Sensitization rate and clinical profile of Congolese patients with rhinitis

Tshipukane Dieudonné Nyembue, M.D.,1,2,3 Wivine Ntumba, M.D.,1 L. August Omadjela, M.D.,2 Christophe Muyunga, M.D., Ph.D.,1 Peter W. Hellings, M.D., Ph.D.,3,4 and Mark Jorissen, M.D., Ph.D.3,4

ABSTRACT

In the African continent, the sensitization pattern and clinical profile are unknown in patients with rhinitis/rhinosinusitis attending the outpatient ear, nose, and throat (ENT) clinics. We therefore aimed to analyze the clinical characteristics of rhinitis/rhinosinusitis patients in Democratic Republic of Congo (DRC), classify allergic rhinitis (AR) according to the Allergic Rhinitis and Its Impact on Asthma criteria, and evaluate the sensitization profile and its associated factors. From January to May 2009, 423 patients with rhinitis symptoms attending the Outpatient ENT clinic of the University Hospital and Saint Joseph Hospital of Kinshasa were evaluated for allergy symptoms, severity, and duration of symptoms and underwent skin-prick tests (SPTs) for a panel of 15 allergens. Of 423 patients 35.2% had positive SPT results, with 40.9% showing polysensitization. Dermatophagoides pteronyssinus (DPT) (68.5%) and cockroach (36.2%) were the most common allergens among sensitized patients. Patients with rhinitis/rhinosinusitis mainly presented in decreasing order with sneezing, facial pain/pressure, nasal obstruction, postnasal discharge, nose itching, clear nasal discharge, and eye itching. Persistent and moderate/severe AR represented 61.4 and 69.3%, respectively. Sensitization was independently associated with younger age, rhinoconjunctivitis, and reaction to nonspecific trigger factors. In conclusion, 35.2% of patients attending the ENT Outpatient Clinic in DRC for rhinitis problems had a positive SPT to at least one allergen, with mainly DPT and cockroach allergens being involved; and a substantial portion showed persistent and moderate/severe AR. Therefore, allergy should not be neglected as an etiologic factor in rhinologic disease in the African continent.

(Allergy Rhinol 3:e16–e24, 2012; doi: 10.2500/ar.2012.3.0023)

Allergic disorders are increasing and are well documented in industrialized countries. The prevalence of allergic rhinitis (AR) is estimated to be as high as 30% in industrialized European countries.1–3 In addition, nasal allergy is a global health problem that affects quality of life and has an economic burden.3 Environmental factors such as air pollution, local allergens, lifestyle, diet, climate change, temperature, and humidity play a role by causing allergic symptoms, particularly in predisposed individuals.

In contrast to the abundance of data on western countries, the immunologic, epidemiological, and clinical allergologic African data are limited.4 However, an increase of allergic symptoms has been reported in African countries.5,6 Allergic rhinoconjunctivitis symptoms7 vary from 7.2 to 33.3% among 13- to 14-year-old African schoolchildren with 11.8% in Kinshasa, Democratic Republic of Congo (DRC). Moreover, 33.0% of AR was reported among Zimbabwean4 patients presenting with allergic symptoms.

In the DRC, the prevalence of specific IgE-mediated diseases and AR in particular is not known, because of a lack of a screening program of allergic diseases and the quasi absence of specific allergens measurement by serum-specific IgE or skin-prick tests (SPTs) in daily practice. In contrast to rhinosinusitis8 being reported to be present in 30.9% of patients in primary medical centers of Kinshasa, little is known about the prevalence of AR in the DRC. Therefore, we aimed to describe the clinical characteristics of rhinitis/rhinosinusitis to determine the sensitization rate and specific allergens profile, to classify AR according to the Allergic Rhinitis and Its Impact on Asthma guidelines,3 and to evaluate factors associated with sensitization in Congolese rhinologic outpatients.

