeze was observed, confirming that household smoking is an important risk factor in asthma/wheeze among young schoolchildren. In addition, this study also suggested that maternal smoking in pregnancy and current household exposure may be independent contributors to this effect. The study in Polokwane<sup>6</sup> showed that exposure to environmental tobacco smoke at home increased the likelihood of wheeze by 77%.

In adolescents and adults and from a stratified national sample of households,<sup>47</sup> of a total of 5671 men and 8155 women, smoking was associated with wheeze but not with asthma diagnosis. In Thokoza (Gauteng), the use of gas and electricity as domestic fuels was the strongest risk factor associated with exercise-induced bronchospasm.<sup>7</sup>

A case–control study focused on anthropometric measurements, asthma, and atopy in 773 Xhosa children with exercise-induced bronchoconstriction (EIB).<sup>48</sup> The authors measured specific IgE to 5 common aeroallergens, performed skin prick tests (11 aeroallergens), and determined body mass index measured as a standard deviation score (BMISDS). Results showed that increasing BMISDS was associated with an increased risk of EIB after controlling for atopy and income (OR = 1.74). In addition, an increasing BMISDS was also associated with increasing IgE and corresponding positive skin tests ( $P = 0.0001$ ; OR = 37.9). Thus, this study suggested that in Southern African children, fatness also increases the risk of EIB. A relationship between obesity and wheeze may also be observed in young women.<sup>47</sup>

Studies have also been conducted on the possible protection of breastfeeding on the development of allergic diseases in the region.<sup>49</sup> Data were collected from a 15% random sample of households from 2 poor suburbs of Cape Town, in which parents completed a validated ISAAC questionnaire on allergic diseases for children aged 6 to 14 years. Other questions included breastfeeding duration, maternal smoking, and parental allergy. Results were adjusted for possible confounders and for possible clustering within the household. Of the 861 children included in the study, allergic diseases, in general, and hay fever, in particular, were significantly less frequent in those with prolonged ( $\geq 6$  months) breastfeeding. There was a significant linear inverse association between prolonged breastfeeding duration and allergic disease in children without allergic parents but not in children with an allergy in the family.

## MODIFIERS OF EXPRESSION OF ALLERGIC DISEASES IN SOUTHERN AFRICA

The most important modifiers of disease expression in Southern Africa may include helminthic, mycobacterial, and viral infections.

### Parasitic Infection

Infection with certain parasites (eg, schistosomiasis and *Ascaris* roundworm infestation) is extremely common in Southern Africa, where it is endemic in certain areas. Parasites stimulate IgE production and may interfere with mechanisms of allergen-specific IgE production or end organ sensitivity to allergens.

Recent investigations showed that infection with *Ascaris* may occur concurrently with allergy in adolescents.<sup>50</sup> Total IgE levels were markedly skewed toward the left and were not distributed in a Gaussian or a log-normal distribution in black Xhosa high school children in Cape Town. Skin prick tests were positive for aeroallergens in 32.3% of subjects and 34% of the individuals had elevated *Ascaris*-specific IgE levels. As expected, total serum IgE levels were higher in atopic than in nonatopic subjects and correlated with the number of positive skin prick tests, self-reported asthma, and bronchial hyperresponsiveness. In addition, total serum IgE levels correlated with the levels of *Ascaris*-specific IgE.

A previous study in which 17% of the nonallergic controls and 51% of the allergic asthmatics had a clinically detectable immunogenic response to the parasite, the inhalation of *Ascaris* antigen induced asthmatic reactions in 7 of 8 patients who had positive skin prick tests to *Ascaris* but not in the negative controls.<sup>51</sup> Thus, this study suggested that infection with *Ascaris* may indeed be associated with IgE-mediated asthma-like reactions. *Ascaris*-specific IgE responses may be a risk factor for atopic disease in children exposed to mild *Ascaris* infection.<sup>52</sup> This study included 359 randomly selected children aged 6 to 14 years from a poor urban suburb. *Ascaris*-specific IgE levels were elevated in 48% of children, and *Ascaris* eggs were found in 15%. Children with elevated *Ascaris*-specific IgE levels had significantly increased risk of positive SPT to aeroallergens, particularly HDM, atopic asthma (ever and recent), atopic rhinitis (ever and recent), and increased atopy-related bronchial hyperresponsiveness.

Curiously, in a cross-sectional prevalence study, with a nested case-control component, carried out in urban and rural South African children, *Ascaris* infection was associated with an increased risk of EIB (OR = 1.62; 95% confidence interval, 1.23–2.11;  $P = 0.001$ ), independently of total and specific IgE levels, suggesting that mechanisms other than those that are mediated by IgE may be operative in the affected patients.<sup>53</sup>

In contrast, the study carried out in South African 10- to 14-year-old children from Transkei, from different ethnical and sociological backgrounds (traditional rural Xhosa children, recently urbanized Xhosa children and established city white children), failed to show any modifying role of *Ascaris* infection in the development of increased BHR in the rural or urban children.<sup>9</sup>

A previous study from the Western Cape, South Africa, showed that Cape Coloureds and Africans tended to have elevated serum IgE concentrations; however, Cape Coloureds and Africans had high prevalence values of helminthic infestation and a relatively low prevalence of allergic symptoms.

Finally, serum IgE levels were examined in 237 infants aged 2 weeks to 12 months in a remote rural area of Namibia.<sup>55</sup> Median values were higher than those reported from Western countries. Investigations did not suggest that parasitic infestations or atopy were of significant importance for the determination of total serum IgE levels.

### Mycobacterial and Viral Infections

In the study involving a stratified national probability sample of households involving adolescents (>14 years) and adults (5671 men and 8155 women), a history of TB was an independent predictor of both recent wheeze and asthma diagnosis.<sup>47</sup> This study therefore suggested that, in this population, previous TB may predispose to wheeze or asthma. However, it was stressed that heterogeneity of the categories wheeze and asthma diagnosis, which may overlap with post-tuberculous airways obstruction, may have been confounding factors.

The study by Obihara et al<sup>52</sup> showed that in children with negative tuberculin test (<10 mm), elevated *Ascaris*-specific IgE levels were associated with a significantly increased risk of atopic symptoms, whereas in those with a positive tuberculin test ( $\geq 10$  mm) this association was not present. This suggests that infection with mycobacteria may be protective against the *Ascaris*-associated increased risk of atopic allergic disease. Whether a similarly protective effect of mycobacterial infection upon development of atopic symptoms in children not infected with *Ascaris* also takes place, still has to be ascertained.

Human immunodeficiency virus (HIV) infection has very high prevalence values in Southern African countries. Although it is controversial, chronic HIV infection may affect some of the immunological mechanisms related to allergic inflammation, namely, IgE production and other mechanisms. A recent study included 50 HIV-infected children, aged 3 months to 12 years, all of whom were on antiretroviral therapy and 50 HIV-negative healthy controls.<sup>56</sup> The authors failed to find a difference in the frequency of atopy between the groups but the prevalence of asthma was higher than historical data from South African ISAAC studies. It was concluded that there was no association between HIV disease stage and presence of atopy and that bronchial asthma in these children was nonallergic.