METHODS

Study Population

A cross-sectional study was performed from January to May 2009 in the ear, nose, and throat (ENT) service of the University Hospital and Saint Joseph Hospital of Kinshasa. The Saint Joseph Hospital is the referral hospital of >20 primary medical centers scattered throughout Kinshasa.8 During the study period, consecutive outpatients presenting with nasal symptoms related to
rhinitis/rhininosinusitis were included. The exclusion criteria were common cold, use of antihistamines within 5 days before consultation, and patients who did not agree with the study protocol. The Research Section of the Medical School of Kinshasa University and the head committee of each hospital approved the study protocol. Furthermore, patients or parents gave an informed consent before enrollment. Two patients were excluded for dermatographism. Of 423 remaining patients, 74.2% were from University Hospital and 25.8% were from Saint Joseph Hospital.

Questionnaires and Clinical Examination

A questionnaire was administered about age, sex, study level, profession, active/passive smoking, number of rooms and persons in household, keeping cat/dog, having fan/air conditioning, presence of tress/flowers around house, and family/personal history of atopy. We recorded information on medical antecedents such as asthma, rhinoconjunctivitis, eczema, and atopy. We recorded information on medical antecedents such as asthma, rhinoconjunctivitis, eczema, and atopy. We recorded information on medical antecedents such as asthma, rhinoconjunctivitis, eczema, and atopy. Finally, the patient’s complaints have been registered. The level of symptoms related to allergy to food, personal reaction to nonspecific triggers, presence of flowers/trees around home, active smoking, medical antecedents of asthma, and personal reaction to nonspecific triggers were assessed by univariate analysis and independent association confirmed by multivariable analysis. Variables significantly (p ≤ 0.05) associated with sensitization outcome in univariate analysis were included in multivariable logistic regression model. The exposure variables included sex, age group, study level, parent history of atopy, sibling history of atopy, personal allergy to food, personal reaction to nonspecific triggers, presence of flowers/trees around home, active smoking, medical antecedents of asthma, and personal reaction to nonspecific triggers. The backward stepwise selection process started with all suspected variables and removed those with values of p ≥ 0.10. The significance level was set with a value of p ≤ 0.05.

RESULTS

Four hundred twenty-three patients were included. They ranged from 4 to 89 years with a mean age ± SD of 36 ± 15 years; 62.6% patients were women. Of all patients (Table 1), 64.5% lived with more than five members by household, 54.8% shared at least three persons in the same bedroom, 66.7% grew trees/flowers around the house, and 51.1% had a university-level education. Others characteristics according to SPT results are shown in Table 1.
Sensitization Rate

Table 2 showed that CRS, NAR, and AR were the most prevalent diseases in 39.5, 28.8, and 23.9%, respectively. Sensitization to one or more allergens was reported in 149 patients (35.2%). About one-fourth and one-half of patients with rhinosinusitis and rhinitis, respectively, had positive SPT results. Sensitized patients were significantly younger than nonsensitized patients (mean age ± SD, 32 ± 14 years versus 38 ± 15 years; t-test, p < 0.001). The sensitization rate was similar in men and women (34.2% versus 35.6%; p = 0.728). No sex and age groups differences were observed for diagnoses, except AR, which decreased significantly with increasing age (p < 0.001). Among sensitized patients, 59.1% were monosensitized and 40.9% were polysensitized from two to six allergens. Mono- and polysensitization were not statistically different between sexes and between age groups (p > 0.05 for all comparisons).

Sensitization Pattern

Table 3 shows the allergen profile. The most prevalent allergens were DPT and cockroach, followed to a lesser extent by grass pollen mix. Moreover, sensitization did not differ significantly between sexes and between age groups (p > 0.05 for all comparisons). Allergens profile was similar between AR and sensitized rhinosinusitis patients (p > 0.05 for all comparisons).
Clinical Profile

The most prevalent complaints (Table 4) were in decreasing order: sneezing, facial pain/pressure, nasal obstruction/blockage, postnasal drip, itching nose, clear nasal discharge, and itching eyes. Women complained more than men about facial pain/pressure.