### Sociocultural Factors

Until fairly recently, children in many African countries lived mainly in rural areas and were not exposed to the effects of a Western lifestyle. Early studies in a limited number of African countries, including South Africa, showed a very low rural prevalence of childhood asthma, especially where children lived according to a traditional lifestyle. These studies also showed that asthma was not uncommon in urbanized

African children. There has been a massive migration over the past 20 years from those in rural communities to the large peri-urban squatter areas. The prevalence of current asthma has been on the increase not only in peri-urban and urban but also even in rural areas. This may be due, at least in part, to exposure of rural children to agricultural pesticides and irritants as well as of an increasing tendency to adopt a more Westernized lifestyle, such as the use of beds with mattresses, pillows, and blankets even in the rural areas.<sup>57</sup>

The first study to address urban–rural differences in the prevalence of allergic diseases was an epidemiological study undertaken in 1979 to determine the prevalence of asthma in young urban and rural black (Xhosa) children.<sup>58</sup> One thousand three hundred seventy-five children were studied, 694 from a Cape Town African township and 671 from a rural area in Transkei. Whereas 22 children were found to be asthmatic in the city area, only 1 from the country was diagnosed as asthmatic, giving a prevalence figure for asthma of 3.17% in the urban group and 0.14% for the rural group.

Twenty years later, the study carried out by Steinman et al,<sup>10</sup> of BHR and atopy in Xhosa and white children cross a gradient of environments from rural, peri-urban, to urban environments found an increase in BHR and specific IgE responsiveness when rural children adopted a more Western life style that was similar to the prevalence found in children who were born in a Cape Town suburb.

In Mozambique, using the ISAAC protocol applied to 2630 students aged 13 to 14 years, and in 2383 school-children aged 6 to 7 years, exercise-induced wheeze, nocturnal cough, and ever asthma were reported more frequently in children of the suburban area than in the urban or semirural environments.<sup>9</sup> However, another study by the same group, carried out in Maputo and involving 100 asthmatic children and 99 nonasthmatic children aged between 18 months and 8 years (mean age of around 3 years for both groups), showed that having been born or living in inner Maputo were independent and significant risk factors for bronchial asthma.<sup>59</sup> Curiously, another South African study suggested that urban–rural differences in the prevalence of atopy may be partly due to differences in dietary components in the 2 areas.<sup>60</sup>

In general, the least socioeconomically deprived pupils report a higher prevalence of asthma symptoms "ever" and "in the last 12 months."<sup>60</sup> In contrast, the most socioeconomically deprived pupils reported higher occurrence of asthma symptoms monthly or more frequently in the previous 12 months. In addition, a subgroup of pupils from low-income areas commuting to better-off schools showed the highest symptom prevalence. This study therefore suggests that an increase in the incidence of asthma in this population may be driven by factors associated with improved social circumstances, whereas severity is determined by factors associated with poverty.<sup>60</sup>

Education problems are a special type of socioeconomic issues. Education levels in African populations tend to be low, which may lead to poor patient adherence to treatment based upon wrong perceptions of allergic disease. It is extremely to overcome language and cultural difficulties. In this regard, a South African study carried out in 1955 parents of pupils from 16 schools in Cape Town showed that current

treatment and, to a lesser degree, recognition of asthma by parents were more common among children of higher socioeconomic status.<sup>61</sup> Another study, performed at clinics, hospitals, or respondents' homes in a rural setting, showed that fear and ignorance surrounding asthma were common, strengthening the need for a greater level of patient education in the rural areas.<sup>62</sup>

In the study from Maputo (Mozambique), knowledge about asthma was poor<sup>63</sup>: 11% of the adults thought that asthma was contagious and transmitted from person to person, and 4% thought that it was transmitted by contaminated food. A large proportion of the parents thought that asthma could be cured by medical treatment in 7% of cases and by alternative treatment in 43% of cases. The precipitating factors were well identified by the adults, but they had an inaccurate perception of the symptoms of an asthma attack. Finally, the actions of the various classes of drugs used were poorly understood.