| Table 3  | Prevalence of allergen sensitization |
|----------|--------------------------------------|
|          | Positive SPT Responses n | Among Sensitized Patients n = 149 (%) | Among All Patients n = 423 (%) |
| Indoor allergens | 138 | 92.6 | 32.6 |
| *Dermatophagoides pteronyssinus* | 102 | 68.5 | 24.1 |
| Cockroach | 54 | 36.2 | 12.8 |
| Cat dander | 12 | 8.1 | 2.8 |
| Dog dander | 5 | 3.4 | 1.2 |
| Guinea pig dander | 2 | 1.3 | 0.5 |
| Rabbit dander | 2 | 1.3 | 0.5 |
| Outdoor allergens | 24 | 16.1 | 5.7 |
| Grass pollen mix* | 15 | 10.1 | 3.5 |
| *Parietaria judaica* | 5 | 3.4 | 1.2 |
| *Artemisia vulgaris* | 4 | 2.7 | 0.9 |
| *Aspergillus mix*# | 4 | 2.7 | 0.9 |
| *Alternaria alternata* | 3 | 20.0 | 0.7 |
| *Cupressus sempervirens* | 3 | 2.0 | 0.7 |
| Food allergens | 19 | 12.8 | 4.5 |
| Crab | 13 | 8.7 | 3.1 |
| Wheat flour | 5 | 3.4 | 1.2 |
| Soybean | 2 | 1.3 | 0.5 |

*Grass pollen mix (cocksfoot, vanilla, timothy, ray, and meadow).

#Aspergillus mix (fumigatus, nidulans, and niger).

SPT = skin-prick tests.

| Table 4  | Clinical complaints of rhinitis/rhinosinusitis patients |
|----------|--------------------------------------------------------|
|          | Among All Patients | Sensitized Patients | Nonsensitized Patients | p-Value |
| n (%)    | 423 (100.0) | 149 (100.0) | 273 (100.0) | <0.001 |
| Sneezing | 326 (77.1) | 132 (88.6) | 194 (70.8) | <0.001 |
| Facial pain/pressure | 310 (73.3) | 104 (69.8) | 206 (75.2) | NS |
| Nasal obstruction/blockage | 304 (71.9) | 109 (73.2) | 195 (71.2) | NS |
| Postnasal discharge | 293 (69.3) | 99 (66.4) | 194 (70.8) | NS |
| Itching nose | 217 (51.3) | 100 (67.1) | 117 (42.7) | <0.001 |
| Clear nasal discharge | 178 (42.1) | 78 (52.3) | 100 (36.5) | <0.01 |
| Itching eyes | 172 (40.7) | 80 (53.7) | 92 (33.6) | <0.001 |
| Itching ears | 163 (38.5) | 68 (45.6) | 95 (34.7) | <0.05 |
| Smell loss/decreased | 156 (36.9) | 66 (44.3) | 90 (32.8) | <0.05 |
| Shortness of breath | 93 (22.0) | 36 (24.2) | 57 (20.8) | NS |
| Dental pain | 86 (20.3) | 29 (19.5) | 57 (20.8) | NS |
| Nocturnal cough | 83 (19.6) | 40 (26.8) | 43 (15.7) | <0.01 |
| Fever | 77 (18.2) | 27 (18.1) | 50 (18.2) | NS |
| Purulent/discolored nasal discharge | 71 (16.8) | 27 (18.1) | 44 (16.1) | NS |
| Ear pain/fullness | 65 (15.4) | 23 (15.4) | 42 (15.3) | NS |
| Halitosis | 64 (15.1) | 24 (16.1) | 40 (14.6) | NS |
| Wheezing | 45 (10.6) | 24 (16.1) | 21 (7.7) | <0.01 |

Percentages within column do not sum 100 because symptoms are not mutually exclusive.
(78.9% versus 63.9%; \( p < 0.001 \)), postnasal drip (73.6% versus 62.0%; \( p = 0.013 \)), itching nose (57.0% versus 41.8%; \( p = 0.002 \)), itching eyes (46.0% versus 31.6%; \( p = 0.004 \)), nocturnal cough (23.4% versus 13.3%; \( p = 0.011 \)), and ear pain/fullness (19.2% versus 8.9%; \( p = 0.004 \)). Clear nasal discharge, sneezing, and wheezing decreased significantly (\( p < 0.05 \) for all) with increasing age, and postnasal drip and facial pain/fullness increased significantly with age (\( p < 0.05 \) for all). The average level of VAS for sneezing, itching nose, itching eyes, and clear nasal discharge was statistically higher in sensitized than in nonsensitized patients (Table 5). Between sexes, only itching eye had a significantly higher level of VAS in women than in men (mean \( \pm \) SD, 5.4 \( \pm \) 2.1 versus 4.6 \( \pm \) 2.3; \( t \)-test, \( p = 0.038 \)). According to the Allergic Rhinitis and Its Impact on Asthma criteria, about two-thirds of AR patients had persistent and moderate/severe illness (Table 6). Endoscopically, nasal mucosa was more congestive or pale in allergic than in nonallergic patients (77.2% versus 63.5%; \( p = 0.004 \)).