A study aimed to obtain information useful to asthma care in a relatively poor, high asthma prevalence population involved 72 parents of children with asthma or recurrent wheezing.<sup>64</sup> There was a reasonable level of understanding of the causes of asthma, although variable acceptance of the diagnosis. Willingness to undertake home management of acute episodes and environmental control measures was high. However, reported treatment was characterized by reliance on syrups, use of home remedies, resistance to inhaled therapy, and relatively low compliance with prescribed treatment. Thus, this study showed that there is an urgent need to improve the quality of asthma care communication and general knowledge of the situation in patients and relatives.<sup>65</sup> In fact, these factors strongly affect implementation of therapy and adherence to prescribed asthma treatments. This was further explored in a study that aimed to analyze the impact on quality of life of asthma on South African asthmatics.<sup>64</sup> Symptom analysis of asthmatic patients showed that 21.4% of respondents were coughing on most days, 25.6% were wheezing on most days, and 22.8% were experiencing nighttime symptoms on most days. Symptoms were exacerbated by exercise in 56.9%, whereas nocturnal waking due to asthma occurred in 36.9% more than 4 times per week. Only 35.1% of respondents had not missed school or work in the preceding year. In the study by Ehrlich et al<sup>4</sup> in 1995, of children with more than 12 recent attacks of wheeze, only 60% were reported as asthmatic and only 55% were receiving regular treatment, confirming that underdiagnosis and undertreatment of asthma were still important problems in the region. The extent and progress with this problem can be further gauged from a retrospective study that aimed to investigate the incidence of fatal and near-fatal asthma between 1980 and 1997 in Cape Town.<sup>66</sup> There were 1506 reported deaths (mean age, 56 years) from asthma, 39 and 3% occurred in people younger than 55 and 15 years, respectively. The average annual asthma mortality rate ( $8.1 \pm 1.9$  per 100,000 population) was highest among people of mixed race ( $10.1 \pm 2.0$ ), followed by blacks ( $6.8 \pm 3.1$ ) and whites ( $5.0 \pm 1.9$ ,  $P < 0.001$ ). Asthma mortality declined by 0.28 deaths per 100,000 population per year; rates decreased in all ethnic groups. Most deaths (72.3%) were outside a health facility,

and a significantly higher number of deaths occurred on weekends. Pediatric asthma intensive care unit admissions also declined by 1.81 children per year, but the annual number of adults admitted to intensive care unit for asthma did not change. These results indicate that the incidence of fatal and near-fatal asthma in this area has declined over the period, and this may reflect generally improved asthma management. However, the relatively high asthma mortality rate in people of mixed race and the predominance of deaths outside health facilities and on weekends suggest problems with access to care.

Fewer studies have addressed the issue of patient adherence to treatment for allergic rhinitis. This was one of the objectives of a questionnaire-based study about allergic rhinitis that was applied to 1181 patients in South Africa.<sup>67</sup> This study showed that nasal symptoms affected sleep in 76.6% of sufferers, and in at least a third, this was every night. The quality of life was poor in 85.2% of patients, due to uncontrolled symptoms. About 37% of patients did not take rhinitis medication or did not take it as frequently as recommended, and various perceived concerns regarding having and being treated for allergic rhinitis were identified, suggesting multiple reasons for nonadherence.

### Racial Differences

One of the earliest reports on childhood asthma in Southern Africa was published in 1969 and analyzed asthma hospital admissions of black, Indian, and white children in Durban, South Africa, during a 5-year period (1963–1967).<sup>68</sup> There were only 9 admissions for asthma among black children (admission rate of 0.02 percent of all hospitalizations), which was much lower than that of white children (0.79 percent) during the same period, suggesting that there could be race-linked socioeconomic and cultural differences associated with asthma admissions to hospital.

In Cape Town, South Africa, the prevalence of EIB was compared between 698 white and 494 colored schoolchildren.<sup>69</sup> The prevalence of EIB was significantly higher among white (5.87%) than colored children (4.05%).

More respiratory tract infections occur in colored patients, and they are more exposed to their own and secondary cigarette smoke.<sup>70</sup> Curiously, sensitization to pets and grass pollens was more common among whites, whereas allergy to *Aspergillus fumigatus* and *Ascaris lumbricoides* was found more frequently among colored patients. Although both white and colored patients had problems with regular prophylactic control of their symptoms with inhaled beta<sub>2</sub>-agonists, this was greater in the colored group (60%) than the white group (27%).