**Patient Characteristics According to Sensitization**

In univariate analysis (Table 7), personal reaction to nonspecific trigger factors, parent history of atopy, personal history of food allergy, sibling history of atopy, university level, and medical antecedents such as asthma and rhinoconjunctivitis increased significantly the risk of sensitization, whereas the opposite was observed with active smokers. Passive smoke, keeping pets, history of tuberculosis, and presence of more than six persons in the household were also negatively but not significantly linked to positive SPT.

Using a multivariate model (Table 7), rhinoconjunctivitis in the past and personal reaction to nonspecific trigger factors remained statistically associated with sensitization. Compared with first age group, sensitization was statistically lower when the patient’s age increased in both univariate and multivariate analysis. In addition, the reduced odds were observed with the presence of trees/flowers around the house in both analyses.

**DISCUSSION**

The present study reported 35.2% of positive SPT responses mainly to DPT and cockroach among rhinitis/rhinosinusitis Congolese patients. This sensitization rate is near 30.7% reported among Ugandan women\(^1\) with asthma and/or eczema, and to 31.6% in Belgian patients\(^14\) with rhinologic symptoms. The prevalence of sensitization depends on study design, population, and SPT method used. Allergens profile reported in the current study is in accordance with several African studies\(^4,13,15-17\) predominated by house-dust mites (HDMs) and, to a lesser extent, by pets or cockroach pollens. Furthermore, HDMs\(^18\) are mainly associated with skin sensitization around the world, particularly in hot and humid conditions. The tropical climate,
| Variable                                      | No.     | OR (univariate analysis) | 95% CI          | p Value | OR* (multivariate analysis) | 95% CI          | p Value |
|----------------------------------------------|---------|--------------------------|-----------------|---------|-----------------------------|-----------------|---------|
| Sex                                          |         |                          |                 |         |                             |                 |         |
| Male                                         | 54/158  | 1                        |                 | 0.727   |                             |                 |         |
| Female                                       | 95/265  | 1.07                     | 0.70–1.67       |         |                             |                 |         |
| Age group in years                           |         |                          |                 |         |                             |                 |         |
| ≤19                                          | 30/55   | 1                        |                 | 0.0006  |                             | 1               |         |
| 20–39                                        | 77/199  | 0.52                     | 0.28–0.96       | 0.38    | 0.19–0.75                   |                 |         |
| 40–59                                        | 35/142  | 0.27                     | 0.14–0.52       | 0.23    | 0.11–0.48                   |                 |         |
| ≥60                                          | 7/27    | 0.29                     | 0.10–0.80       | 0.27    | 0.09–0.84                   |                 |         |
| Personal reaction to nonspecific trigger factors |         |                          |                 | <0.001  |                             | <0.001          |         |
| No                                           | 26/172  | 1                        |                 |         |                             |                 |         |
| Yes                                          | 123/251 | 5.39                     | 3.25–9.12       | 5.08    | 2.99–8.64                   |                 |         |
| Parent history of atopy                      |         |                          |                 | <0.001  |                             |                 | 0.063  |
| No                                           | 109/352 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 40/71   | 2.87                     | 1.65–5.01       | 1.73    | 0.97–3.08                   |                 |         |
| Personal history of food allergy             |         |                          |                 | <0.001  |                             |                 | 0.065  |
| No                                           | 131/395 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 18/28   | 3.62                     | 1.53–9.03       | 2.26    | 0.95–5.37                   |                 |         |
| Flowers/trees around house                   |         |                          |                 | 0.026   |                             |                 | 0.01   |
| No                                           | 60/141  | 1                        |                 |         |                             |                 |         |
| Yes                                          | 89/282  | 0.62                     | 0.40–0.96       | 0.54    | 0.33–0.86                   |                 |         |
| Rhinoconjunctivitis in the past              |         |                          |                 | 0.014   |                             |                 | 0.027  |
| No                                           | 130/388 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 19/35   | 2.35                     | 1.10–5.06       | 2.44    | 1.11–5.39                   |                 |         |
| Sibling history of atopy                     |         |                          |                 | <0.001  |                             |                 |         |
| No                                           | 101/333 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 48/90   | 2.62                     | 1.58–4.34       |         |                             |                 |         |
| Eczema in the past                           |         |                          |                 | 0.200   |                             |                 |         |
| No                                           | 134/390 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 15/33   | 1.59                     | 0.72–3.45       |         |                             |                 |         |
| Asthma in the past                           |         |                          |                 | 0.002   |                             |                 |         |
| No                                           | 134/400 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 15/23   | 3.72                     | 1.43–10.36      |         |                             |                 |         |
| Tuberculosis                                 |         |                          |                 | 0.608   |                             |                 |         |
| No                                           | 144/406 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 5/17    | 0.75                     | 0.20–2.37       |         |                             |                 |         |
| Study level                                  |         |                          |                 | 0.043   |                             |                 |         |
| Under university                             | 63/207  | 1                        |                 |         |                             |                 |         |
| University                                   | 130/216 | 1.51                     | 0.99–2.30       |         |                             |                 |         |
| Passive smoke                                |         |                          |                 | 0.741   |                             |                 |         |
| No                                           | 129/363 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 20/60   | 0.90                     | 0.66–1.66       |         |                             |                 |         |
| Active smoke                                 |         |                          |                 | 0.027   |                             |                 |         |
| No                                           | 139/375 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 10/48   | 0.44                     | 0.19–0.95       |         |                             |                 |         |
| Keeping pets                                 |         |                          |                 | 0.649   |                             |                 |         |
| No                                           | 85/235  | 1                        |                 |         |                             |                 |         |
| Yes                                          | 64/188  | 0.91                     | 0.59–1.39       |         |                             |                 |         |
| Dampness in house                            |         |                          |                 | 0.074   |                             |                 |         |
| No                                           | 119/356 | 1                        |                 |         |                             |                 |         |
| Yes                                          | 30/67   | 1.61                     | 0.91–2.83       |         |                             |                 |         |
| No. of person by household                   |         |                          |                 |         |                             |                 |         |
| 1–5                                         | 55/150  | 1                        |                 |         |                             |                 |         |
| >6                                          | 94/273  | 0.91                     | 0.59–1.41       |         |                             |                 |         |

*Adjusted OR for other variables in the model. Goodness of fit by Hosmer and Lemeshow method (p = 0.671). Sibling history of atopy, asthma in the past, active smoking, study level, and sex were removed from the multivariate model.

OR = odds ratio; CI = confidence intervals.
which is favorable to HDMs, could explain its high prevalence. Additionally, Brazilian patients\textsuperscript{19} with AR were predominantly sensitive to HDMs and cockroach. In the U.S.\textsuperscript{20} population, HDMs were reported as the main allergen followed by pollens. In contrast, the Norwegian schoolchildren\textsuperscript{21} were mostly sensitive to pollens, pets, and lowly to mite and mold. Similarly, the Belgian\textsuperscript{14} patients with rhino logic diseases reacted predominantly to pollens (69.9\%) and DPT (62.1\%) followed by animals allergy (26.3\%). These results confirm that sensitization patterns vary between regions of the world. To better understand allergy, each region needs allergens related to environmental exposures and climate. The same goes for cockroaches,\textsuperscript{23} abundant in low-income housing and in warm and humid areas. Also, cockroaches may be present in western countries.\textsuperscript{20,23,24} The high exposure and sensitization to cockroaches in our study could be explained by underprivileged settings. The deterioration of dwellings, hygiene, and work conditions is associated with civil war during the last 20 years in DRC. In addition, our study reported the large family size and at least one-half of patients shared the same bedroom with more than three persons. Pollen allergy is less frequently reported in African studies\textsuperscript{4,16,25} as in our series. The low prevalence of pollen allergy reported in African countries could be due to the fact that pollen extracts used for SPT are originated from Mediterranean climate and not necessarily found in Africa. Although pollens\textsuperscript{20} are universally distributed, its nature differs worldwide depending on vegetation, geography, temperature, and climate. The observed reactivity to nonnative pollens may indicate that there is possible cross-reactivity with local pollen families or maybe individuals were first sensitized outside the country borders. Furthermore, this low sensitization to exotic pollens could underestimate atopy, particularly among patients solely reactive to pollens. Food and mold allergy in the present study was low as reported elsewhere in African studies.\textsuperscript{4,13,27,28} The prevalence of AR (23.9\%) in our series was <33.0 and 48.6\% reported among Zimbabwean\textsuperscript{4} and Kenyan\textsuperscript{27} patients, respectively. AR was three times self-declared more than NAR in Europeans studies.\textsuperscript{2,29} The high prevalence of NAR in the current study could be because of the negative SPT to exotic pollens used, not always compatible with tropical flora. Furthermore, some patients with nasal symptoms should probably have only a local nasal IgE inflammation,\textsuperscript{30} independent to systemic allergy detectable on skin or in serum and thus be classified as NAR. Nevertheless, the reported 45.3\% of sensitization among all rhinitis patients corroborates the fact that 53\% of rhinitis symptoms in many population-based studies\textsuperscript{30} are attributed to atopy. The most prevalent symptoms in our work were sneezing, facial pain/pressure, nasal obstruction/blockage, and postnasal drip, each of them present in more than two-thirds of the patients. Sensitized patients expressed a higher VAS score than nonsensitized patients for sneezing, itching nose, clear nasal discharge, and itching eyes. Molgaard \textit{et al.}\textsuperscript{29} reported sneezing and eyes itching more frequently than in AR subjects; and nasal congestion, rhinorrhea, and reduced sense of smell were similar in both allergic and nonallergic subjects. In a Belgian survey\textsuperscript{2} AR patients reported significantly more symptoms than NAR patients. AR was found to be persistent and moderate/severe in 36.1 and 89.3\%, respectively,\textsuperscript{32} during the pollen season. Also, Bachert \textit{et al.}\textsuperscript{2} reported that AR patients suffered more from moderate/severe and persistent symptoms than NAR patients. In our series, about two-thirds of AR patients had persistent and moderate/severe symptoms. These results suggest that patients seek medical help when they have worsening symptoms that affect their activities. The high cost of treatment in developing countries where few people are insured and use (or make use of) the alternative medicine could explain that patients with mild or intermittent complaints are not usually seen at ENT services. Used univariate analysis the family allergic and own previous allergic diseases are risk factors for sensitization. This finding reinforces the fact that atopic diseases are mediated by heredity and environmental factors in agreement with several studies. Active smoke was negatively correlated to sensitization, and passive smoke showed a statistically nonsignificant tendency to reduce the risk of atopy. In this study, smoke is not detailed and it does not specify the duration and intensity of exposure to smoke. Others studies reported an association between exposure to smoke and sensitization in infancy with statistically significant heterogeneity.\textsuperscript{33,34} After adjustment, sensitization is strongly associated with younger age, history of rhinoconjunctivitis, and reaction to nonspecific trigger factors. Arbes \textit{et al.}\textsuperscript{20} reported that younger age was independently associated with allergy in the American population. Nonspecific trigger factors such as air pollution and climate change are known to increase the nasal response to a normal stimulus resulting in nasal hyperreactivity in both atopic and nonatopic patients. During the last 20 years, Kinshasa has been mainly polluted by second-hand vehicles and biomass fuels used as energy source. There is evidence that pollutants\textsuperscript{3,35} promote the effects of aeroallergens and increase the prevalence and severity of allergic respiratory diseases in both nonallergic and allergic individuals. Interestingly, the presence of trees/flowers around the house had an inverse association with sensitization; and pollen counts are higher closer to the trees and flowers. Pollen monitoring is not available in several African countries including ours. This finding agrees with a large ecological European study,\textsuperscript{35} which reported inverse association between pollen counts and prevalence of AR. It seems that high pollen exposure promotes a protective role against atopy. Typically, allergic diseases\textsuperscript{36} were found less in rural areas than in urban areas and lowest in farming areas, suggest-
ing that contact with animals is also protective against sensitization.