In a prospective study, a questionnaire was applied to white asthmatic children in Johannesburg to compare these with a similar population of black asthmatic children resident in Soweto, from whom data had been previously obtained.<sup>71</sup> Although there were many common clinical points, some differences were apparent. For instance, cold weather was a much more frequent trigger of cough and wheeze in Soweto than in Johannesburg (64.6 vs 10.5%). In addition, environmental dust was described as trigger of symptoms a lot more

frequently in Soweto than in Johannesburg (38.6% of children vs 13.1%). In addition, although fungal extracts tested were different, mould sensitivity was less common in black children from Soweto than in white children from Johannesburg. Although genetic factors may have explained part of the results, the poorer living conditions in Soweto may explain the differences observed. In a study carried out in 1991, in Zimbabwe, children of different race but with similar socioeconomic background demonstrated that the prevalence of bronchial hyperresponsiveness was similar between black and white children of a similar social status.<sup>72</sup>

A very important study aimed to determine whether death rates from asthma have been rising in South Africa calculated asthma mortality rates among colored and white South Africans from official figures for the years 1962 to 1988.<sup>73</sup> Sharp increases in the 1960s were noted in both groups. However, since the early 1970s, death rates in whites have generally shown a downward trend. In contrast, rates in colored patients remained generally high and were consistently higher than those in white patients across different age ranges. Again, the intergroup differences detected seem to be due to greater exposure to environmental triggers or to well-known inequalities in medical care between white and colored patients rather than to genetic differences between these 2 racial groups.

Although socioeconomic, cultural, and health facility accessibility differences may explain most of the interracial differences observed by some studies in some features of expression of respiratory allergic disease, a genetic basis may not be fully excluded. In this regard, a curious study used an amplification refractory mutation system–polymerase chain reaction to analyze the prevalence of 3 mutations in the beta chain of the high-affinity IgE receptor (F $\epsilon$ epsilon RI-beta): I181L, V183L, and E237G in a sample of black and white asthmatic and control subjects in South Africa.<sup>74</sup> One of the main objectives was to determine whether the discrepancy in the prevalence of atopy in these groups could be attributed to these variants. A significant difference in the frequency of I181L between white asthmatics (28%) and white control subjects (3%) was detected, and also between black control subjects (16%) and white control subjects. Furthermore, there was a significant difference in the frequency of E237G between black asthmatics (20%) and white asthmatics (12%), and also between control subjects (20%) and white control subjects (5%). E237G was significantly more prevalent in blacks (20%) than in whites (8.5%). This study concluded that I181L might predispose to atopy in the white population but not in the black population. In addition, the significantly higher prevalence of E237G in blacks than in whites might explain why blacks tend to have more severe asthma than whites.

This review has shown that systematic studies of allergies and asthma have confirmed that the prevalence of respiratory allergic diseases has been increasing in Southern Africa both in urban and in rural environments. Various factors may contribute toward this situation, in particular, recent changes in exposure to certain aeroallergens or other irritant environmental triggers due to migration and adoption of a Western life style. Certain cultural and socioeconomic

factors may also influence accessibility to healthcare and adherence to treatment of these diseases. Furthermore, importance of communication with patients with allergic diseases in their own indigenous African language has recently been studied and emphasized by Levin<sup>75,76</sup> and must be taken into consideration both in assessing the prevalence of disease in the region and in formulation of treatment plans in the future.

Thus, studies from Southern Africa in the context of westernization, parasite infestation and TB have provided new insights into many of the factors believed to influence the expression of allergic diseases, such as asthma and rhinitis, some of which are not consistent with the hygiene hypothesis, which more fully explains the development of allergens in more affluent countries.

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