There are some weaknesses and constraints associated with the present study. A selection bias may be present because we did not use a representative sample of Kinshasa. However, this bias was minimized by including patients from several primary health care centers scattered throughout Kinshasa and referred to Saint Joseph Hospital. A second limitation is related to a cross-sectional study, which can establish the relationship between a risk factor and outcome, but only a single association. Third, we used exotic pollen extracts, because most specific tropical allergen extracts were not commercially available. Nevertheless, this is the first time to provide new insights on allergy of upper respiratory airways in Congolese patients, particularly allergen profiles. There is a need for further epidemiological study to better understand allergic disease to improve its management in our settings. In conclusion, sensitization is highly prevalent in Congolese rhinologic patients with mainly DPT and cockroach allergens. CRS, NAR, and AR represented the most prevalent diagnoses. A substantial portion of AR patients showed persistent and moderate/severe symptoms. Allergic patients expressed higher VAS scores for sneezing, itching nose, clear nasal discharge, and itching eyes. Atopic sensitization was significantly associated with younger age, a history of rhinoconjunctivitis, and personal reaction to nonspecific trigger factors.

ACKNOWLEDGMENTS

The authors thank all patients without whom this study would have been impossible and the administrative staff of the University Hospital of Kinshasa and Saint Joseph Hospital of Kinshasa for collaboration. Finally, they thank the Belgian technique cooperation for funding and scholarship given Tshipukane Dieudonné Nyembe.

REFERENCES

1. Bauchau V, and Durham SR. Prevalence and rate of diagnosis of allergic rhinitis in Europe. Eur Respir J 24:758–764, 2004.
2. Bachert C, van Cauwenberge P, Olibrecht J, and van Schoor J. Prevalence, classification and perception of allergic and nonallergic rhinitis in Belgium. Allergy 61:693–698, 2006.
3. Bousquet J, Khaltavs N, Cruz AA, et al. Allergic Rhinitis and Its Impact on Asthma (ARIA) 2008 Update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). Allergy 63:8–160, 2008.
4. Sibanda EN. Inhalant allergies in Zimbabwe: A common problem. Int Arch Allergy Immunol 130:2–9, 2003.
5. Asher MI, Montefort S, Björksten B, et al.; ISAAC Phase Three Study Group. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. Lancet 368:733–743, 2006.
6. Zar HJ, Ehrlich RJ, Workman L, and Weinberg EG. The changing prevalence of asthma, allergic rhinitis and atopic eczema in African adolescents from 1995 to 2002. Pediatr Allergy Immunol 18:560–565, 2007.
7. Ait-Khaled N, Othiambo J, Pearce N, et al. Prevalence of symptoms of asthma, rhinitis and eczema in 13- to 14-year-old children in Africa: The International Study of Asthma and Allergies in Childhood Phase III. Allergy 62:247–258, 2007.
8. Omadjela LA. Le profil des pathologies ORL dans un systèm des soins de santé primaires: Cas du Bureau Diocésain des Œuvres Médicales de Kinshasa. Congo Med IV:1210–1214, 2007.
9. Spector SL, Nicklás RA, Chapman JA, et al. Symptom severity assessment of allergic rhinitis: Part 1. Ann Allergy Asthma Immunol 91:105–114, 2003.
10. Bousquet PJ, Combescurè C, Neukirch R, et al. Visual analog scales can assess the severity of rhinitis graded according to ARIA guidelines. Allergy 62:367–372, 2007.
11. Bernstein IL, and Storms WW. Practice parameters for allergy diagnostic testing. Joint Task Force on Practice Parameters for the Diagnosis and Treatment of Asthma. The American Academy of Allergy, Asthma and Immunology and the American College of Allergy, Asthma and Immunology. Ann Allergy Asthma Immunol 75:5543–5625, 1995.
12. Fokkens W, Lund V, and Mullol J. European position paper on rhinosinusitis and nasal polyps 2007. Rhinol Suppl 20:1–136, 2007.
13. Mpairwe H, Muhangi L, Ndibazza J, et al. Skin prick test reactivity to common allergens among women in Entebbe, Uganda. Trans R Soc Trop Med Hyg 102:367–373, 2008.
14. Nyembe TD, Vinck AS, Corvers K, et al. Sensitization to common aeroallergens in tertiary referral outpatient ENT clinic. B-ENT 7:79–85, 2011.
15. Avotodo AA, Ooyeide O, Ogunesi A, and Onadeko BO. Skin sensitivity patterns to inhalant allergens in Nigerian asthmatic patients. Cent Afr J Med 38:187–191, 1992.
16. Addo-Yobo EO, Custovic A, Taggart SC, et al. Risk factors for asthma in urban Ghana. J Allergy Clin Immunol 108:363–368, 2001.
17. Yazidi AA, Nejari C, and Bartal M. Skin sensitization to pollens in Morocco. Multicenter study. Rev Mal Respir 18:523–529, 2001.
18. Von Mutius E. Influences in allergy: Epidemiology and the environment. J Allergy Clin Immunol 113:373–379, 2004.
19. Pastorino AC, Kuschin NC, Arruda IK, et al. Sensitization to aeroallergens in Brazilian adolescents living at the periphery of large subtropical urban centres. Allergol Immunopathol (Madr) 36:9–16, 2008.
20. Omosara OA, Durand JA, and Kass AS. Prevalence of positive skin test responses to 10 common allergens in the US population: Results from the third National Health and Nutrition Examination Survey. J Allergy Clin Immunol 116:377–383, 2005.
21. Bakken HN, Naested P, Bolle R, and Nystedt W. Skin sensitization in school children in northern and southern Norway. J Asthma 44:23–27, 2007.
22. Sarpont SB, Hamilton RG, Eggleston PA, and Adkinson NF Jr. Socioeconomic status and race as risk factors for cockroach allergen exposure and sensitization in children with asthma. J Allergy Clin Immunol 97:1393–1401, 1996.
23. Ricciarini Sforza GG, Della Torre F, Antonicelli L, et al. Sensitization to cockroach in Italy: A multicentric study. Allergy Asthma Proc 18:560–565, 2007.
24. Van Gysel D, Govaere E, Doli E, and De Baets F. Cockroach sensitisation in Belgian children. Eur J Pediatr 165:662–664, 2006.
25. Van den Biggelaar AH, Lopuhaa C, van Ree R, et al. The prevalence of parasite infestation and house dust mite sensit-
zation in Gabonese schoolchildren. Int Arch Allergy Immunol 126:231–238, 2001.
26. Todo-Bom A, and Tavares B. Aerobiology and allergenic pollens. Eur Ann Allergy Clin Immunol 36:189–190, 2004.
27. De Souza M. Allergies and skin testing: A Nairobi experience. East Afr Med J 71:473–475, 1994.
28. Westritschnig K, Sibanda E, Thomas W, et al. Analysis of the sensitization profile towards allergens in central Africa. Clin Exp Allergy 33:22–27, 2003.
29. Molgaard E, Thomsen SF, Lund T, et al. Differences between allergic and nonallergic rhinitis in a large sample of adolescents and adults. Allergy 62:1033–1037, 2007.
30. Powe DG, Jagger C, Kleinjan A, et al. Entopy: Localized mucosal allergic disease in the absence of systemic responses for atopy. Clin Exp Allergy 33:1374–1379, 2003.
31. Zacharasiewicz A, Douwes J, and Pearce N. What proportion of rhinitis symptoms is attributable to atopy? J Clin Epidemiol 56:385–390, 2003.
32. Van Hoecke H, Vastesaeger N, Dewulf L, et al. Classification and management of allergic rhinitis patients in general practice during pollen season. Allergy 61:705–711, 2006.
33. Bräbäck L, Breborowicz A, Julge K, et al. Risk factors for respiratory symptoms and atopic sensitisation in the Baltic area. Arch Dis Child 72:487–493, 1995.
34. Schäfer T, Krämer U, Dockery D, et al. What makes a child allergic? Analysis of risk factors for allergic sensitization in preschool children from East and West Germany. Allergy Asthma Proc 20:23–27, 1999.
35. Burr ML, Emberlin JC, Treu R, et al.; ISAAC Phase One Study Group. Pollen counts in relation to the prevalence of allergic rhinoconjunctivitis, asthma and atopic eczema in the International Study of Asthma and Allergies in Childhood (ISAAC). Clin Exp Allergy 33:1675–1680, 2003.
36. Riedler J, Eder W, Oberfeld G, and Schreuer M. Austrian children living on a farm have less hay fever, asthma and allergic sensitization. Clin Exp Allergy 30:194–200, 2000.